Wonder Waste

EWB Challenge 2015

Executive Summary

Bambui is a rural community in Cameroon, Africa undergoing a rapid urbanisation causing additional pressure on their existing resources and environment. An area that is in crucial need of improvement to accommodate this exponential growth is waste management. The current waste management consists of illegal dumping, uncontrolled dispersion of waste, and the overflow of waste being burnt. These practices do not only pose health risks but also damages the environment (EWB Challenge 2015d). The main cause for these unethical practices is the excessive amount of waste being produced and not properly disposed of. To prevent this problem, reducing the amount of waste through the implementation of a recycling or composting education program will effectively benefit both the environment and community.

To implement recycling and composting practices the approach chosen consists of practical and engaging educational strategies for primary school teachers and students with the anticipated effect of encouraging recycling and composting practices in the wider community. This approach was applied to six design considerations concerning the type of education programs to implement in the design process. All six comprised of a practical project relating to either a recyclable or composting process such as reusable bags, recycling bin, and a composting bin. The majority created a tangible item for the children and teachers to keep as a reward in order to remind them of the importance and use of the demonstrated recyclable or composting activity, thereby creating a sustainable strategy. However, the sustainability of this method had to extend to the entire community and surrounding environment, therefore a strategy devised to create a sense of ownership and

motivation in a concept was priority. To meet this requirement, amongst other criteria, the final concept chosen combined two of the concept considerations, creating a composting and recycling education program called Wonder Waste.

The proposed solution is comprised of four parts aimed at BASSUG (Bambui Union of Sustainable Self – Help Group) and primary school teachers and students. It will involve two education workshops on composting and recycling, the creation of a compost bin, maintenance of a school garden with compost applied to only half of it, and harvesting the crops for profit. The implementation of the program will be addressed through consultation sessions with BASSUG and the participating primary schools.

The project has been designed to act in accordance to the best interests of the community by providing social, environmental and economic benefits, thereby ensuring sustainability. The aspects catering to these benefits consist of its economic feasibility, community engagement, environmental sustainability, and visual evidence of the beneficial outcome of the program. The strategy to instil a sense of ownership was also devised to ensure its sustainability. With these factor combined, Wonder Waste will not only reduce landfill waste but also result in numerous positive outcomes for the people of Bambui.

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1 Team Reflection

Leader & Co-Chief Researcher –

As the leader of the group it was my job to ensure that everyone did their parts correctly and effectively to produce a quality result on our final report. I believe the group worked very cohesively and everyone did their parts that were allocated to them early to ensure that the report itself could be put together earlier and the flow of it could be checked and edited. I feel as if I did a satisfactory job as the leader, however, I could have put in more of an effort to ensure everyone were doing their tasks and that everyone stayed on track during the report writing.

Vice Leader & Co-Chief Researcher & Chief Editor –

As engineers, it is in our best interest to propose a viable solution to suit a designated problem. It was therefore my aim as co-chief researcher to sharpen the team's knowledge on Bambui, their issues and current waste management practices. I also upheld the position of Vice Leader entitling secretary and treasurer tasks such as meeting minutes and project finance (refer to Appendix D for minutes). An addition to my role assigned later in the project was Chief Editor in order to keep consistency to the report. Through the 11 weeks with my team, I believe I have diligently carried out my roles and offered extra support where needed. As a team, we worked towards a common goal and I believe we achieved this goal by attending all team meetings, effectively collaborating and helping each other where support was needed.

Co-Chief Technologist –

My position in our group is responsible for CAD drawing. Unfortunately, there were not many CAD works in progress since it was an education program. Out of my position, I tried to attend all the workshop classes and the outside meeting, in order to clearly know what our project was about. I provided some ideas to solve the major problem that became a part of the final solution. Moreover, I finished most works assigned to me on time to not delay the project because of me. In contrast, I think I should help more with the research of project rather than push two or three teammates research all the stuff. Briefly, I think our group promoted the project smoothly.

Co-Chief Technologist –

As a member of the EWB Challenge group "The Inner Circle", my title role was Technical Drawing. This was a role that I shared with fellow team member Roy. Due to the fact that there were not many technical drawings needed for our education oriented design, I instead helped with research into background data about waste and recycling in Bambui.

Upon reflection as a team member, I am happy with my punctuation and in person practical team work that I contributed. Whilst my written work was I believe sufficient, I don't think its quality was on par with other team members. This I think is one of my weak points.

Overall my work ethic and loyalty to my group was well above average and I think this of my fellow team members also. This I believe is what has made our team so successful.

Chief of Written Communications –]

My experience of being the chief of written communications for my group, group 6D, has been an interesting one. I volunteered to take on the job, because I wanted to be of some help to my group, and I thought to myself that I could take on the job - but it turned out to be a lot tougher than I thought. Putting the draft report together was the biggest challenge for me, and so was the editing.

Overall, working with my team mates was a fun experience. This is also the first group that I have been a part of where everyone actually collaborated and did their own parts. They were also very helpful, which made my job a lot easier.

Chief of Verbal Communications –

My role on the team was Chief of Verbal Communications. This role meant that I was in charge of creating and designing any areas of presentations including videos or presentations. To fulfil my role in the team I was the main editor of the Design Prototype video which included footage and information from other members of the team. I also helped to contribute to the team by assisting other members where I could as well as trying to go to every team meeting that I could. I feel that I could have improved on completing tasks earlier so that there was more time to review them before it was submitted. I feel that the group was very well organized and worked well together throughout the EWB project.

2 Introduction

The Fondom (kingdom) of Bambui is located in the northwest region of Cameroon, Africa. It is sub-divided into village quarters and has a historical setting of over 400 years, making it a culturally rich area (Figure 1) (Bonu 2012). The village is headquarters for the Tubah sub-division with the community council, Tubah Council, building located near their main markets (EWB Challenge 2015d). The village is also fortunate enough to be in close proximity with the University of Bamenda. However, since the development of this university in 2010, Bambui is undergoing a rapid urbanization consequently increasing pressure to existing resources such as land, water and housing facilities (EWB Challenge 2015c).

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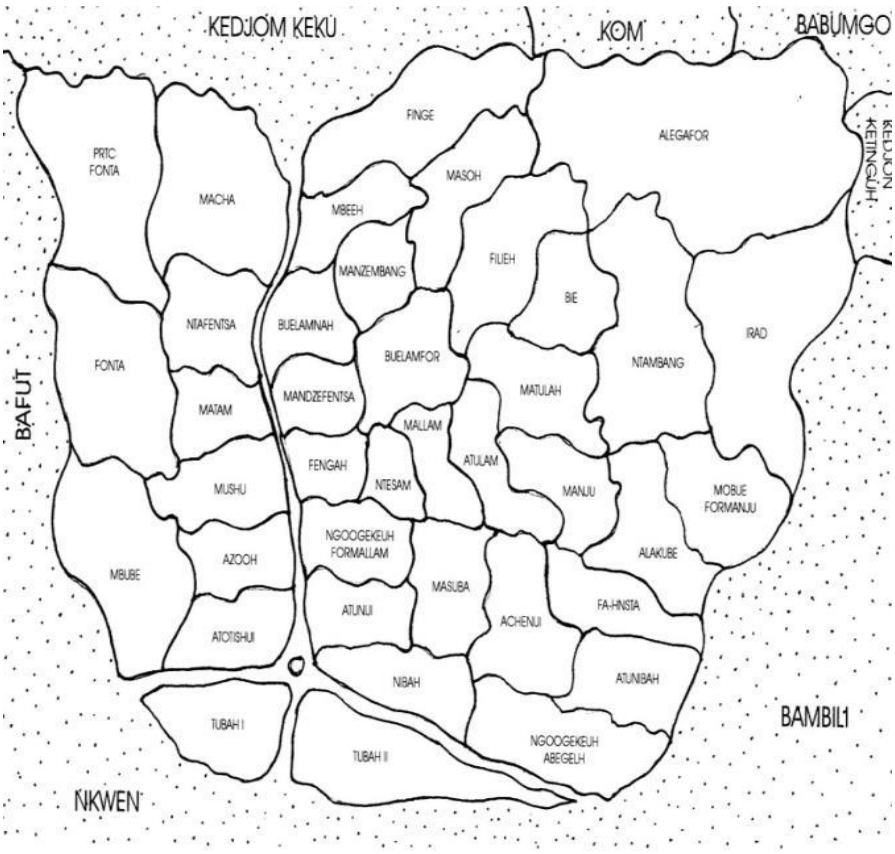


Figure 1: Map of Bambui quarters (EWB Challenge 2015d)

3 Background Research

3.1 Population

The population in Bambui is approximately 17 000 people, however it is growing at an exponential rate (Tubah Council 2012). The cause for this population is the movement between neighbouring villages. This movement includes government workers who move to Bambui for work, whereas students will move to Bambili or Bambui to study. This is because the surrounding area is renowned for being an education hub in the northwest region of Cameroon with the higher institutions of the University of Bamenda and the famous College of Arts, Science and Technology (CCAST) (Tubah Council 2012).

There are a number of organisations and initiative groups that the population of Bambui take part in. These various community groups include Mbororo Social and Cultural Development Association of Cameroon (MBOSCUDA), Bambui Youth Organisation (BAYO), Common Initiative Groups (CIGs), and the Bambui Union of Sustainable Self Help Groups (BASSUG) (EWB Challenge 2015d).

3.2 Cultural and Social Setting

Bambui's culture, government, and political system is centred on the Fon (or *Mfor*), the sub-chiefs (or *Taah*) and the community (*Kwifor*) (Bambuifondom, 2013). The Fon is in charge of the tasks involving the domestic, as well as the external matters. Domestically, he oversees the making and carrying out of the laws of the land and is the final court of appeal for unresolved matters. The Fon is also the chief priest, who oversees the offering of sacrifices to the gods and ancestors of the kingdom. He manages important festivals, the most important being at the end of the year *Mandele*, also known as the Fon's dance.

Externally, the Fon represents the kingdom at all important political, economic and cultural events (Bambuifondom, 2013).

The Fon is assisted and advised by sub-chiefs, nobles, and titled royals. The most well-known of them are the *Meufor*, the mother of the Fon or a sister that represents her and three relatives that act as assistants called *Mofor*, *Ndifor* and *Tabefor* (Bambuifondom, 2013).

Table 1: Religious beliefs in population (bambuifondom, 2013)

Religion	Percentage of Population (%) Approx.
Indigenous beliefs	40%
Christianity	40%
Muslim	20%

The religious beliefs of the people of Bambui, much like the religions of Cameroon in general, are split between three separate religions (Table 1) (Bambuifondom, 2013).

3.3 Transportation

The transportation network is a connection of roads, streets and farm to market roads. This network is in a fairly poor condition consequently making the roads difficult to travel on, especially for rural farmers who cannot afford to purchase a motorised vehicle to transport their goods from the farms to the markets (Figure 2) (EWB Challenge 2015d).

Figure 2: An example of a rundown road (EWB Challenge 2015d, p. 44)

These rundown roads, although passable during dry season, will become completely impassable during the wet season, further limiting transportation systems (EWB Challenge 2015d). There is also a lack of public

transportation, thus the current transportation system cannot account for the transportation needs of all the people, such as the elderly and sick (EWB Challenge 2015b).

Bambui also faces an issue that involves motorcycles, and more specifically, the accidents that are caused and that involve motorcycles. To reduce, and possibly eliminate these accidents all together, the community decided to introduce various seminars and workshops to educate locals on the dangers of driving and how to avoid those dangers when driving (EWB Challenge 2015b).

3.4 Terrain

Bambui is one of the four fondoms located in Tubah Sub-Division, in Mezam Division of the North West Region of Cameroon, Africa. Bambui's region stretches

Figure 3: Location of Bambui in Cameroon, Africa (Maphill, 2011)

approximately 8.5km North to South and 10km East to West and covers an area of about

80.5 square kilometres (80.5km^2) (Bonu 2012) (Figure 3).

Figure 4: 3D Map depicting Bambui's terrain (Maphill, 2011)

In Mathias Alubafi Fubah (2014), *The Art of the Bambui Kingdom (Western Grassfields, Cameroon)*, he describes Bambui as divided into three main regions; Bambui plains in the west, the low plateau in the centre and the high lava plateau in the east and north-east. This virtually depicts Bambui's landscape in the shape of a bowl with its terrain mainly flat in the centre and flanks surrounded by the Sabga hill or the foothills that separate the kingdom from its neighbours (Bambuifondom 2013) (Figure 4). A west-facing escarpment separates these two plateaus (high lava and low). Dense patches of indigenous forest (montaine forest) cover the Northern highlands with Savannah vegetation scattered between the dense forest areas (Bonu 2012, Fubah 2014). Bambui shares its borders with

Bafut to the west, Kedjom keku to the north, Kom (Boyo Division) to the north-east, Kedjom Ketingo to the east and southeast, Bambili to the south, and Nkwen to the south-west (Fubah 2014). Also Bambui's fertile volcanic soils and large watershed supply gives the Bambui community a fortunate aspect of agriculture to its land, primarily used for crops such as vegetables and cereals (EWB Challenge 2015b).

3.5 Climate

Bambui's climate is classified as a mild tropical climate, making the climate suitable for agricultural purposes (Bambuifondom 2013). It lies within the subequatorial climatic region characterised by two distinct seasons: the wet and dry (Fubah 2014). The wet season (mid-March to early November) occurs during the summers whilst the dry season (early November to mid-March) is in the winter (EWB Challenge 2015d). Between the driest and wettest months, records show a difference in precipitation is 372 mm (Climate-Data 2014) (Table 1).

Table 2: Precipitation data in 2013 (Climate-Data 2014)

month	1	2	3	4	5	6	7	8	9	10	11	12
mm	8	31	123	170	178	247	341	338	380	251	47	11

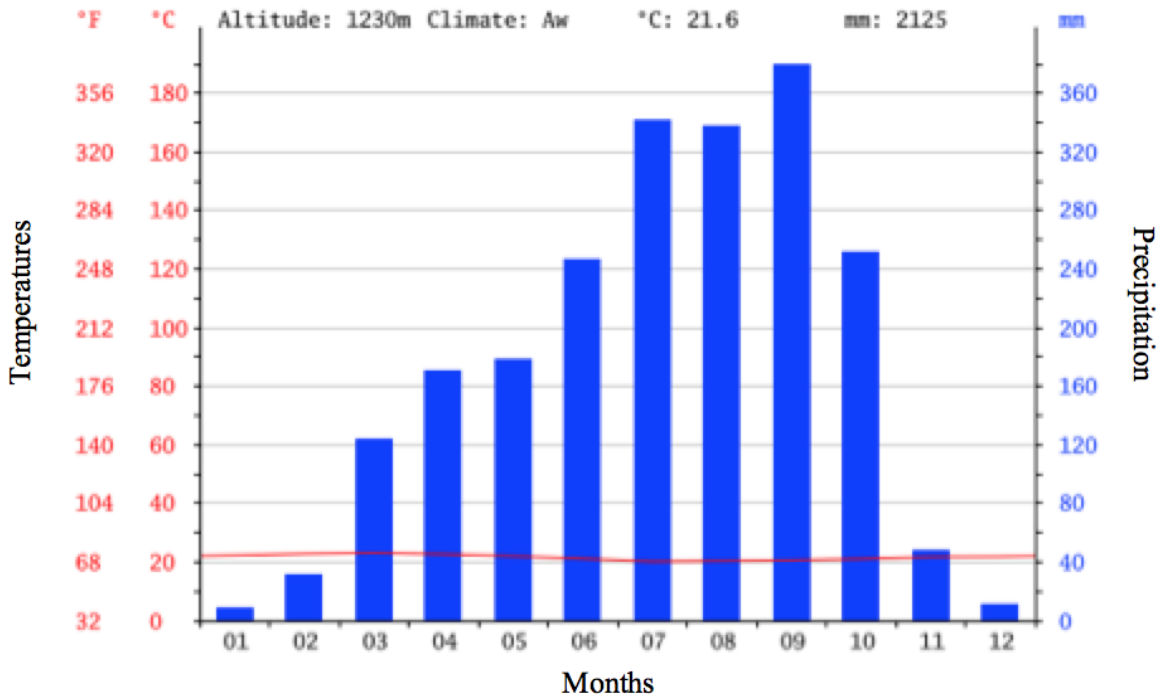


Figure 5: Average precipitation and rainfall in Bambui (Climate-Data 2014)

In Bambui, the average precipitation falls is about 2125 mm. January is when the precipitation has been recorded to be lowest, with an average of 8mm. Whereas September is when the highest precipitation occurs, with an average of 380mm (Climate-Data 2014) (Figure 5).

