Ensuring Sustainable Environment and Development: A Study of Solid Waste Management in the University of Lagos, Nigeria

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Abstract

Management of waste is vital to environmental sustainability and sustainable development efforts which are key goals of the SDGs. This experimental research examined solid waste management within the University system. It employed a combination of enlightenment and the introduction of a specifically designed bottle-shaped dust-bin to ascertain sorting of solid waste into appropriate containers and encourage the University residential community's adherence to the reduce, reuse and recycle (3Rs) approach. The study was conducted using Sensitization Campaigns, Interviews, Observation and the Questionnaire. The research raised five questions and used a combination of qualitative and quantitative techniques for data gathered from 250 residents of the staff living quarters of the University of Lagos, Nigeria. A careful examination and measurement of the contents of existing dustbins revealed that there was up to 75% increase in the adherence rate to recycling after the campaigns. The various challenges faced were noted and it was emphasized that in order to bring about environmental sustainability, the driving principle must be sustainable development, and the University system must re-examine its role in leading-by-example to increase its contribution to sustainable development. It is hoped that if the idea of the self-explanatory bottle-shaped bin is adopted, it can be useful in encouraging proper sorting of garbage. The study finally proposed a model for sustainable development within the University environment and in the society at large that will be responsive to environmental sustainability.

Key words: Environment, Development, Sustainability, 3Rs (reduce, reuse, recycle), Method, Adult Education.

Introduction

The management of waste, especially solid waste (non-liquid and non-gaseous by-products of human activities that are deemed useless and of no economic value) is an essential aspect of daily life and has been an issue once human beings started forming enough communities to put stress on natural and material resources (Jubril, Ibrahim and Jamilu, 2012). The human being has proved to be the most culpable of the species in the desecration of the environment. Most human activities, and especially in the process of developing, invariably create waste, much of which can pose risks to the environment and to public health, especially if not well managed (Zhuang, Kimbal, Hogg, Zhao, Oechel, Cassano and Running, 2008). The urge is therefore to find solutions to this. Waste is normally generated in households, commercial establishments, institutions, and businesses; and any substance or object that is meant to be disposed of should adhere to the environmentally-friendly principle of reduce, reuse and recycle (3Rs) – Jubril *et al*. (op cit). Treating the environment with respect in order to sustain it is a recent passion, once the world became more aware of how our activities harm the earth which sustains us, and which we may lose if the status quo is maintained. Hence, the different world gatherings like the Rio Earth Summit in 1992, have called for more attention on the need for humans to treat the environment

in a manner that will not leave negative impact for the future generation – environmental sustainability (UN, 1992). The Agenda 21 emanated from the United Nations-led Rio 1992 Earth Summit which enjoined nations to integrate environmental issues into their planning and implementation strategies for sustainable development. It further urged restraint and efficiency in production, consumption and conservation (UN, 1992). Furthermore, the UNESCO and Japan-led World Conference on Education for Sustainable Development, held in Nagoya, equally emphasized the critical role of education in bringing about a more stable and sustainable society in the face of pressing global challenges. Subsequently, other higher education meetings were held in Nagoya by Global Universities Partnership on Environment and Sustainability (GUPES) in 2014, and the International Conference on Higher Education for Sustainable Development: Higher Education Beyond 2014, all of which lent credence to the contribution of Universities into building awareness on sustainable development, as well as sustainable environment.

Accordingly, the Brundtland Commission aptly described sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED, 1987). Duran, Gogan, Artene and Duran (2015) see an interlink between environmental protection and sustainable development. They maintain that environmental protection is a vital component of sustainable development, and without viable environmental conditions, sustainable development cannot be ensured. They argued further that the human component in sustainable development has a major role to play in engendering a sustainable environment. In fact, sustainability signifies human's ability to maintain responsibility to the environment and other resources on a long-term basis. Major goals of sustainable development include minimizing depletion of natural resources; promoting development with the least harm to the environment; and, embracing environmentally friendly practices. Industrialization damages the environment, but makes up with alternative practices that restore the equilibrium. Education of all concerned parties can help forge a balance and synergy between environmentalists and developers. Valeria and Monni (2008) also accede to the struggle between environmental sustainability and development. Consequently, a major outcome of the Rio Summit was to ensure sustainable development goals (SDGs) that will consider all the elements of sustainable environment, because environmental problems will always constitute a threat to both human survival and development, with adverse effect on the SDGs.