The average temperature annually is 21.6°C with March being the warmest month with an average temperature of 23.1°C. The coldest temperature of the year has been recorded to occur in the month of July with the average of 20.2°C (Climate-Data 2014) (Figure 5).

3.6 Economy

Bambui relies heavily on a subsistence economy of agricultural production. Primary crops produced for their economy are vegetables and cereals (EWB Challenge 2015b).

Examples include maize, yams, sweet potatoes and tomatoes. Along with their crops, Bambui's economy benefits from their livestock as a source of income as well. Their livestock provides profitable produce such as milk from their cattle and goats as well as meat from their pigs and fowls (Bonu 2012).

These local crops and animals are sold at the weekly central markets in Bambui where many villages come to sell and exchange their produce. The market is a vital economic opportunity for the Bambui community to trade and sell farming produce for not only its community, but with neighbouring villages of Bambili, Kom, Bafu, Bamenda and Duala (Figure 6) (EWB Challenge 2015b).

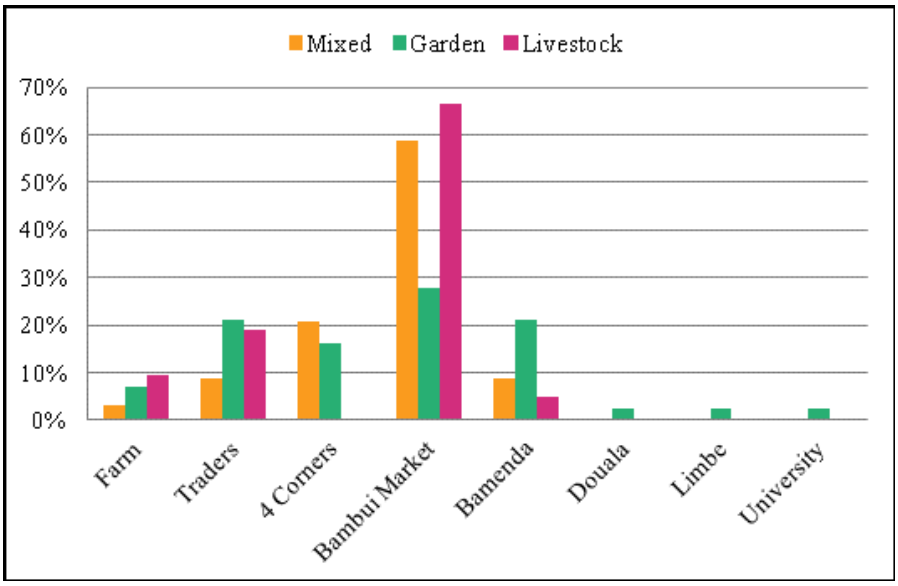


Figure 6: Graph of the market places to sell agricultural produce. Bambui Market is by far the most profitable for the agriculture community (EWB Challenge 2015d)

3.7 Education

Today, Bambui is home to one of the most prestigious schools in the country along with several primary schools, secondary institutions and higher institutions (Bonu 2012). In Bonu's (2012) book, *A Short History and Traditions of Bambui 1700 – 2012*, he lists sixteen Primary and Nursery schools (Table 2), two Secondary Schools, and six higher institutions located in Bambui (Figure 7).

Table 3: Primary and Nursery Schools in Bambui 2011 - 2012 School Year (Bonu 2012)

SN	SCHOOL	CREATION	ENROLMENT
1.	Catholic School, Saint Peters (RCM)	1942	535
2.	Catholic School, Saint Jude (RCM)	1955	122
3.	Government Bilingual School, Tubah	1994	230
4.	Government School, Achieni	2002	191
5.	Government School, Finge	1993	250
6.	Government School, Jorobure		214
7.	Government School, Macha	1983	271
8.	Government School, Mallam	1979	320
9.	Presbyterian School, Baforkum	1981	32
10.	Presbyterian School, Tubah		163
11.	Destiny Bilingual	2008	175
12.	Saint Bridget Bilingual Nursery and Primary	2011	82
13.	Catholic Nursery School, Bambui		58
14.	Destiny Nursery School, Bambui		54
15.	Courage Bilingual Nursery and Primary School	2011	119
16.	Cameroon Baptist School, Finge	2009	82

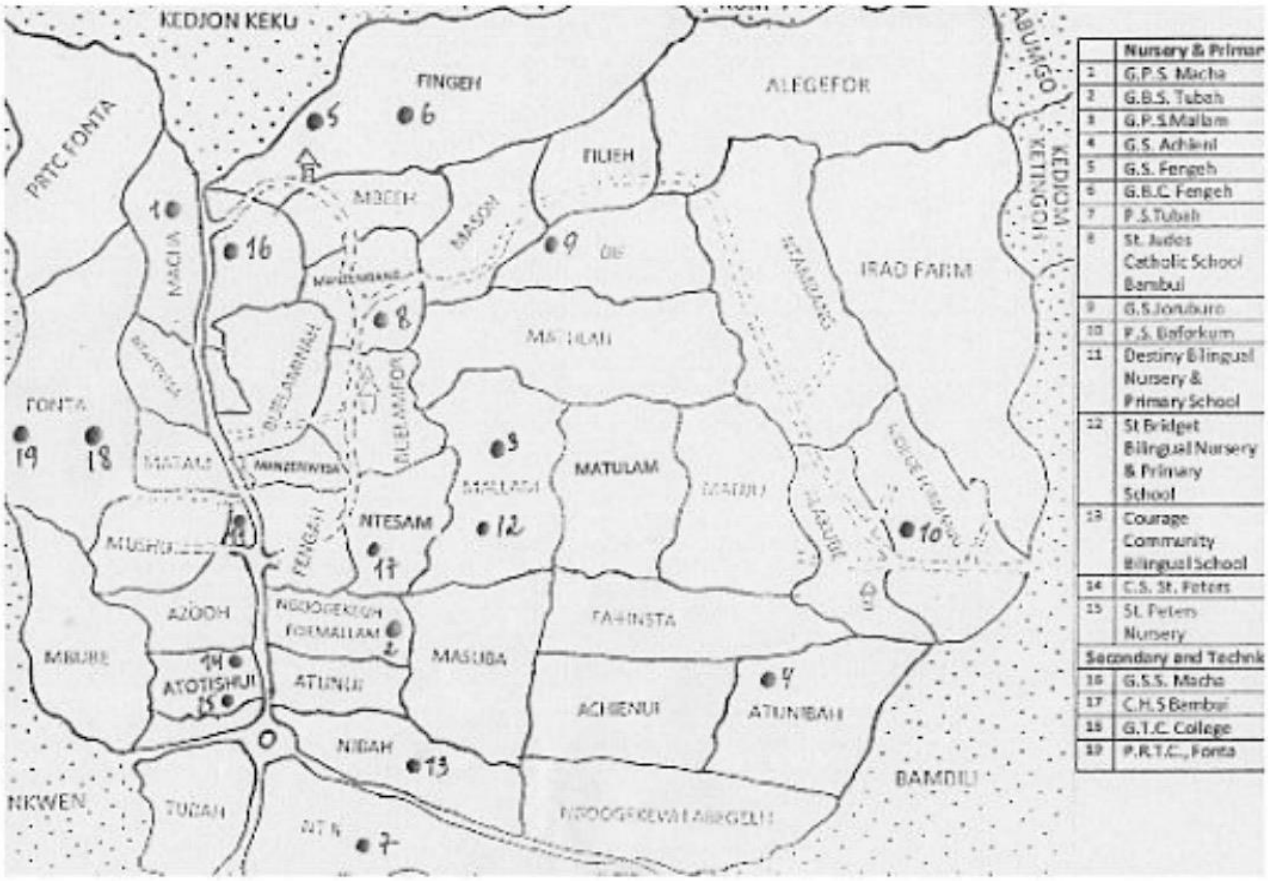


Figure 7: Location of Schools in Bambui (Bonu 2012)

One of the higher institutions Bonu mentions is the National Polytechnic Bamenda (NPB), formerly named National Polytechnic Bambui. It is one of the prestigious private higher educational institutions (universities) in Cameroon. The institution started teaching in 1996 with about 16 students and has now over 15000 graduates (National-Polytechnic-Bamenda 2015). Other higher institutions mentioned include the University of Bamenda, Catholic University of Bamenda, School of Agriculture of the University of Dschange, Institute of Agricultural Research for Development (IRAD), and St. Peter's Teacher Training College. As Bambui is among the neighbouring fondoms near these institutions, the number of Cameroon people desiring a higher education has contributed greatly to the

increase of population in Bambui and pressure on their existing resources (EWB Challenge 2015c).

In Cameroon, the academic calendar starts in the month of September and ends in June (EPDC 2014). The school year is broken into trimesters; September to December, January to March and April to June, meaning there is approximately 36 weeks of school in a year. The compulsory ages for children to attend school start with the admission age of six years old until fourteen years old (EPDC 2014).

Thanks to the western education, Bambui is an Anglophone area with the Bambui native tongue, Bambili-Bambui, still spoken by most Bambui people. It is also thanks to this educational movement that females have equal rights and access to education and development opportunities (Bambuifondom 2013).

3.8 Farming

Bambui's fertile volcanic soils, large watershed, and tropical climate create a suitable environment for a subsistence economy of agricultural production (EWB Challenge 2015b). According to Emma Fromant and George Jones in their work, *F2M Feasibililty Report* (2015), Bambui's current agricultural industry can be distinguished into the following 'sectors'; mixed crops, garden crops, livestock, bee farming, plantain farming, fish farming and coffee farming

Table 4: Farming produce in Bambui (EWB Challenge 2015d)

Mixed	Garden	Livestock	Other
Maize	Tomato	Pigs	Plantain
Beans	Sweet Pepper	Chicken	Bananas
Cassava	Chilli Pepper	Cows	Guava
Coco Yam	Lettuce	Rabbit	Pineapple
Yellow Yam	Cabbage	Guinea Pig	Papaya
Pop Corn	Radish	Goats	Honey
Ground nuts	Green spice (parsley, basil etc.)	Fish	Bees Wax
Potato	Onion		Coffee
Sweet Potato	Strawberry		Palm oil
Okra			Palm wine
			Plum

(Table 3). Fromant and Jones (EWB Challenge 2015d) also state the majority of Bambui are self-subsistence farmers meaning they produce small amounts to primarily feed their family and will occasionally sell their produce to pay for expenses.

It is common agricultural practice to start land preparation in December to January and planting in March. This will follow with continual weeding until harvest in June – July (Table 4) (EWB Challenge 2015e).

Table 5: Calender farming practices in Bambui (EWB Challenge 2015e)

December - January	Land preparation
February	All farms for early crops should be ready
March	Planting of early crops Complete planting, fertilizing
April	Weeding
May	Weeding
June-July	Harvesting and Storing
July	Planting late maize and sweet potatoes
August	Planting of soya beans etc.

Note Plantains are planted in both March and September

Agricultural unions have established a role in the Bambui farming industry. The unions are used to inform, support and organise agricultural workers to enable an opportunity for the agricultural industry to develop and grow (EWB Challenge 2015d). The Bambui Union of Sustainable Self – Help Group (BASSUG) is one of the unions Bambui has in their agricultural community. The union aims to bring farming groups in the area together to promote local farmers and solve common problems such as marketing, training, etc. It is also in their interest to coordinate activities for its affiliated members to raise the standard of living of farmers and the community at large (Matoso 2012).

4 Problem definition

4.1 Problem Scope

Bambui's current waste management consists of illegal dumping, uncontrolled dispersion of waste, and the overflow of waste being burnt. These practices do not only pose health risks and environmental damage but also degrades the quality of Bambui's soil by breaking the nutrient cycle (EWB Challenge 2015d, p. 75). The main cause for these unethical practices is the excessive amount of waste being produced and not properly disposed of (Figure 8). To prevent this problem, reducing the amount of waste through the implementation of a recycling or composting education program will effectively benefit both the environment and their community.

Figure 8: Example of waste at the small market (EWB Challenge 2015d)

4.2 Technical Review

Waste in Bambui

The current lifestyle habit in Bambui is to dump and incinerate the overflow of

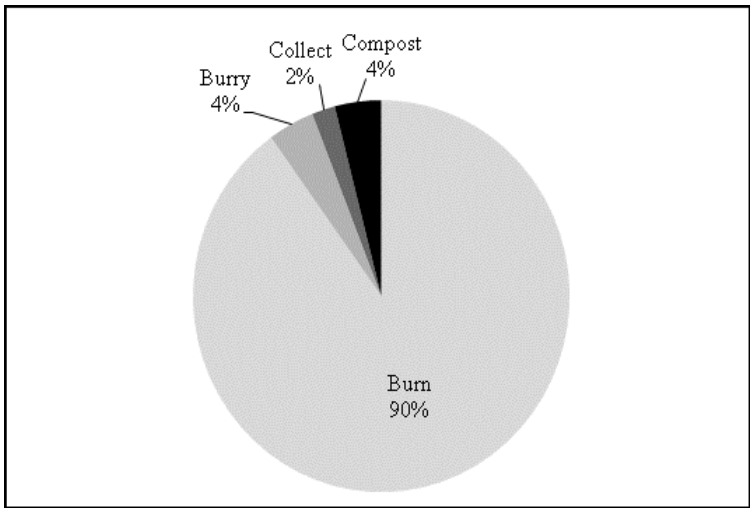


Figure 9: Waste disposal of the surveyed farmers (EWB Challenge 2015d)

waste produced. This practice occurs not only in the households of Bambui, but also at their markets, hospitals, "Mini Cities" (accommodations for non-local students), and official dumpsites (EWB Challenge 2015c). In a survey conducted by Fromant and Jones (EWB Challenge 2015d), 48 farmers were asked what practice they carry out on their farm waste. Ninety percent of the farmers responded with burning their waste. Only four percent of the farmers responded with using the farm waste as compost material (Figure 9) (Mbeng. L. O. 2012), state in their work that "No country [in Africa] has specific waste management legislation", this is further indication to the common waste lifestyle practices of the Cameroonian people.

There are two main dump sites in Bambui, however the maintenance to these are unregulated and uncontrolled (EWB Challenge 2015c). The unmanaged waste negatively affects its surroundings, including the risk of contamination to a water supply in the area called Bambui Tubah watershed (EWB Challenge

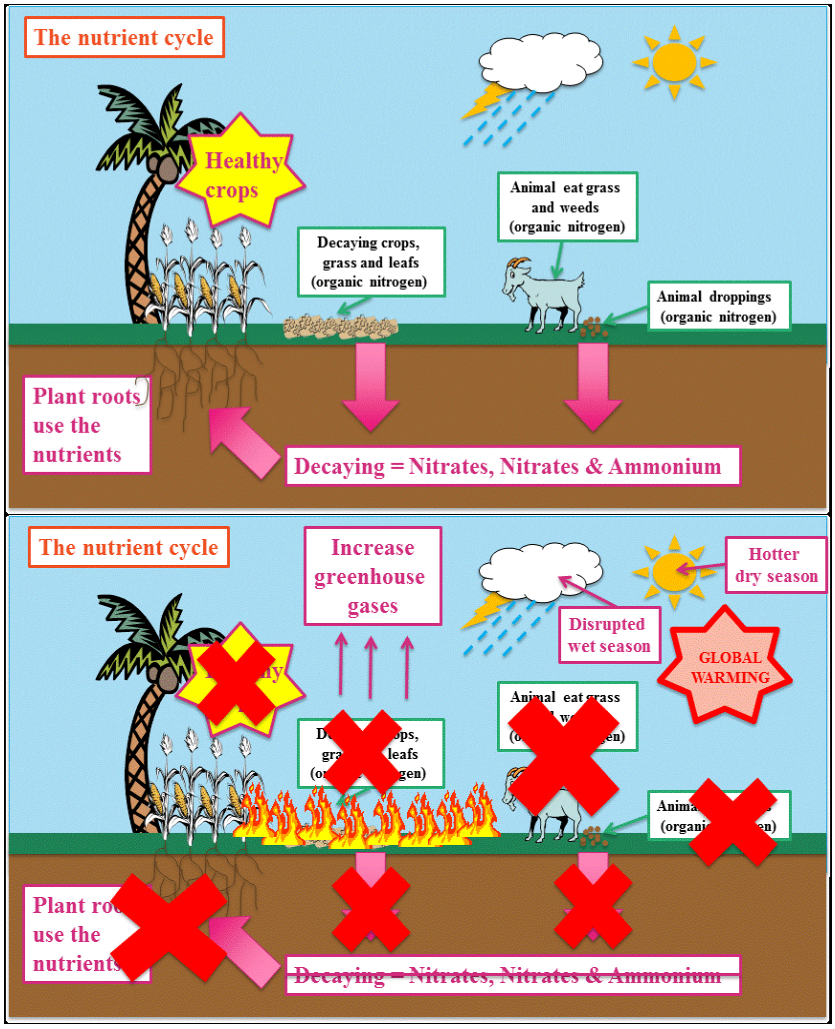


Figure 10: The nutrient cycle (top) and the negative effect of burning on the cycle and environment (bottom) (EWB Challenge 2015d, p. 75)

2015c). The aspiration for maintained and environmentally sustainable dump sites are currently impossible for the local council due to the lack of funds. The lack of funds also prevents the local council from implementing a waste management system (EWB Challenge 2015c).

The current practice of burning waste periodically is not an ideal solution, as it has a negative impact on the environment. These impacts include the degradation of soil because burning the waste on land causes a disruption in the soil's nutrient cycle (Figure 10) (EWB Challenge 2015d). The smoke and fumes from the fire also contributes to the emission of greenhouse gases, a leading cause of global warming (EWB Challenge 2015d, p. 75).

In order to improve the condition and maintenance of the dump sites, the two primary issues of illegal dumping and the lack of waste education in the community need to be addressed. Additionally, the Bambui's Waste Management Board has reported that about eighty percent of waste generated within households are biodegradable, meaning one suggestion to address this issue is turning the biodegradable waste into fertilizers to improve the soil quality for the farming industry (EWB Challenge 2015c).

Existing Solutions

According to Mbeng, Phillips, Fairweather (2012), the only disposal method currently operating is an open dump or low grade landfills (Figure 11). In addition to these landfills, waste will also be illegally dumped along the roadside (Figure 12) (EWB Challenge 2015c).

Figure 11: Main landfill in Bambui (EWB Challenge 2015c)

Jenny Turner (a EWB representative) stated on a forum post on the EWB challenge website that the Tubah Council (the local council of Bambui) tried in the past, to collect the waste of the households outside on the street. However, the households encountered the issue of not having enough bins to put their waste into. There was also the issue of animals entering the bins and dispersing the waste (Turner 2015a).

Figure 12: Illegal dumping on roadside (EWB Challenge 2015c)

According to Reignite Action for Development's documentation of current issues on waste management, there are presently an insufficient number of bins provided around vital areas such as schools, the market, "mini cities" and hospitals (EWB Challenge 2015c). Instead, at the market for instance, all waste is dumped into one pile and collected on Mondays and Thursday. These piles have been recorded to be in close proximity to eating areas and toilets, thereby raising hygiene and sanitation concerns (EWB Challenge 2015c). Previously a group of VSO (Voluntary Service Overseas) volunteers had implemented waste separation of biodegradable and non-biodegradable in the market waste piles, however once the volunteers left, the former mixed waste method continued (Turner 2015b).

In Reignite Action for Development's report, there is also a record of hospitals in Cameroon sharing a similar dumping practice to the market. All waste, including hazardous

Figure 13: Burning waste on roadside (EWB Challenge 2015c)

medical waste, is dumped in piles behind the hospitals and once the pile accumulation becomes a problem the waste will be burnt and swept into an adjacent pit (EWB Challenge 2015c) (Figure 13).

In a nearby town called Limbe, there is currently a campaign run by the "Hygiene and Sanitation Department". Each month between 8am and noon, all government office, public and private businesses will close to take place in the cleaning of their surrounds and business premises. However, this campaign has proven to be ineffective and often overlooked by businesses (Mbeng. L. O. 2012).

Daily Waste

From Reignite Action for Development's report on the form of waste in Bambui, it is evident that the most prolific form of waste is organic material (EWB Challenge 2015c). To further investigate household waste, Mbeng, Phillips, et al. (2012) conducted a visual inspection, sorting and weighing of waste that was produced in participating households in towns nearby Bambui. From their findings, they were able to detail what kind of waste was found (Table 6) and how much of it was produced (Table 7).

Table 6: Household Waste Composition Profile (Mbeng. L. O. 2012)

Categories	Putrescibles	Plastics	Metals	Papers	Glass	Textiles	Fines	Misc
Sub-Categories	Food remnants, fresh and decaying leaves, vegetation and other garden waste	Plastic bottles and packaging	Cans and bottle caps, ferrous metal and aluminium items	Newspapers, magazines, office papers, junk mails and envelopes	Glass bottles and jars	Clothes and shoes	Ash, dust and sand	Wood, stones and pebbles, waste electrical and electronic equipment and batteries, used paints and solvents

Table 7: Description Statistics for Waste Generation in February and April (Mbeng. L. O. 2012)

Residential Areas	7-Day Survey Period (Kg)					
	February (Dry Season)			April (Wet Season)		
	Total Generation	Mean (Weekly Average	Per Capita Generation Kg/Pers/Day	Total Generation	Mean (Weekly Average	Per Capita Generation Kg/Pers/Day
High income	213.5	30.5	0.66	246	35.1	0.76
Medium income	269.5	38.5	0.58	299	42.7	0.65
Low income	282	40.3	0.53	320.5	45.8	0.60

5 Design requirements

There are six design requirements to be considered for the evaluation of potential compost and recyclable education program concepts in context to the community of Bambui.

Sustainability

For an education program to be successful, long-term sustainability must be achieved. The assessment for sustainability will be based on whether the project is able to balance the social, economic and environmental needs for the present and future generations of Bambui. The measures of social, environmental and economic benefits (also known as the "triple bottom line") in Bambui's educational context concerning waste management will

assist in determining the successful continuation of the project in the future. A sustainability model was developed to ensure the recognition of these desired outcomes (Figure 14). This sustainability requirement will also cover implementation and maintenance considerations, as these are primary factors to implementing a long-term project.

- The program must be a long term project that can have feasibility for administrative capabilities by the community, making it active for many years without requiring an EWB representative
- Simple educative program concerning waste management practices to suit all age groups, allowing the entire community to carry out the program

Impacts to Community

In context to an education project in waste management, the project's impact to the community will need to be considered. A requirement to ensure a positive impact to the community is the consideration of cultural and social factors. This is evident from the teaching material's requirement to be aligned with the cultural and social practices of Bambui. Social factors also include the possibility of

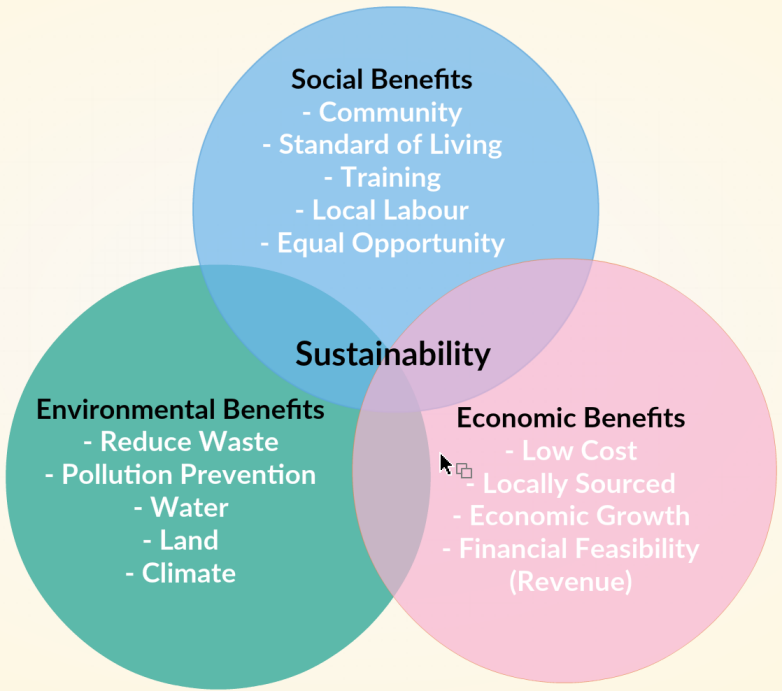


Figure 14: Sustainability Model developed for desired project outcomes

local labour utilisation, working and academic institution conditions and community living standards. Cultural factors include local religion and cultural practices, events and circumstances.

Community engagement will also be facilitated in the aim for the education waste project to positively impact in the community. Through community engagement, the project will require to utilise every possible avenue where people of the community can become involved or consulted, allowing for an easier and suitable implementation process. This will also aid in the successful continuation of the project leading to people within the community knowing the correct waste disposal knowledge.

- Project must be culturally and socially appropriate for the Bambui community and must not negatively affect its social, culture or religious values
- As waste management is not solely based on technical design, rather behaviour change (Kumara 2000), therefore the project must consist of educational components applicable to the lifestyle of Bambui
- Project must have community engagement to be effective. Use all possible avenues to involve more of the community as the involvement will act as a measure of the success of the overall project
- The project will aim to improve the current living standard of the community through waste reduction and proper disposal. From the improved living standard the project will reduce the risk of disease, climate change, and environmental damage.

Environment

The concept must address all environmental aspects, including environmental sustainability and environmental durability. The waste management practice to be taught, must improve the surrounding environment and reduce the community's ecological footprint.

- The project must aim to improve waste practice that will not negatively affect the environment as the current incineration method causes soil damage, increase in greenhouse gas emissions and global warming
- The project must be viable in all local weather conditions, especially during the wet season
- The concept must consider the total lifecycle impact to achieve the waste management outcome
- Aid to improve the environment through waste reduction and reuse waste and recyclable material when possible

Materials

The materials required in the education program should be assist in reducing costs and allowing the design to be easily and locally implemented into the community.

- Materials are to be sourced and available from the local community
- Materials required must be suitable and cultural acceptable to the community
- Materials should be environmentally friendly where applicable
- Material demand must be sufficient to carry out the education program

Technical Design

The final design must be appropriate to the Bambui community in order to successfully implement.

- The concept must be designed in accordance to the community's current waste management ethics
- To aid implementation of the waste education program, the design must be simple and require low-level or no skills.

Cost

The budget for waste management in Bambui has been exceeded, therefore the cost requirement for the educational project is to have no or low cost concerning implementation, material, program delivery costs and maintenance (EWB Challenge 2015c).

- Materials must be cost effective and readily available
- If labour force is required to carry out the education program, the labour force must be local to minimise cost
- The project outcome should be considered for feasibility to economic benefit. For instance; if the project outcome is able to be sold, the product should serve as revenue against the project cost.
- The project's ability to invest into the sharing of knowledge with no cost

The final design will aim to address each of these design requirements to ensure a successful implementation of a project suitable to the Bambui community with the overall goal of reducing and encouraging proper waste disposal within the community.

6 Design Concepts

The following prospective concepts have the aim of addressing the issue of reducing and proper disposal of waste through the implementation of a recycling/composting education program. All concepts share the similar approach of practical and engaging educational strategies with the target audience of primary school teachers and students. This approach will help educate, inspire, and encourage a primary school audience with the anticipated effect of encouraging recycling and composting practices in the wider community.

6.1 Design Options

Concept 1 – Education of Compost

Teaching the people of Bambui on composting practices, such as what waste to use and the benefits of composting, and hopefully implement composting on a household level. The compost could then be used on farms to help crops grow leading to cost and economic benefits. The education program would consist of seminars aimed at both teachers and children to teach them about composting and recycling practices and how these practices are important to the community.

Benefits:

- Will help economy of Bambui with their crops – economic benefits
- Is an activity beneficial for both adults and children to learn – community engagement
- Simple design as it is not a difficult or complex system to implement – appropriate for community

- Locally sourced materials (organic/biodegradable waste) – cost benefits
- Positive impact on local environment – environmental sustainability
- Program for local community to keep ongoing as it requires no skill and the least amount of effort – sustainability

Limitations:

- Incorrect material in compost could ruin quality and could cause damage to the crops – negative impact on community and economy
- Some crops cannot use nutrients of some compost materials – must undergo testing (delay implementation process)
- Knowledge and memory of community: Going into detail as to what is acceptable for composting might not be memorable for people – negative impact on sustainability

Concept 2 - Recycled Bottle Bin and Poster Project

To minimise waste, an educative approach on recycling was considered. This concept would result in an educational project where a workshop educates primary students and teachers on how to recycle. The talk will follow with the creation of a recycling bin made out of recycled plastic bottles. After creating the bin, the students will create posters on recycled material (e.g. cardboard) and place these posters on the bin indicating what can and cannot be recycled. The materials required for creating the bin would consist of using a wire frame and discarded plastic bottles. The product could be used to separate different kinds of recyclable waste making the recycling easier to implement into the waste disposal practice of the school. These bins would make use of plastic waste and could be easily

made as more plastic bottles are recycled. The bins created would then be placed around the schools and encourage recycling practice with the posters attached to them. The posters would serve as reinforcement for recycling practices.