Principle 4 of the Rio Declaration further submits that environmental protection is an integral part of achieving sustainable development (UN, 1992). Sustainable development is thus generally considered to have three components which are the environment, society and economy (Duran et al, op cit). The synergy of these three elements is intertwined, not separate, but with the all-important denominator firmly embedded in the middle – human well-being (see Fig.1). This study is therefore hinged on the theory that maintaining a sustainable environment is about human long term maintenance of the earth in terms of economic, social and environmental dimensions. Figure 1 below indicates this synergy.

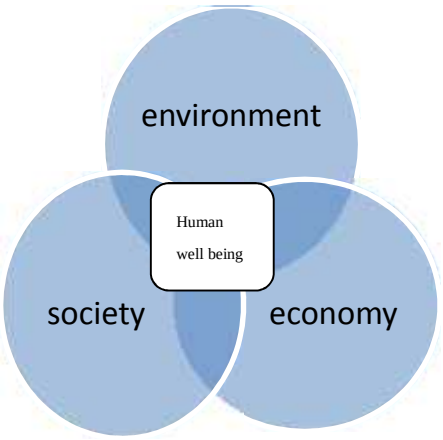

Fig.1: Overlapping circles of sustainability - Bakare (2012) field work.

There are different types of sustainability diagrams, all with the concentric overlapping circles of the three components; but with adult education in mind, the composite diagram was modified to show the heart of the diagram to be human well-being; as human beings are to take responsibility for managing the environment. This diagram thus shows how interrelated the three dimensions are and the importance of human well-being at the core of interactions with the environment, society and the economy. Humans create the fallout from their development efforts and must therefore be mindful of its effect on the environment in the long term for human well-being. Furthermore, Principle 1 of the Rio Declaration on Environment and Development, which supports Agenda 21, equally agrees that human beings are at the centre of concerns for sustainable development. If human beings are so central to environmental sustainability, then adequate knowledge about the cause and effect of actions on the environment would be the best way to reverse whatever damages are caused, and stem the tide of environmental degradation. Garbage recycling is just a part of the way the environment can be taken care of. Bakare (2012) had noted several forms of environmental pollution including air, water, noise and visual, among others. She also reaffirmed the influence of poverty on environmental degradation and advocates the use of adult education to ameliorate the situation. There is no doubt that adult education has a role to play in harnessing opportunities for the populace to be more aware of their responsibility towards the earth and environment. The International Conference on Higher Education for Sustainable Development (ICHESD) had equally affirmed the "essential role and responsibility of higher education institutions towards creating sustainable societies". Subsequently, Keating (1992) noted that, while the quality of our future depends on people's ability to learn and change; education can further enhance effectiveness by developing informed engagement, agency and empowerment among all affected stakeholders, while building lasting and sustainable change.

In order to achieve sustainable development, environmental protection should be an integral part of the development process. Just as the developed nations are expected to acknowledge the responsibility they bear for the pursuit of sustainable development, individual countries are also expected to contribute their own quota to the maintenance of the environment (UN, op cit). This suggests that we eschew unsustainable patterns of consumption. Nigeria tends towards being a consumptive society - wasting a lot of resources and paying scant attention to the way the environment is treated, until more recent times. Also, the culture supports certain misconceptions that impact management of the environment. Re-using or reducing resources traditionally suggests inadequacy or poverty in some Nigerian cultures, and gutters are tacitly meant for dirty