This concept also has the potential to have the bins sold at the community markets for an economic benefit to the primary schools, thereby helping with academic funding. In order to have long-term sustainability, an easy to read manual on how to create the bin would be a part of the implementation process.

Benefits – Recycled Bottle Bin:

- Fun and engaging way for kids/teachers/parents to learn of the opportunities with recycling/reusing material – positive impact on community
- Reuse of locally sourced material – positive impact on environment
- Materials are recycled – cost benefits and environmentally friendly
- Use bin for various purposes – sustainability
- Demonstrate opportunities for children to expand on – sharing ideas for the community

Limitations – Recycled Bottle Bin:

- Technical design could be too complicated for teachers and students – difficult to implement project
- There could be safety and risk hazards involved with creating the bin such as the tools needed and the sharp ends of wire
- Not much of an educative practice by itself – not engaging for the community

Benefits – Poster:

- Memorable for children and adults alike – sustainability
- Fun, interactive and creative way to engage children – community engagement
- Personal learning experience – offers the opportunity to share ideas with the rest of the community
- Can keep some of their poster as a tangible reward – positive impact on community
- Poster material is recycled material (e.g. cardboard) – environmentally friendly

Limitations - Poster:

- Could lose interest and choose to not participate – hinders sustainability
- Paint to use as writing material might not be locally sourced – costly
- A self-motivated activity – hinders sustainability

Concept 3 - Education on Reusable Bags

Education on reusable bags would teach the primary school students and teachers the reuse of plastic bags as well as creating reusable bags out of recycled material, ultimately reducing the amount of plastic and useful waste. The bags could potentially be used for many different purposes such as the student's lunch bag or school bag.

Benefits:

- Decreases plastic waste – positive environmental impact
- Simple concept for both kids and adults to grasp – simple design
- Can be used for various purposes – generates ideas for community and has a positive impact on community
- Materials are recycled locally – cost benefits and environmentally friendly

Limitations:

- Not a very interactive or engaging activity therefore motivation from community could be lost – hindering implementation and sustainability of project
- Creating reusable bags may require costly material – material cost

Concept 4 - Recycling Education Games and Creations

Taking another recycling approach to minimise waste disposal, the Recycling Education Games and Creations aims to teach the primary students on recycling techniques through the use of educational games and creative thinking. This concept would consist of a workshop with a series of interactive games to teach the students recycling techniques and practices. For example, quizzes with prizes for answering correctly to encourage the children to learn. The games workshop would follow with a creational exercise where students walk to a waste site, collect recyclable material, and create an item from them. The materials required to craft would only be glue, tape and scissors. For instance, an item that can be created easily from recycled material is a pencil holder or flower pot, which could be created from an empty aluminium can, glass jar or plastic bottle. From this activity, the children could expand on the idea with the potential of creating an arts and crafts club within the primary school to continue the recycling object creations.

Benefits:

- Engaging, interesting and fun way to learn – positive community engagement
- Memorable, creative and feasible to an arts and crafts club for long implementation - Sustainable
- Environmentally friendly activity - Environment

- Rewarding activity for students – positive impact for community

Limitations:

- Distracting from the purpose of the activity – decreasing sustainability factor of design
- Children could conduct negative behaviour – negative social practice
- Motivation could be lost – hindering sustainability of project
- Maintaining control of class can prove to be difficult – social practice
- Hygiene and sanitation issue with collecting recyclable items – impact to community

Concept 5 – Educational Mobile Applications

Rather than solely a primary school audience, this concept had the approach of the wider community reducing waste through a mobile applications consisting of various social and engaging methods to encourage recycling and composting practices. For example, a social method of sharing what items the user has composted or recycled could be represented in graph form shared with friends. This could create a friendly competition between the community to visually represent who recycles or composts most. An engaging method would be creating mini games relating to recycling practices to educate as well as entertain the user. The application would also have easily accessible information about how and what to compost and recycle. The application will need to be culturally and socially sensible for the Bambui community.

On an EWB forum, Jenny Turner (EWB representative), states “each adult would have a mobile phone and there might be 2 – 6 adults in a household”. From this information, the concept has the potential to engage a large part of the community.

Benefits:

- A fair number of Bambui residents recorded to have mobile devices – implementation for a potential audience
- Limitless opportunities – opportunity for long term sustainability
- Easily and always accessible for mobile device users – opportunity for long term sustainability
- Apps need to be culturally and socially sensible for community

Limitations:

- Creating application could prove to be difficult especially for coding – complex technical design
- Does not involve entire community of Bambui (non-mobile users) – limiting impact on community
- Constant updates and maintenance – Skill required to do maintenance

6.2 Design Selection

To evaluate the viability of each educative waste management concept, a design matrix was used (Appendix A). The design matrix comprised of the design requirements explained in the previous section. Each criterion was weighted with a percentage according to their priority. For instance, sustainability accounted for the highest percentage of thirty of the overall weight (out of 100%) because sustainability will determine the success of the

project meaning it is the highest priority. The process of evaluating each concept in terms of this criteria, aided in providing insight into which project was most feasible to implement into Bambui's waste management situation.

The first criteria to consider for each concept was sustainability. To access each concept against this criteria, the method of applying each concept to the sustainability model defined with the measurements of social, environmental and economic benefits in context to Bambui's waste management was used. Without complying with these measurements the concept would no longer be viable. From this elimination criteria, the concept with the lowest score resulted with Educational Mobile Applications. Although there are limitless opportunities to this design, it did not have the potential to reach the entire community as it limited the target audience to only mobile users. Also, the coding and publishing of these applications are complexities to the requirement of being a simple to implement educative program. Another hindrance on sustainability discussed was the maintenance and constant updates to the applications results in the cost-related task to complete with relatively high-level skills. The failure to meet the sustainability model and requirements eliminated Education Mobile Applications from the design considerations.

The next criteria of high priority was environment with a weighting of 20%. Each concept was able to suitably aid in improving the environment through waste reduction from recycling or composting, however not all designs satisfied environmental sustainability. The design of least satisfaction to this requirement was Education on Reusable Bags. The scepticism lied with the plastic component of this design; if the reuse of the plastic bags were to be a popular option in Bambui, the amount of plastic bags

produced could increase with the demand. It was also the durability of plastic that would cause the community to only reuse the bag several times before leading to the disposal of the bags yet again; creating the same environmental damage as before. It is from this deduction that the long-term effect to this project would leave an ecological footprint superior to the other design concepts.

The third criteria to assess with the next three design concepts were material with a weighting of 15%. Comparing the materials required for Recycling Education Games and Creations, Education of Compost, and Recycled Bottle Bin and Poster Project, the one that had the most probability of using more resources to successfully implement the program was Recycling Education Games and Creations. The design did involve using recycled material, however the materials to create the recycled objects and games were not guaranteed to be cost-effective or environmentally-friendly. This can be seen from the materials required to craft; glue, tape and scissors or create quizzes; e.g. paper.

From the evaluation of the design matrix, the concepts were ordered from highest to lowest according to their sum score. The results narrowed down the design options to the two most suitable; Education of Compost and Recycled Bottle Bin and Poster Project. Both adequately meet the criteria necessary to implement a successful education on waste management, however both lacked in some areas compared to the other. To meet the design measures, a proposal to combine the two concepts was considered. After discussion and evaluation to the design of both concepts, it was decided to create an education program consisting of components from both design concepts.

7 Final Design

7.1 Summary of the Design

The final design has the preliminary components of the Education of Compost and Recycled Bottle Bin and Poster Project design concepts forming a final design called Wonder Waste. This project is comprised of four parts aimed at BASSUG (Bambui Union of Sustainable Self – Help Group) and primary school teachers and students. The first part of this design is a workshop involving BASSUG delegates and primary school teachers to create a compost bin made from recycled bottles and a garden. The educational workshop aimed at students will commence next, where they will learn about composting and recycling, plant seeds in the newly created garden, and create posters of what can and cannot be composted. The next part is the maintenance of this garden as a communal effort from the students and BASSUG spanning over three months. During these three months, organic waste will be thrown into the created compost bin and placed on only half the garden. The last part to this design is the harvesting of the garden, where all produce will be separated according to which side of the garden had compost. All produce will be sold at the main market as promotion to the program and as funding for the school.

7.2 Detailed Description

For this project to be successful, with the possibility of compost practices being implemented further into the Bambui community, the participants involved must have a clear understanding of how to compost, what can and cannot be composted, and the beneficial reasons to compost. To educate these critical points, the educational program has been devised to not only elaborate on this information but to put this information into

practice by giving the primary school the practical project of creating and maintaining a compost garden.

As this project involves the academic community and agricultural practices, the project must accommodate the primary school and farming calendar of Bambui. Reignite Action for Development (EWB Challenge 2015e) has recorded that the practice of farming takes place over the months of March, April, May, and June. It is also during these months that the Bambui primary schools are still in session (EPDC 2014). From these aligning academic and agricultural calendar months, the education program will take place during this time.

Workshop 1

The first workshop (in the first year of the project) will be presented by an EWB representative and directed toward BASSUG delegates and 5th/6th year primary school teachers. The EWB representative will briefly state what composting is, how it works and its benefits. After describing composting they will touch on recycling and how it can benefit the community. They will then show the audience the already made bottle compost bin. The speaker will go into detail about each part and how simple it is to make. A practical activity on how to make one will follow with the teachers and BASSUG delegates working together.

After creating the bin the speaker will address the implementation of the 5th and 6th year student's compost program. The role for the teachers and BASSUG will be detailed during this time. Their main shared role will involve encouraging all students and faculty to dispose of biodegradable waste in the created bin whenever they can. One of the

encouragement strategies that will be recommended is 'leading by example' where they, themselves, will dispose of biodegradable waste to help the compost program. Their BASSUG role will mainly be to act as supervisor to the maintenance of the garden. The 5th year primary teachers' role will be to appoint a 5th year student once a week to carry out the maintenance of the garden. After this information is given, the small designated garden will then be shown to the teachers as reference to the project ahead. Any questions may be asked by the participants at any time during the workshop.

Workshop 2

The second workshop will be presented by an EWB representative, BASSUG delegate, and a primary school teacher. The audience will comprise of 5th and 6th year students of a selected primary school. Similar to the first workshop, the representative will talk about compost and recycling. They will show the bin created by their teachers and BASSUG delegates to the students. The speaker will go into detail about what is allowed in the bin and what is now. All examples spoken by the speaker will be drawn on the provided blackboard in the classroom to help the children understand. The workshop will go outside to the garden. The speaker will give students vegetable seeds and ask for the students to plant these seeds in the garden. The BASSUG delegate will recommend how the students are to plant the seeds and how far apart. The speaker will pull out a sample of compost, demonstrate the turning of compost using a small branch and distribute the sample on <u>half</u> the garden. Only half the garden will be given compost and the other will be left alone. This is to demonstrate the effectiveness of plant growth with compost visually to the students and community. Once the compost demonstration is over, the workshop will go back into

the classroom and commence a poster creating session. The poster material will be flat recycled objects (such as cardboard) for the children to paint on. The students will paint what can and cannot composted on the poster material. They may refer to the blackboard of the items the EWB representative drew on the board previously. The posters will be collected to dry. The representative will detail on the roles that will be given to the 5th and 6th year students. Essentially, the 5th year students will be carrying out the maintenance of the garden while the 6th years oversee their work and help when they can. The 6th years will also be responsible for encouraging compost practices throughout the student body.

After the Workshop

Once all posters are dry, the posters will be taken to a clay wall of the school (with a shaded roof) and nailed to this wall. The bin will be placed by this wall, thereby allowing the posters to be a reminder of what can and cannot go into the bin. This will decrease the risk of non-biodegradable materials from entering the compost mix.

During the Course of the Program

During the months of March, April and May, the teachers and students will be disposing of biodegradable waste into the compost bin. Once a week a 5th year student will be appointed to water and turn over the compost. If the bin is full it is the student's job to dump the compost on the compost-half of the garden and re-layer the bin with twigs and straws. It is also the student's job to do any necessary weeding and watering of the garden.

Once a week, a BASSUG delegate will check on the garden and advice the 6th year students what actions should be taken if they deem that the garden needs any agricultural improvements. It will be the 6th years' responsibility to carry out these improvements and

communicate this feedback to the 5th year students, to help them put the feedback into future practice.

The crops produced will be harvest in the month of June before the school holidays. The 5th and 6th year students will divide produce that had compost and those that did not and label them accordingly. They will sell this produce at the main market with BASSUG delegates and teachers present. This will act as a promotional opportunity for the program and use the produce revenue as funding for the school and continuation of the project.

Recommencement of the Program

For the program to continue into the next farming season in March, BASSUG delegates will be given the role of preparing the garden for planting again. This will take place in early March before the recommencement of the program. The recommencement will start after the garden is prepared in March. This will instigate a handover process from the previous 5th years, now 6th years, to the previous 4th years, now 5th years. The 6th years will use their knowledge gained from last year to help the 5th years plant seeds in the newly prepared garden and educate them on how to maintain the garden and their weekly role. Instead of an EWB representative, a BASSUG delegate will hold a session to inform the 5th year students of what can and cannot be composted. Again, the posters will be on recycled material and the content will consist of what can and cannot be composted. The previous year posters will be removed and replaced with the new ones. The roles as 6th years will continue as overseers to the garden process while the 5th years continue to maintain the garden.

7.3 Manufacturing Plan – Compost Bin

To create the composting bin made from recycled bottles, these series of steps took place:

1. Place a selected number of bottles to form the desired circumference of the bin
2. Poke two holes on each side of the bottle (top half and bottom half), each hole must be aligned with each other and the other bottles (use a sharp tool such as an awl tool). Also poke a hole through the bottom of every bottle
3. Using a pair of wires string the bottles together, threading once through the upper holes and once again with the second wire through the lower holes. Tie each end of the two wires to create a loop
4. Repeat steps 2 and 3 until the layer of bottles create the desired height of the bin
5. Align all bottom holes ensuring each bottle with a bottom hole has another underneath it or above it to keep the layers in line. This will create columns
6. Thread a wire through every third bottle column
7. Tether each wire to the chicken-wire base plate (this will help keep it upright)
8. Layer the interior of the cylinder the bottles have formed with chicken-wire or similar
9. Trim chicken wire to fit the final desired shape and height. Secure all chicken wire where necessary with string.
10. Blunt edges by folding over the exposed edges of the chicken wire

To create the lid of the bin:

1. Using a malleable wire and tying its ends, create a circular loop slightly larger than the same size of the circumference of the created bin

2. Approximate how many bottles will likely fit horizontally in the circle of the wire
3. Take the same number of straight wire pieces as bottles
4. Take the lid off the bottles and poke a hole through their bottoms using an awl tool or similar
5. Thread a malleable wire piece through each bottle and put each across the circular wire
6. Tie each wire end to attach each wire to the circular wire creating circle with bottles filling it horizontally

7.4 Implementation Strategy

BASSUG

The Bambui Union of Sustainable Self – Help Group (BASSUG) is a union representing the agricultural community of Bambui and the Mezam division (NOWEFOR 2014). It is the organisation's aim to solve common problems such as training and coordinating activities to help the standard of living for farmers and the community at large (Matoso, 2012). From the project's objective and practices, it is believed this project aligns with BASSUG's aims. This is evident from the potential this project has in reducing landfill waste through

Figure 15: Members of BASSUG outside the BASSUG Hall (Matoso, 2012)

the practice of compost, thereby improving Bambui's standard of living. Compost will not only improve standard of living, but will also enrich the soil it is applied to, hence improving the growth of crops (EWB Challenge 2015d). If this were to be emphasized to the BASSUG president and delegates, the appeal for this project will work even more in their favour. Additionally, it appeals to educative means of recommending the best practices for farmers by providing BASSUG the opportunity to educate the younger generation on their farming practices while integrating the practice of compost. BASSUG is also an ideal administrative group for this project as the practices they learn from the compost program could be integrated into their weekly meetings with other union members held at the BASSUG Hall (Figure 15) (Matoso 2012).

Before the implementation of the compost program in primary schools, a consultation must be held with the president of BASSUG, Mr. Attia Gideon, and any other administrative delegates. This consultation will involve the debriefing of the project ahead, why the project will benefit them (as defined in paragraph above), their response, questions and their recommendation strategy for implementing this program in accordance to their social and cultural practices. If approved, it will be BASSUG's role to implement this program into the primary schools of Bambui. This will entitle them preparation roles such as collecting used bottles, flat recycled objects (e.g. cardboard) and creating the school garden. It will also be their role to have delegates attend and run the workshops, oversee the progress of the students, and implement this program in every school.

Primary Schools

From the flexibility this project offers, it is intended that this project can be implemented in all 14 primary schools of Bambui. It is planned to implement this project in two primary schools every year, meaning this project's implementation process will span over the course of seven years. For successful implementation, research on the primary schools have concluded with two satisfactory primary schools believed to be the best options to commence the compost program first. These two schools are Government Bilingual School Tubah (G.B.S. Tubah) and St Bridget Bilingual Primary and Nursery

Figure 16: Map of school in Bambui. Location 2 is the G.B.S. Tubah and location 12 is St. Bridget Bilingual Nursery and Primary School (Bonu 2012)

School. These schools are ideal as they both have the potential to act as promotional

opportunities due to their location. This can be seen by their close proximity to the Bambui's Main Market, Tubah Council and the centre of the village (Figure 16). Also, due to their school's Bilingual teachings, it will help with the understanding of the compost program's instructions without any hindrance of language complications. G.B.S. Tubah has also photographic evidence indicating an ideal amount of land to place a garden (Figure 17). St Bridget Bilingual Nursery and Primary School has also shown photographic evidence but not particularly of ideal land, instead the image shows the need for a composting program to reduce their waste. This can be seen by the evidence of food scarps and waste outside of their school (Figure 18).

Figure 17: Front of the Government Bilingual School Tubah (Matoso, 2012)

The food scraps are also an indicator that the students eat on the premises during school; hence the student's allocated lunch time can serve as a primary time for encouragement to dispose of organic waste into the compost bin.

Figure 18: Waste and food scraps outside of St Bridget Bilingual Nursery and Primary School (Matoso, 2012)

Similar to the consultation with BASSUG, there will also be a consultation with the primary school board before the implementation of the compost program. During this consultation, any questions, issues and information, such as cultural and social practices, may be discussed. This is also the opportunity for a BASSUG representative to attend this session to further explain its necessity in Bambui's community. After all, it is planned that BASSUG delegates will approach the other primary schools to continue the program's implementation. Also before implementation an inspection of how many people make up the primary school and how much waste is produced must be carried out. This is to

accommodate the amount of compost bins necessary to reduce the generated waste of the students and faculty.

Manual

To assist in the implementation process, a simple printed manual will be given to all schools that adopt the program. This manual will act as a visual aid by containing images demonstrating the creation of the compost bin and posters, what can and cannot be composted and maintenance of the garden and compost (Appendix B). The manual has also the potential to be translated into their native language, Bambili-Bambui and French by a willing resident, in order to assist teachers who are not adequate readers of the English language.

Crops

To ensure that the garden crops are grown successfully, an investigation was carried out to select suitable garden crops for Bambui's climate and soil. From the investigation, the chosen crops are onions, carrots, and cabbages as they are of native origin to the area, require sunlight, and are compatible with composted soil (EWB Challenge 2015d, EWB Challenge 2015e).

Timeline of Implementation

To aid in the implantation design process, two Gantt charts were created to perceive the duration of the compost program as well as the duration of the implementation to all primary schools. These Gantt charts can be seen in Appendix C.

7.5 Technical Design

Participatory Numbers

The number of students in a classroom for a year level has been approximated to a fluctuating number between 25 to 50 students (EPDC 2014). This fluctuation depends on the number of students of the school and the number of students that make up a year level. Therefore, there is a possibility of requiring another composting workshop for a large number of student participants. The current workshop has been designed to accommodate an approximate maximum of 50 students. If this maximum is exceeded, the material requirements will need to increase, for instance the number of poster material.

The current first workshop designed for the $5^{th}/6^{th}$ year teachers has the maximum expectancy of a maximum of 10 participants. If this maximum is succeeded, the possibility of creating a second bin could be a viable option to ensure all present teachers participate in the creation of a compost bin.

To understand the community engagement potential of this project, an estimation on how many community members will be reached by this project was calculated. With 14 primary school consisting of approximately an average of 200 students and faculty of about 10 (Bonu, 2012), more than 50 members in BASSUG (Jones 2014), average number of family members of six to eight (EWB Challenge 2015), and an attendance to the main market of over 200 (EWB Challenge 2015b) the estimated amount of people to be influenced by this project is 4060 people.

Garden

For the garden to be of adequate size to accommodate approximately 50 seeds and not take up too much of the school's land, the dimension of 5 metres in length by 6 metres in width is recommended. For every metre across the garden's width, a row will be designed for planting. This will create a total of 6 rows. Between the third and fourth row a 5-metre long branch (approximate diameter of 150mm) is to be placed. This will act as a divider for the garden helping with the division between the composted soil from the non-composted soil.

Compost Bin

Composting is a natural process of breaking down recycled organic materials, such as leaves and vegetable scraps, into rich soil for crops and plants. Compost aids in the prevention against pests and diseases and enriches the soil it is applied to (EWB Challenge 2015d). The chemical components required to create this compost are carbon (which can be obtained from dry leaves, straws, sticks and brown grass) and nitrogen (such as fruit and vegetable scraps) (EWB Challenge 2015d). To accommodate this break down process the compost containment must be well-drained, aerated, and covered to offer protection from the

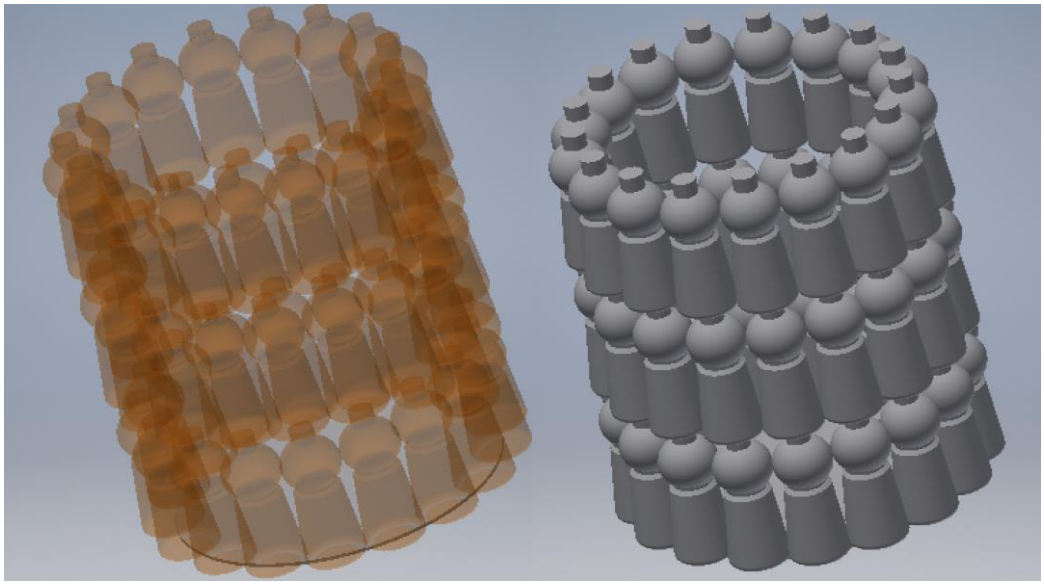


Figure 19: Transparent (left) and solid (right) model of compost bin

weather and pests. With these factors in mind, the compost bin was designed. The body of the modeled bin is comprised of 51 bottles in total with 17 bottles per row, 17 columns and 3 rows (Figure 19). The dimensions consist of a height of 609.27 mm, diameter of 465 mm, and a radius of 232.50mm (Figure 20). The interior of the bin is layered with approximately 5-metres of chicken wire to meet the requirement of drainage ability and aeration. To cover the bin's diameter of 465mm, the lid was designed with a slightly larger diameter of 540mm. With every bottle averaging approximately 240mm in height and 55mm in width, against the bin diameter, a lid of approximately 540mm in diameter can hold about 5 to 6 bottles across horizontally to sufficiently cover the bin (Figure 21). This will meet the requirement of preventing pests from entering the compost and offering protection against the weather.

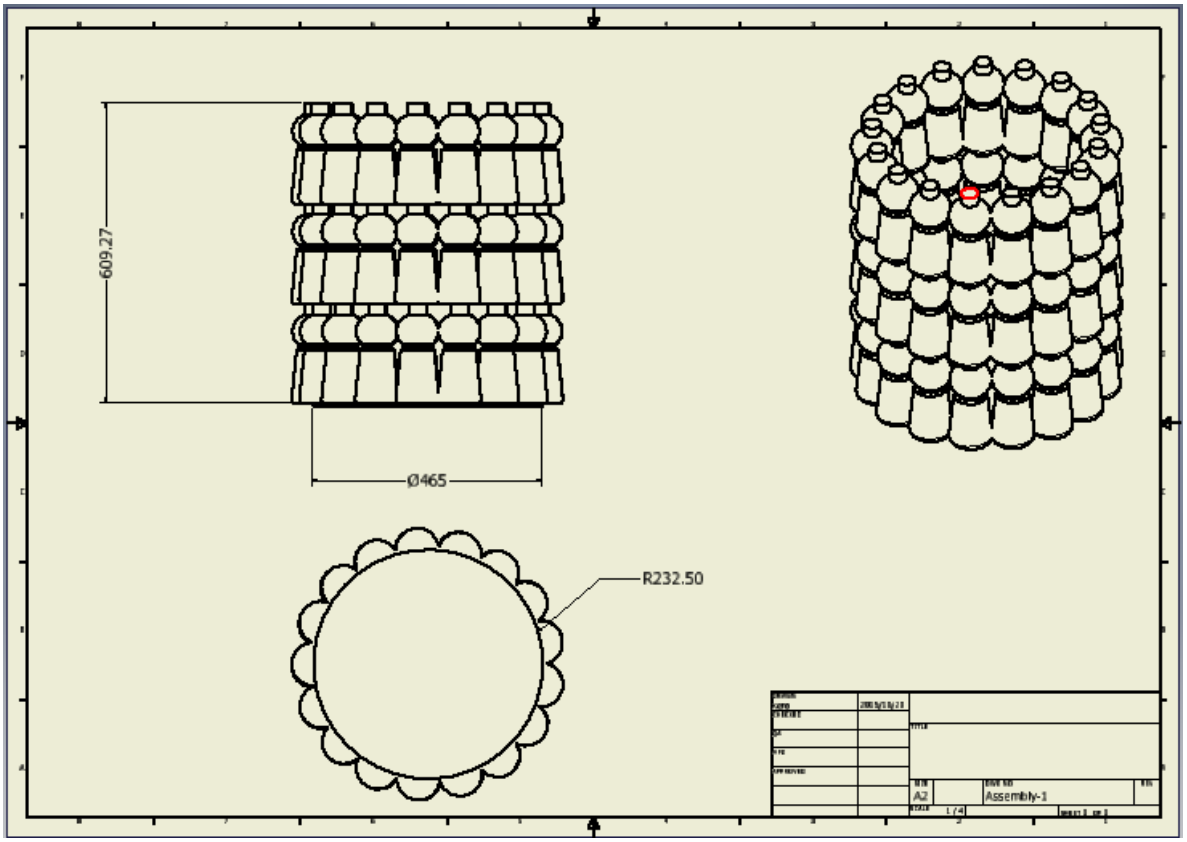


Figure 20: CAD drawing of dimensions of the compost bin

The number of compost bins and their dimensions will be dependent on the number of children attending the primary school and its faculty. The current capacity (volume) of the modeled bin is approximately 103 litres as calculated from multiplying its radius of 232.50mm, height of 609.27mm and π. For a school of a particularly large student body, the capacity of the bin can be increased by adjusting the dimensions with the number of bottles necessary to reach the desired capacity. There is also the possibility to create more compost bins to accommodate a large primary school. This will require an increase in materials such as the number of bottles and wire.

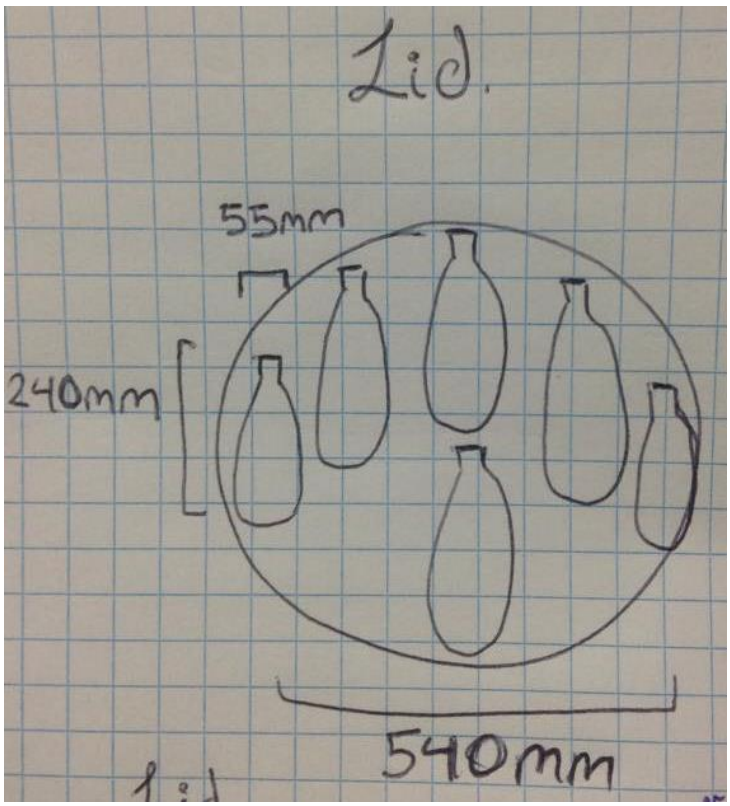


Figure 21: Lid dimensions

Materials

As defined in the sustainability model developed, the materials required for this project must be locally sourced and have no or low cost. To meet this requirement, research into the available materials in Bambui was carried out. The locally sourced materials required are detailed in Table 8. The necessary transportation of the required materials will

be encouraged to be done by foot, if the school is in walking distance of the shop, market or waste site. This will reduce any negative impact on the environment. However, if the school is not in walking distance, a motorised vehicle may be used to transport the items.