things. According to Banjo, Adebambo and Dairo (2009), beliefs affect general behavior, and thus create a fertile background for adult education - re-learning and reorientation. There is therefore a need to refocus on the emerging principle of the 3Rs and practice them, in order to engender a sustainable environment. Chukwuemeka, Ugwu and Igwegbe (2012) posit that Nigeria has not gotten solid waste management right over the years, and that it has not been mindful of the fact that waste disposal practices of 30 years ago differs from that of today. The typical practice was to carelessly throw waste in the backyard or wasteland. Unfortunately, waste generated currently may be non-biodegradable in nature. Banjo et al (op cit) agree with Chukwuemeka et al (op cit), and add that typical waste disposal practices of some people in Nigeria involve throwing waste into the gutter or drainage. They see the waste disposal habits of people as coloured by ignorance and lack of awareness of the implications of their practices on the environment. It is thus unanimously agreed that appropriate education and sensitization are necessary to raise awareness on proper waste disposal practices. Regardless of residential location, there is a need to sensitize University campus residents about waste management in order to ensure better management of their solid waste. It is thus understood that without proper education, orientation and awareness at all levels of society, it will be difficult to manage solid waste.

Environmental education involves all organized efforts geared towards creating awareness about the environment, how human activities affect the ecosystem and what can be done to ensure sustainable protection of the environment Trends in development show that education is germane to sustainability, especially adult education (UNESCO, 2006). Right from the time sustainable development was first endorsed at the United Nations General Assembly in 1987; the parallel concept of education to support sustainable development has also been explored. According to the UNESCO, from 1987 to 1992, the concept of sustainable development morphed into the 40 chapters of *Agenda 21* as noted in Chapter 36 of the Agenda - "Promoting Education, Public Awareness, and Training" (UNESCO, op cit). All these are in the realm of adult education, which can be used as a method *per excellence*, to promote instant reaction and immediate impact in the management of the environment. Also, environmental issues are best handled with the collaboration of the people concerned; and the study was to help spread environmental information widely around the University campus, along with the use of innovative technologies (the bottle-shaped bin) to ensure progressive environmental practices (and the eventual attainment of the SDGs). It is believed that achievement of sustainable development in Nigeria will require efficient management of solid waste, aided by environmental education. This is because a degraded environment cannot sustain continued growth and will subsequently impact negatively on the entire development of a nation (Emeribe, 2000). The exploitation of resources for development has grave consequences on the environment and the relationship between the environment, poverty and economic change. If sustainable development is therefore seen as implied development without destruction, then, it is mandatory to see that renewable resources are used judiciously, so that sustainable development then translates into sustainable environment. The link between sustainable environment and sustainable development can be further clarified: Industrialization, which is a necessity for development, unfortunately, invariably leads to environmental degradation. This is why education is necessary to help harness sustainable development in a manner that the least destruction is wrought on the environment.

The University of Lagos (Unilag) is one of the first generation Universities in Nigeria, fondly called the University of first-choice and the nation's pride. It has Academic and Administrative, residential as well as commercial areas from where waste is generated on a daily basis from these different locations. It is a micro-community that replicates the larger society in terms of the diversity of the staff members living on campus. The staff's residential quarters was used as the central focus of this study. It is believed that, in line with the vision and mission of the University, apart from learning and research, the institution also pledges service to humanity. Spreading environmental education to neighbouring communities (to begin with) could serve as its social responsibility that will also affect national developmental efforts positively, as the University strives to lead by example.

Problem of the Study

The University community contributes to environmental degradation by not abiding by the dictates of the three Rs – to reduce, re-use and recycle generated waste. The University community is expected to live up to certain standards and lead by example, but certain factors inhibit this expectation. A key issue nowadays is that people extract resources from the ecosystem around them faster than they can be replaced, and their actions threaten the very life support system that sustains us. This study focuses on the adherence to the principle of the 3Rs within the context of the University community, and how the members' activities affect their environment, and subsequently sustainable development efforts. The development of the University as a system is fundamentally hinged on the way the environment is managed. If waste generated is not well managed, it will hinder progress generally, be detrimental to health and well-being of residents, affect workers' morale, and generally affect the socio-academic life within the University community, thereby hindering progress. This is because the method of waste management dictates the environment and impinges on overall development efforts.