Table 8: Materials required for project

Material/Tools	Units	Cost (Y/N)	Sourced
Wire Cutters	1	Yes	Hardware Store
Hammer	1	Yes	Hardware Store
Awl tool or similar	2	Yes	Hardware Store
Nails (4mm)	50	Yes	Hardware Store or Market
Paint	2 litres	Yes	Hardware Store or Market
Reused Plastic Bags	4	No	Waste Site
Reused Plastic Bottles	55	No	Waste Site
Durable String	50 metres	Yes	Hardware Store or Market
Seeds	50	Yes	Market
Malleable Wire	5 metres	Yes	Hardware Store
Printed Manual Pages	4	Yes	Printing Store
Thin Wire Mesh	5 metres	Yes	Hardware Store
Recycled flat objects	50	No	Waste Site
Dirt	12 kg	No	School
Large Branch	5 metres	No	School
Small Branch	1.5 metres	No	School

Cost Analysis

Although, visual evidence of all required materials can be seen in Bambui's markets (such as the seeds seen in Figure 19), if materials were to run out it would result in a hindrance to the success of this project. To prevent

Figure 22: Image of seeds sold at the main market in Bambui (Matoso, 2012)

this, the cost analysis conducted is based on research from suppliers in Cameroon rather than solely Bambui's available resources (Table 9). This gives the possibility of sourcing insufficient material inventory from an available supplier from Cameroon, giving the possibility of still sourcing locally but with an added cost of transport.

As seen from the cost analysis, the approximate total of all material costs is 10, 738.95 CFA or AUD $25.29. The next cost to evaluate is the cost of an EWB representative running the two first workshops of the program. The costs to be considered are the labour hours required of the EWB representative. The workshops should only run for a maximum of three hours each, therefore the labour hours required of the EWB representative is six hours. The most relevant information regarding labour hours was a forum post on the EWB website by Dan Craddock (2015), EWB representative, stating the average labour cost in Bambui is 2500 CFA per day and 300 CFA per hour. If this is applied to the EWB representative's approximate six hours of work, it will add up to a total of 1800 CFA or AUD $4.19. This will give an approximate total cost of 12, 895.30CFA or AUD $30 for the project.

Table 9: Cost analysis of required materials

Item	Unit	Price (CFA)	Price (AUD)	Information Source
Nails (4mm)	4kg	3,500.00 CFA	$8.34	(EWB Challenge 2015f)
Wire Cutters	1	898.38 CFA	$2.09	(weiku.com, 2012)
Awl Tool or Similar	2	1,723.68 CFA	$4.01	(weiku.com, 2012)
Hammer	1	1,500.16 CFA	$3.49	(weiku.com, 2012)
Paint	2L	2,310.93 CFA	$5.55	(ec21.com, 2015a)
Thin Wire Mesh	5 m	144.31 CFA	$0.25	(alibaba.com, 2015a)
Malleable Wire (Steel)	10 m	127.20 CFA	$0.31	(alibaba.com, 2015b)
Durable String	5 m	50.00 CFA	$0.12	(EWB Challenge 2015f)
Printed Paper (Manual)	4 sheets	0.40 CFA	$0.00	(alibaba.com, 2015c)
Seeds	50	483.89 CFA	$1.13	(ec21.com, 2015b)
Total Cost		**10,738.95 CFA**	**$25.29**	

For the painting exercise of the posters, there was a consideration to have paint brushes, however to keep costs low, finger painting has been concluded to be sufficient enough for this project. This opportunity could be re-evaluated if enough revenue is created from the produce sold at the market.

Funding

From BASSUG's leadership in this project, there is the possible perception that as a Union of farmers, they have some of the equipment and tools required to create the garden and compost bin. Before the purchasing of necessary materials, a proposal for this favour could be put forth during the consultation. If they are willing to lend the equipment, it will decrease the cost immensely. As a Union they could also apply for a loan from NOWEFOCH (North West Farmers' Organisation Credit House), which could be paid off by the revenue generated from the produce sold after harvest. NOWEFOCH is the created microfinance bank of NOWEFOR (North West Farmers' Organisation); the organisation responsible for creating BASSUG (NOWEFOR 2014).

There is also the opportunity for funding from Engineers Without Borders. The cost of approximately AUD $30 could be generously donated as EWB has proven to have a sufficient amount of funds evident from recently receiving a grant from Microsoft worth US $50, 000 in October (EWB Challenge 2015).

8 Design Assessments

8.1 Prototype Evaluation

To validate the final design, a prototype of the compost bin was created. There were several discoveries that were not foreseen in the design plans. However all these

discoveries were compromised in the final design of the project. For instance, during the creation of the bin, the tools required were different from tools originally thought to be necessary. The tool requirements were modified to compensate for the different tools used. Another discovery was the hazard concerns present in the prototype model. This was evident from the sharp edges that were created by the chicken wire after cutting. To prevent this, the design has been modified to blunt all edges of the chicken wire by folding the edges over.

Considering the weather in Bambui, there were several negative impacts to the prototype compost bin, especially when it comes to wet season. The prototype had initially only the third bottle of every layer with a hole through its bottom. This would help drainage of the water, however every first and second bottle would create an opportunity for rainwater to confine inside the bottle. This would result in the risk of the bin being tipped over due to the weight of water leaked into these bottles. To counteract this challenge, the design has been modified to have holes in the bottom of every bottle rather than every third in a layer. Another negative weather impact was the potential for a strong gust of wind to knock over the compost bin. To prevent this, a weighted component to the final design was added. This addition consists of four weighted plastic bags filled with surrounding dirt to tether each side of the bin. The plastic bags will be recycled from waste sites around the vicinity.

8.2 Social Impacts

This project has been designed to act in accordance to the best interests of the community. To ensure that these satisfactory needs are met, the respect for the social,

cultural and religious practices has been integrated into the project. This is evident from the scheduled consultations with BASSUG and the primary schools to ensure them the opportunity to express their concern or proposals to integrate any cultural, social and religious practices they deem necessary for the project.

The current standard of living in Bambui is a growing concern, especially for the health risks regarding water contamination from the uncontrolled dispersion of waste seeping into its surrounding environment and water supply (EWB Challenge 2015c). To address this issue, the project is designed to accomplish the defined goal of reducing waste through the practice of compost and collection of recyclable materials. It is from this minimisation of waste that the anticipated effect of lowering the risk of water borne illnesses will lead to a better health standard for the community. The visual aesthetics and lessening of olfactory issues from the reduced waste, will also improve the morale of the community. All these factors contribute to the improvement of Bambui's living standard.

Fromant and Jones (2015), surveyed 42 youths of Bambui regarding education and a career in agriculture. From their investigation they discovered the majority of youths had a lack of motivation to partake in the agricultural industry in the future, instead the majority

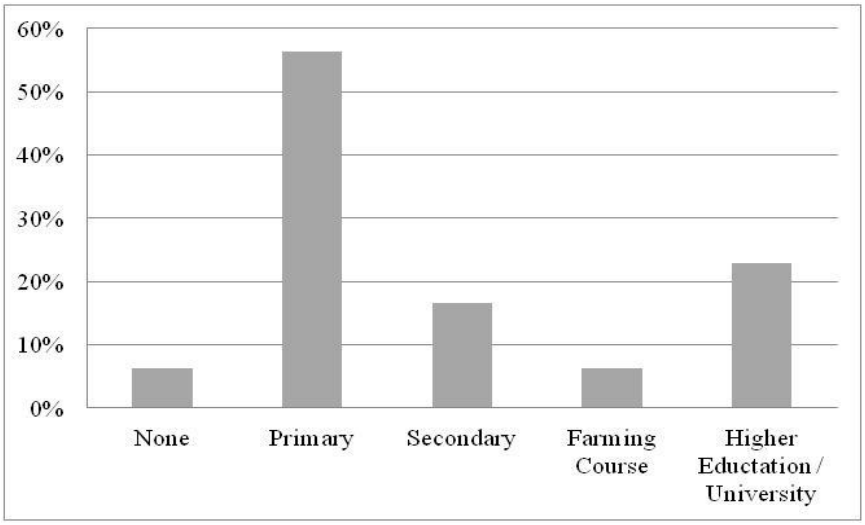


Figure 23: Highest education achieved by farmers (EWB Challenge 2015d)

expressed interest in looking for ‘fast money’ alternatives, such as taxi services. This is an alarming issue as the development of agriculture in Bambui serves as their main subsistence economic income (EWB Challenge 2015b). Furthermore, with the growing population in Bambui it is imperative for the agricultural industry to meet their demands (EWB Challenge 2015d). It is from the proposed project where this social influence could act as an avenue to improve youth participation in farming. This can be seen from the farming practices from BASSUG and the integration of composting practices that the youth are being exposed to. Putting these farming methods into practice, learning patience and working as a team to meet their goal of harvest, has the anticipated effect of instilling into the children that agriculture is a viable business option and realise the variety of jobs available to them. It also acts as an avenue of training for BASSUG and establishes the importance of working as a union to the students, aiding their roles in the community. Not only does the program expose students to best farming practices, but also exposes students to the markets and the finance sector of agriculture, evident from the harvested produce to be sold at the market. It is from this exposure that the project can facilitate a social link between the youth, Union, farmers and traders.

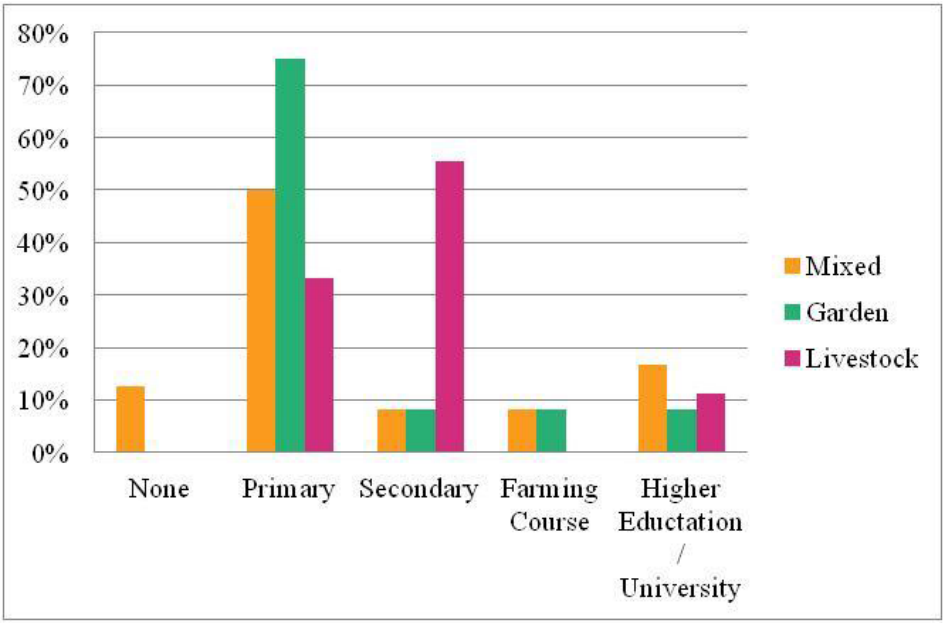


Figure 24: Highest level of education achieved by the farmers by sector (EWB Challenge 2015d)

Fromant and Jones (2015) also conducted a survey on 48 farmers regarding their education. From their findings they discovered that the highest level of education achieved by farmers is Primary school (Figure 23). They also categorised farmers in accordance to their farming sector (mixed, garden and livestock) with the result of 70% of the garden sector achieving a Primary school education (Figure 24). From these recorded statistics, the project is justified to have a social impact on the majority of future farmers and their training as it has been designed to suit a Primary school audience and the garden producing garden sector crops (onions, cabbages and carrots).

In order for the compost program to be successful, the school community will need to change their daily lunch habits slightly to dispose of organic waste properly. However, this project has been designed to make this transition as easily adaptable as possible. For instance, the use of the posters to indicate what can and cannot be composted serves as a

convenient visual guide for the students and faculty. Also the aspect that the 6th year students pass down their knowledge of composting and garden maintenance to the 5th year students will aid in the adaptation to the disposal habit. Moreover, this hand over process serves as a social opportunity to strengthen the bond between these two year levels and encourage team work.

8.3 Economic Impacts

The main economic benefit this project yields, is the enriching property compost adds to increase crop growth and quality. It is from this conversion that the organic waste now has value. The value is then added to the outcome of the produce and its price on the market once harvested. The money collected from the market can serve as financially feasible revenue for the school and the continuation of the project.

There are costs associated with implementing this project such as the material required for garden maintenance and creating the compost bin, however these costs have been established to be of low cost and locally sourced, as defined in the cost analysis section of this report. It is derived from this low cost and product revenue that the program can be continued on to the next year and possibly source enough revenue to contribute to funding for the school.

From Fromant and Jones' (2015) statistics concerning youth participation and the average farmer level described in the previous section, it can be further drawn that the project will have an impact on the economic growth of the community as well. The exposure to the farming practices and the financial sector of agriculture will provide as credible encouragement for the students to become involved in the development of

agriculture. This predicted increase in agricultural workers will have the anticipated effect of supporting Bambui's agricultural industry to meet the growing demands of the rapidly rising population. To verify this increase, a survey after several years of the project's commencement could survey the amount of agricultural workers and their opinion if Wonder Waste had an influence on them. There could also be a second survey conducted on Primary school students to ask if they express any interest in a career in the agricultural industry.

8.4 Environmental Impacts

The primary environmental benefit this project offers is the conservation of landfill space by recycling organic resources. This outcome will benefit both the environment and community as the reduction of waste will prevent environmentally damaging practices, such as burning the overflow of waste, and reducing health risks (for instance, the seepage of waste into the water supply causing water borne illnesses) (EWB Challenge 2015c). Additionally, the composting process will add nutrients to the applied soil sustaining the nutrient cycle, thereby improving plant growth and quality (EWB Challenge 2015d). The project also reduces waste through the practice of recycling, evident from the education program's design to use recycled plastic bottles, plastic bags and flat objects. Furthermore, from this environmentally friendly practice of compost and recycling, Bambui's ecological footprint will be reduced thus benefiting the local environment and climate.

From the project's design it has been evaluated that it is suitable to Bambui's climate and is environmentally durable. The suitability to Bambui's climate is self-evident from the program's locally sourced materials, local practice as instructed by BASSUG, and the

absence of foreign material, resulting in the elimination of any potential harm or contamination to the local ecosystem and fauna. The project's environmental durability has been evaluated from the prototype as well as research into Bambui's climate. The changes made to the design included improving the compost bin's drainage ability (due to Bambui's high precipitation in wet season) and the bin's capable endurance of local weather conditions, ensured through the use of weights (which can be untied to perform the task of dumping the compost).

8.5 Limitations

Garden Condition

In order to demonstrate the effectiveness of compost, profitably and healthy crops must be grown. The condition of the garden can, however, be effected negatively by environmental factors such as flooding causing damage to the crops. Another hindrance is the possibility of pests or diseases infecting the crops. Main pests and disease recorded in the garden sector of Bambui include blight, medfly, black spots and aphids (EWB

Figure 25: Examples of medfly (left) and aphids (right) (EWB Challenge 2015d)

Challenge 2015d) (Figure 25). The prevention of these factors, are dependent on the local environment, however to minimise the possibility of the crops being infected or destroyed, the BASSUG's expertise on the local farming area and conditions will act as guidance for prevention methods.

BASSUG, Primary School and Community Proposals

BASSUG, the participating Primary schools and the Bambui community play essential roles for the successful implementation of this project. It is therefore crucial that the proposal is persuasive in terms of social and cultural sensitivity, sustainability, and evidential benefits in social, environmental and economic contexts. To convince each member of this project, the proposal will be tailored to suit the individual party. For instance, the proposal to BASSUG will appeal to their aim as an organisation to improve the standard living of farmers and the community by elaborating on the practice of compost reducing landfill waste thereby improving the standard of living. Additionally, the proposal for BASSUG will appeal to their agricultural educative means by emphasising that this project is an opportunity for them to outreach to all primary school students in the community; or potential future farmers in their perspective. The tailored proposal for the Primary schools will consist of appealing towards the student's wellbeing such as the reduction of waste will aid in the prevention sanitation and hygiene issues among the student and faculty. If there is any difficulty encountered with an oral proposal, the consideration of an interpreter to translate the proposal in the language the party understands is a possibility. Also the use of visual aid will help in getting the message across. The community's encouragement for composting practices will mainly take place

during the selling of the produce grown by the students. With the distinct separation of what crops had compost applied and crops that did not, should serve as a visual aid regarding the effectiveness compost has on plant growth. It is from this visual evidence and oral communication between the interested community member and either a BASSUG delegate or student that should convey a message of encouragement to spread this practice into the wider community.

9 Conclusion

In context to the Bambui community, the defined cause of the unethical waste management practices is due to the excessive amount of waste being produced and not properly disposed of. To assist in the prevention of these practices, the composting and recycling education program, Wonder Waste, is to be proposed. This design satisfies the design criteria required to successfully implement a sustainable education solution applicable to the community of Bambui. The aspects of Wonder Waste that ensures its sustainable design is its economic feasibility, community engagement, and visual evidence of the beneficial outcome of the program. Also the strategy devised of instilling a sense of ownership to encourage motivation as seen by BASSUG's role, teachers creating the bin and the students planting and maintaining the garden, will aid in placing a successful continuation of the project in both the schools and further into the community. The design is sound, flexible and simplistic. With these factors combined, a favorable improvement to Bambui's waste management can be achieved.

10 Appendix

10.1 Appendix A: Design Matrix

	Sustainability	Material	Environment	Technical Design	Cost	Impacts to Community	Sum
	0.30	0.15	0.20	0.10	0.10	0.15	1.00
1) Bags	4	5	6	8	7	8	5.85
2)GamesAndCreation	7	6	4	6	10	5	6.15
3) Bin and Poster	8	7	10	6	9	8	8.15
4) Compost	9	10	10	7	10	7	8.95
5) Mobile APP	2	1	2	4	2	1	1.90

10.2 Appendix B: Wonder Waste Manual

Wonder Waste Manual

Step 1.

Firstly, note where the holes should be, two either side, top and bottom. Also don't forget one on the bottom base.

Step 2.

Pierce the holes with a pair of scissors or a knife.

Step 3.

Thread the metal wire through the holes.

Step 4.

String 17 bottles into a continuous loop, tying the ends of the wire together.

Step 5.

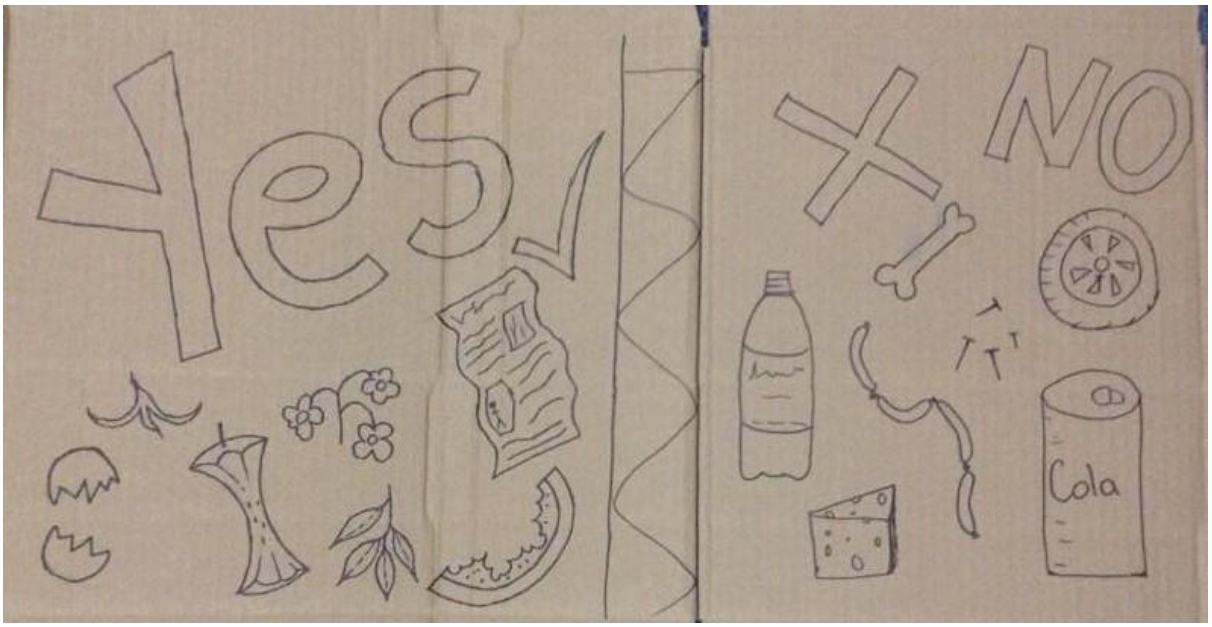
Stack 3 layers of looped bottles together and bind them with vertical wire through every 3 bottles, from top lid to bottom hole, so that they make columns.

Step 6.

Finally use any available chicken wire or mesh to secure the base and insides of the bin.

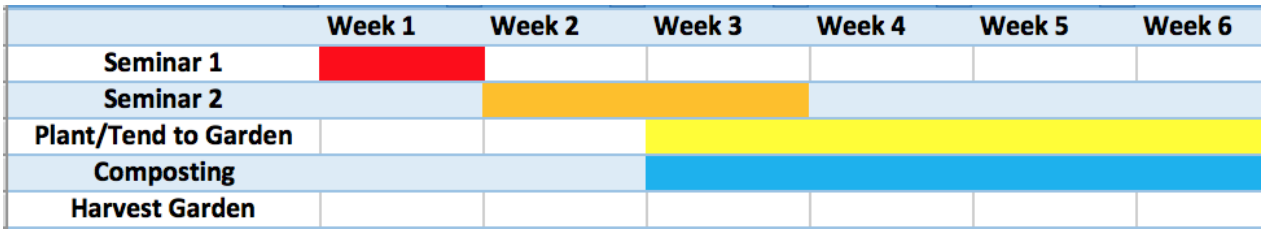
In addition to the bin.

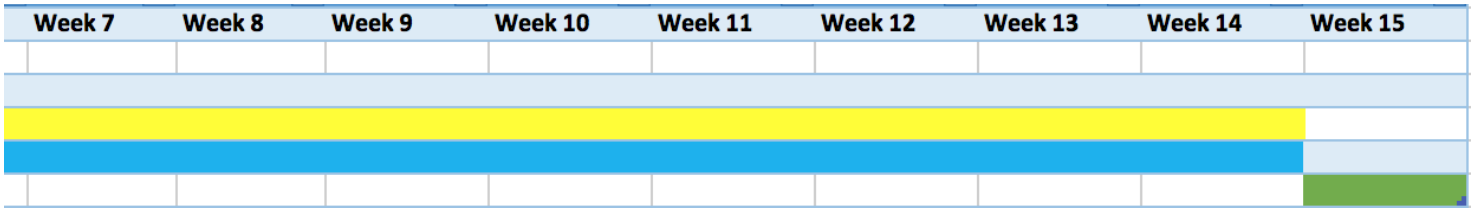
- Regular workshops can benefit your community by helping each other recycle and compost ✓
- Tell your friends and family so that everyone can give a helping hand ✓
- Keep adding to the compost and churning it so that the nutrients break down ✓
- Help paint some posters to put up around the bins so that everyone knows what to reuse. ✓



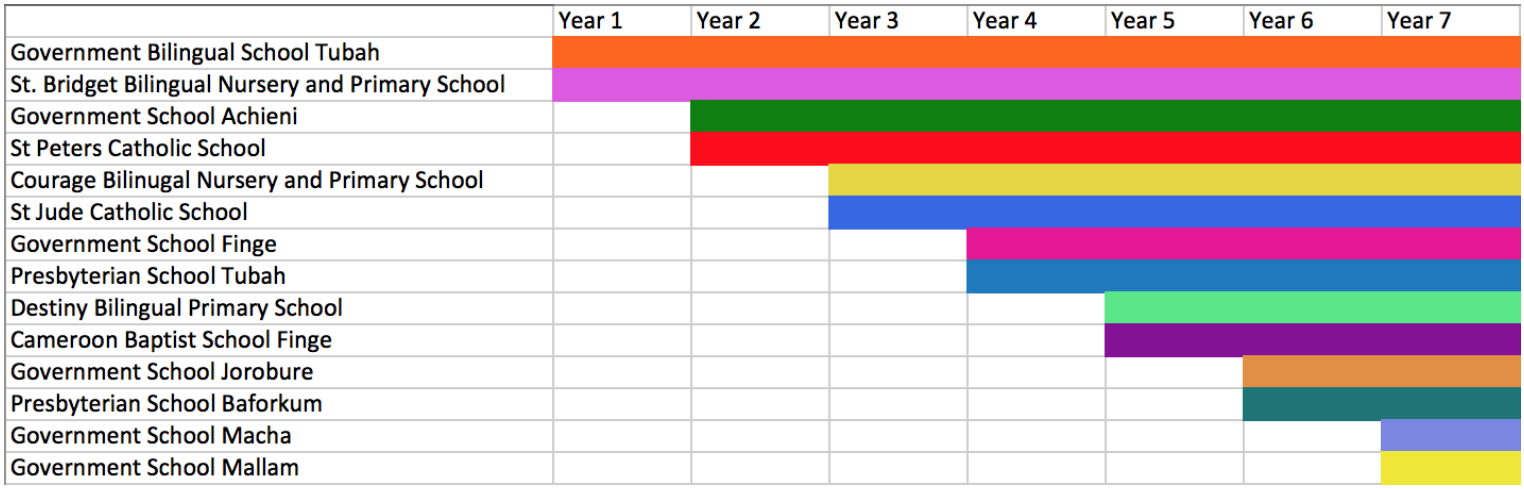
10.3 Appendix C: Gantt Charts

Implementation Process of Workshops





Implementation Process of Primary Schools



10.4 Appendix D: Meeting Minutes

The Inner Circle

Meeting Minutes #1

11th of August 2015

Location: SILC

Meeting Commencement: 16:50

1. **Opening of the Meeting:**

   1.1. <u>Attendees Present</u>

   Tristan Freeth

   Roy Xie

   Rachel Mesler

   Romar Castro

   <u>Apologies</u>

   Alex Ostojic Reason: Sick

   Stefan Ostojic Reason: Sick

   1.2. Confirmation of Team Agreement

   Tristan suggests adding a small section mentioning that we can add amendments during the course of this project

   Send Tristan Team Agreement as PDF in order to get signatures during next meeting (12/08)

   1.3. Confirmation of Contact Details

   Confirmed. All members have received previous documents and can be contacted on both Facebook and Email

2. **Items to be Discussed:**

2.1. Individual Decisions on Design Area

Roy: Waste Management

Reasons: easy to understand, everyone relates, all degrees don't have a complication, experienced team member in recycling material, team member has connections of a family member working at a recycling & plant fertilizer industry and also has background knowledge on plants that might come in handy during this design process

Tristan: Agrees with Waste Management

Romar: Agrees with Waste Management

Rachel: Agree with Waste Management

Stefan & Alex: Agree with Waste Management (via Facebook messenger)

If not possible, Water Supply

Reason: Water saving and education is a relatable issue, common topic of discussion in modern society, urgent issue, education experienced team member so their experience could help us come up with an effective educative and sustainable design

2.3. Timeline for Project

Timeline implemented on Gnatt Chart on Excel. Rachel will email draft to everyone today, after meeting. Tomorrow there will be confirmation on dates.

3. Items Requiring a Decision

3.1. Design Area

1st Preference: Waste Management

2nd Preference: Water Supply

3.2. Next Meeting Date

12th of August 11:00 – 13:00

3.3. Timeline Dates Set for Each Week of Projects

Still in draft. Will confirm tomorrow during meeting

4. Closing of the Meeting

4.1. Review the Meeting

Productive. We chose a design area and a reason as well as completing the Gnatt chart draft.

4.2. Confirm Upcoming Timeline Dates

Research dates and goals will be confirmed after meeting tomorrow (12/08)

Meeting Finished: 17:37

The Inner Circle

Meeting Minutes #2

18th of August 2015

Location: SILC

Meeting Commencement: 17:00

1. **Opening of the Meeting:**

1.1. <u>Attendees Present</u>

Tristan Freeth

Roy Xie

Rachel Mesler

Romar Castro

Alex Ostojic

Stefan Ostojic

1.2. Confirmation of Team Agreement Amendments

Everyone agreed

1.3. Signing of Team Agreement

Alex Signed. Tristan will send pdf to Rachel.

1.4. Confirmation of Design Area

Waste Management Design Area

Challenge Chosen:

Recycling Education and Awareness Program

1.5. Confirmation of Previous Minutes

Confirmed

2. Items to be Discussed:

2.1. Design/Bambui Research

All team members will send a document of research each by Thursday

2.2. Confirmation of Timeline for Project

Will confirm on later dates closer to project date submissions

2.3. Key Question

Rachel will send picture of key question exercise with minutes

2.4. Develop Mind Map

All mind maps collected by team leader Alex

3. Items Requiring a Decision

3.1. Research Goals

Will be confirmed after tomorrow's workshop

3.2. Next Meeting Date

Tomorrow 19th of August during workshop in Library

3.3. 8 – 12 Design Concepts

Design concepts within Mind Maps collected by team leader Alex. Will chose one concept to follow during workshop tomorrow

4. Closing of Meeting

4.1. Review the Meeting

Research section will be completed during workshop tomorrow

4.2. Confirm Upcoming Timeline Dates

This week's Gnatt chart is to work on drafting the report chapter. Planning to commence report drafting after Friday's lecture on Report #1 information

Meeting Finished: 18:00

The Inner Circle
Meeting Minutes #3
25th of August 2015
Location: SILC

Meeting Commencement: 17:00

1. **Opening of the Meeting:**
   - **1.1. <u>Attendees Present</u>**

     Tristan Freeth

     Roy Xie

     Rachel Mesler

     Romar Castro

     Alex Ostojic

     Stefan Ostojic
   - **1.2. Confirmation of Design Area and Design Challenge**

     Everyone understand
2. **Items to be Discussed:**
   - **2.1. Design Concept/Bambui Research**

     All team members will send their research documents to the OneDrive account named EWBChallenge

     Tristan:

     Education Research

     Mesh Bag Research

     Scopus database

     Roy:

Key Research Question

Will send research to OneDrive

Stefan:

Reusable Bottles Idea – approved original idea of building a bin

Posters Concept – Printing posters electronically is a bit of a problem maybe need to paint/hand make posters

Alex:

General Life

Population – 50,000

Culture

Links to articles will be released on OneDrive

Romar:

Education – use to be passive with education until TTC happened

Has uploaded to OneDrive

2.2. Collaboration of Research Articles Chosen

Submitted on OneDrive

2.3. Design Concepts: Identify Opportunities and Limitations for Each

<u>Bags</u>

Opportunities:

- Fairly easily obtained and reusable
- Weaving material

Limitations:

- Material needs to be locally sourced (from research does not look viable to make bags out of waste because the materials are not appropriate

<u>Educational Programs (Games):</u>

Opportunities:

- Targeting a young audience

- Educating as well as having fun

Limitations:

- would a game be sustainable?
- Is culturally appropriate? Would they find it fun?

Education Flowchart:

Opportunities:

- Could be implemented late in design stage of posters

Limitations:

- Same as poster

Reuse Bottles:

Opportunities:

- Games
- Making objects
- Primitive shape – easy to construct

Limitation:

- Is there enough bottles to reuse to make it effective?

Compost:

Opportunities:

- A lot of organic waste to recycle
- Lots of biodegradable material

Limitations:

- Need motivation for the community

Posters:

Opportunities:

- Lots of information to put on the posters
- Paint posters – make it for the kids to do after a seminar
- Teachers could help implement programs

Limitations:

- If printing, electricity supply is not reliable
- Needs to be weatherproof

Easy Manual:

Opportunities:

- Get the kids to do it, makes it tangible for the kids

Limitations:

3. Items Requiring a Decision

3.1. Design Concept Solution

Seminar (Game) + Poster (Kid Made) + Bin + Compost = Education

Target Audience = Teachers + Kids

Reward System = something tangible to keep it. Motivation (otherwise not sustainable)

Two Separate Seminars: Adult + Younger Audience

3.2. Report Goals and Strategy

Decide by tomorrow for who does what

Goal to put it all together by Tuesday meeting next week

3.3. Next Meeting Date

Tomorrow 26th of August during Workshop

4. Closing of Meeting

4.1. Review the Meeting

Report Goals and Strategy will be completed during workshop tomorrow

Transport taken from Rachel to Alex

4.2. Confirm Upcoming Timeline Dates

Up to date

Meeting Finished: 18:00

The Inner Circle

Meeting Minutes #4

1st of September 2015

Location: SILC

Meeting Commencement: 17:00

1. **Opening of the Meeting:**

   1.1. <u>Attendees Present</u>

   Tristan Freeth

   Roy Xie

   Rachel Mesler

   Romar Castro

   Alex Ostojic

   Stefan Ostojic

   1.2. Confirmation of Report Outline

   Understood

   1.3. Confirmation of Previous Minutes

   Understood

2. **Items to be Discussed:**

   2.1. Design Concept/Bambui Research

   Tristan (Waste Management in Bambui and Previous Projects):

   - Sorting recycling started however once volunteer's went home, sorting no longer part of lifestyle (2012)
   - School and Market dump waste out the back and burn it – only implementation of waste management
   - Truck come to market that comes to pick up waste twice a week (not all waste collected though)

- Medical waste is burned – hazard (found in pdf water and sanitation on OneDrive)
- General dumping and burning is current waste management in Bambui

Romar (Waste Management in Bambui and Previous Projects):

- Waste taken outside of houses (animals got into waste so they burn waste instead) including burning plastic. This is where bin implementation is a good investment

Roy (Design Considerations and Requirements)

- Will be done by tomorrow

Alex (Background):

- Finalised by tomorrow

Stefan (Problem Definition):

- Put on OneDrive by tonight

Rachel (Background Research and Design Concepts - Benefits and Limitations):

- Put on OneDrive and finished

2.2. Collaboration of Written Report Research

Will be finalised by tomorrow

2.3. Design Concept Final:

Educational Seminar on Composting Bin + Poster

Two Separate Seminars one aimed at Primary School Children and the other at Teachers and Parents

3. Items Requiring a Decision

3.1. Design Concept Solution (FINAL)

3.2. Report Draft Editing

Comments on Your Page

Upload to OneDrive

Romar Editor

Stefan – Concept Selection done by tomorrow

3.3. Next Meeting Date

Tomorrow 2nd of September during Workshop

4. Closing of Meeting

4.1. Review the Meeting

It went well – Stefan 2015

Twas good – Alex

4.2. Confirm Upcoming Timeline Dates

Up to date so far

Meeting Finished: 17:50

The Inner Circle

Meeting Minutes #5

8th of September 2015

Location: SILC

Meeting Commencement: 17:00

1. Opening of the Meeting:

1.1. <u>Attendees Present</u>

Tristan Freeth

Rachel Mesler

Alex Ostojic

Stefan Ostojic

Roy Xie

Romar Castro

1.2. Review of Report Draft

Referring to Design Matrix more could improve our report

2. Items to be Discussed:

2.1. Design Concept Evaluation/Modelling

Use wires to hold down bottles, not clay

2.2. Design Concept Prototype Plan

Bottle Bin Prototype:

- Bottle collecting (50 bottles) – Everybody
- Wires (25 straight wires, 4 circular wires) - Romar
- Durable string or rope (2 metres) – Ostojic crew
- Chicken Wire (2 metres) – Ostojic Crew or Tristan

Poster Prototype:

- 1 cardboard or recycled flat object – Ostojic Crew
- Paint – Ostojic Crew
- Paint brush – Ostojic Crew

Mini-Garden Prototype – Rachel's mini project

Video Content:

- Time-lapse video of bottle bin building
- Poster creating (one person)
- Look at Storyboard

3. Items Requiring a Decision

3.1. Design Concept Model

Homework read design – get resources by NEXT WEEK

Rachel change clay to wires

3.2. Next Meeting Date

Tomorrow 9th of September during Workshop

4. Closing of Meeting

4.1. Review the Meeting

A-okay – Alex 2015-09-06

Pretty entertaining – Tristan

4.2. Confirm Upcoming Timeline Dates

Up to date so far

Meeting Finished: 18:00

The Inner Circle

Meeting Minutes #6

15th of September 2015

Location: SILC

Meeting Commencement: 17:00

1. **Opening of the Meeting:**

1.1. <u>Attendees Present</u>

Tristan Freeth

Rachel Mesler

Alex Ostojic

Stefan Ostojic

Roy Xie

Romar Castro

1.2. Confirmation of last minutes

Confirmed

2. **Items to be Discussed:**

2.1. Executive Summary Draft

Please read on OneDrive

2.2. Reflection – individual responses to questions

2.3. Collaboration of Reflection

On team document located on OneDrive

2.4. Design Concept Prototype Plan

2.4.1. Who will be doing what for the prototype?

Meet inside SILC at 1pm on Tuesday next week

Also wear button up shirts – bring ties

<u>Alex and Stefan</u>

Chicken Wire

Durable string or rope

Video Camera + Tripod

3 Ties

<u>Rachel</u>

Bottles

<u>Romar</u>

Wire

<u>Tritan</u>

Pliers and Cutters

Screw Driver

2.4.2. Planning your prototype presentation – maximum 10 minutes

Refer to Storyboard image on OneDrive – Rachel homework

2.4.3. $25 Budget Plan

$18.10 left in Budget

2.5. Planning tasks for the rest of the project

2.5.1. Will there be a lot of assignments due during the final week of submission?

Everyone will be pretty busy during this time

3. Items Requiring a Decision

3.1. Executive Summary and Reflection Draft

Look over executive summary on OneDrive

Rachel will have completed reflection draft by Thursday

3.2. Next Meeting Date

Tomorrow 16th of September during Workshop

4. Closing of Meeting

4.1. Review the Meeting

Pretty good ay' – Stefan

Many lols were had – Tristan

I'm tired – Tristan 2015

4.2. Confirm Upcoming Timeline Dates

Up to date so far

Meeting Finished: 18:00

The Inner Circle

Meeting Minutes #7

6th of October 2015

Location: SILC

Meeting Commencement: 17:05

1. Opening of the Meeting:

1.1. <u>Attendees Present</u>

Rachel Mesler

Stefan Ostojic

Roy Xie

Romar Castro

<u>Absentees</u>

Alex Ostojic

Tristan Freeth

1.2. Confirmation of last minutes

Confirmed

1.3. Review of Prototype Video

Stefan is 90% done. Will be finished editing after tonight.

Meet at 10:30am at Tutorial 440 (same room as Workshop) to view finished video.

2. Items to be Discussed:

2.1. Prototype Presentation

Re-read script. File under Prototype on One Drive

2.2. $25 Budget

$13.50 from Stefan and Alex

$6.90 from Romar

$20.40 in total

BRING RECIEPTS TO WORKSHOP TOMORROW (ALEX/STEFAN AND RACHEL)

2.3. Report Editing

Romar – done

Wednesday – Roy

Thursday – Stefan

Friday – Tristan (TBA)

Saturday – Alex (TBA)

Sunday – Rachel

2.4. Next Sections for Team Report – Structure and Outlining

Detailed Description – Needs specifics on what we did on the prototype

Implementation Plan (Process Needed)

Discussion (Strength and Weakness)

Evaluation

Conclusion

5 Main Sections Left! Only One Full Week Left!!! Wait for further instructions from Dhara tomorrow.

3. Items Requiring a Decision

3.1. Prototype Presentation Video (any final edits that need to be done)

Stefan 90% will be finished.

Will be handed on a USB as Plan A

External hard drive used as Plan B

3.2. Next Meeting Date

Tomorrow 7th of October during Workshop

4. Closing of Meeting

4.1. Review the Meeting

A lot less people than usual – Rachel

Not many people, went very short – Stefan

I'm half asleep - Romar

4.2. Confirm Upcoming Timeline Dates

The report needs a push! Running a little behind.

Prototype Presentation tomorrow! Get pumped! :D

Meeting Finished: 17:45

The Inner Circle

Meeting Minutes #8

13th of October 2015

Location: SILC

Meeting Commencement: 17:00

1. **Opening of the Meeting:**

   1.1. <u>Attendees Present</u>

   Rachel Mesler

   Stefan Ostojic

   Roy Xie

   Romar Castro

   Alex Ostojic

   Tristan Freeth

   Patrick McCallum – Honouree Guest

   1.2. Confirmation of last minutes

   Confirmed

2. **Items to be Discussed:**

   2.1. Review of Prototype Feedback

   Research

   - School lunch/curriculum/year levels (which is senior)
   - Primary school close to town
   - Agriculturally oriented school and bilingual
   - Locate the material

   Size of Garden – 5 x 5 metres

   Pitchfork or Branch (2.5cm diameter locally sourced)

   Yes if the community would like to contribute

   Posters must be hang up by nail against clay wall near the bin

   Include in the evaluation section that we could adjust the program into an Agricultural Club – open to public

   Weigh down the bin by tying a string around a bag that was used (reused), and there is a heavy object or sand/dirt in the bag. – Must be put into design plan evaluation

Two schools – one is agricultural orientated and the other in a school near the town centre (RESEARCH)

A manual must be included – English and Bambili-Bambui (do we put this in an appendix? – Ask Dhara tomorrow)

We must make it clear that the program is to be continued into the school curriculum for the senior year level EVERY YEAR

Cost Analysis – Rachel

Scale it – 5 x 5 and two schools and posters must be on side of their building

2.2. Draft Report Editing Finalised

Alex – Edit

Tristan – Edit

Rachel – Put in OneDrive

Roy – Put in OneDrive

2.3. Next Sections for Team Report

- Final Design (Specifics) – Stefan and Alex
    - Summary of Design
    - Detailed Description
        - Implementation Plan
        - Manufacturing Plan (Product – Bin)
        - Component list (materials needed in table in appendix)
    - Overview of Final Design
    - Technical Aspects – such as material, (product drawing – Roy) and (cost analysis - Rachel)
- Design Assessments (Discussion/Evaluation) – Rachel and Roy
    - Prototyping – What did you learn?
    - Social Impacts (Regulatory and Safety Considerations/Cultural)
    - Economic Impacts: Talk about cost of project (Cost Analysis)

- Environmental Impacts - positive
- Limitations? (Strength and weaknesses)

- Design Implementation? (Dhara's structure – ask Dhara)
- Conclusion – Tristan and Romar

2.4. Presentation Structure and Outlining (Rehearsal Next Week)

By next week, group meeting the script finished. Wait until further instructions

3. Items Requiring a Decision

3.1. Final Concept (Evaluation from Prototype)

We've discussed – Summary tonight Rachel

3.2. Designated Final Report Sections

Said in above section

3.3. Final Edit of Report (includes edit of Executive Summary)

Rachel Mesler

3.4. Next Meeting Date

Tomorrow 14th of October during Workshop

4. Closing of Meeting

4.1. Review the Meeting

"Good meeting" – Honouree Guest Patrick McCallum

"Good as per usual" – Alex

4.2. Confirm Upcoming Timeline Dates

The report needs a push! Running behind.

Script needs to be clarified and drafted.

Meeting Finished: 18:00

The Inner Circle

Meeting Minutes #9

20th of October 2015

Location: SILC

Meeting Commencement: 17:05

1. **Opening of the Meeting:**

   1.1. <u>Attendees Present</u>

   Rachel Mesler

   Stefan Ostojic

   Roy Xie

   Romar Castro

   Alex Ostojic

   Tristan Freeth

   1.2. Confirmation of last minutes

   Confirmed

2. **Items to be Discussed:**

   2.1. All Sections of Final Report Uploaded

   2.1.1. Combine Conclusion – Uploaded

   2.1.2. Final Design – Uploaded

   2.1.3. Discussion – Roy: Will upload tonight

   2.1.4. CAD Drawing – Roy: Will upload tonight

   2.1.5. Manual – Tristan: Will upload tomorrow night

   2.1.5.1. Stefan grab screenshots of steps to put into Final upload tonight

   2.1.6. Gnatt Chart – Uploaded

   2.1.7. EndNote References – Alex, Tristan upload tonight

   2.1.8. Reflections due Thursday

2.2. Creating Script for Presentation – TONIGHT. Clarify with Dhara

Introduction/Community – Rachel

Problem Area – Tristan

Problem Definition – Romar

Concept Selection – Stefan

Prototyping – Roy

Final Design – Alex

Impacts (social, economic, and environmental) – Rachel

3. Items Requiring a Decision

3.1. Final Script and Powerpoint

Sunday – Everyone have script finished

Final Edit – Rachel

PowerPoint – Rachel

3.2. Next Meeting Date

Tomorrow 21st of October during Workshop

4. Closing of Meeting

4.1. Review the Meeting

"Yes" – Alex

"Nah - eh" – Romar

"It was okay and please kill me now" - Stefan

4.2. Confirm Upcoming Timeline Dates

The report needs to be uploaded and finished! Running behind.

Script needs to be clarified and drafted.

Meeting Finished: 18:00

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