Purpose of the study

The study will investigate solid waste management practices on campus. The purpose is to establish campus residents' awareness level and acceptance of the recycling process by mounting an educational campaign to sensitize the residents to the effect of their waste management practices on the environment; familiarize them with the 3Rs and encourage them to manage their solid waste more effectively, in a manner that will, not only impact positively on future generations, but will engender overall improvement, well-being of residents, and subsequently the development of the University community. It specifically sought to:

- document the nature of solid waste on campus;
- establish the method of solid waste management on the University campus;
- examine the challenges faced in the course of managing the waste on campus;
- investigate the adherence of the University community to the 3Rs, and measure the effect of an intervention programme on residents' waste disposal behaviour and the adoption of a new practice that is more environmentally friendly, and
- suggest how to engender sustainable development and better environmental management.

It will also explore how Adult Education (rigorous awareness campaigns) could be used to empower the University community to lead by example and foster a sustainable environment on campus, as well as also spread the message outside the University system, as part of their contribution to the larger community, and as a social responsibility.

Research questions

1. What is the nature of the solid waste generated within the university community?
2. How is solid waste managed within the University of Lagos?
3. What are the challenges encountered with the management of solid waste on campus?
4. What is the effect of an intervention program on adherence to the 3Rs?
5. How can adult education contribute to the creation of a sustainable environment on the University campus?

Methodology

Area of study: The area of study was the University residential areas with a view to overall growth and development within the University. The focus of the study is adherence to the principle of the 3Rs as it affects the University community and contributes to its development aspirations.

Design used: The design is quasi-experimental, preceded by Observation and recording of solid waste management practices on campus after pre and post treatment. The experimental tools were made up of the three bins as shown in Figure 2 (consisting of two regular bins and a specifically designed bottle-shaped bin) as a single unit. Twenty of such units were distributed around the campus residential areas for the study.

Fig 2: The bottle-shaped dust bin and the other two waste bins

Population: The population of the study included all residential staff on the University campus which consisted of families of both Academic and Non-Academic staff.

Sample size and sampling technique: The multi-stage sampling technique was employed to obtain a sample size of 250 respondents made up of one or two conveniently selected representative of each family unit. The units consisted of Lecturers, school age children, spouses and other available family members (in the case of a non-literate member being available, a short interview was conducted to establish the waste management practices of the family). It was

verbally ensured though, that the family would have been living on campus for at least two to three years prior. The staff living quarters were mainly targeted to establish the nature of garbage generated within the University residential environment, as well as how it is currently being handled. There are four types of accommodations on campus – the Flat, Bungalow, Duplex and the Triplex, as well as their assigned Boys' Quarters. There are 380 of all types of buildings on campus according to the Works and Services Management records. Seven people were purposefully assigned to each family unit, consisting of five people in the main house and two in the Boys' Quarters. This gave an estimated figure of 2660 potential respondents. To obtain the sample at the first instance, the living quarters were stratified accordingly into High Rise, Bungalows, Flats, etc. Each family apartment was counted as a unit containing an average of 5 persons per family with 2 people in the Boys' Quarters. The proportionate sampling technique was then used to randomly select family members who also met the other criteria, and according to the designated locations. Residents of Boys' Quarters also formed part of the random sample selection, and at least one representative was sampled from each family unit as a respondent, depending on availability.

Instrumentation: Three instruments were used for the study: Questionnaire, Interview and Observation (pre and post treatment, and recording of nature of inspected waste). The treatment consisted of a combination of interviews and intervention (using a Sensitization Awareness Campaign mounted around campus living quarters, handing out leaflets, use of banners and posters, Rallies, mini structured interviews (backed by a 6-item check list derived from the questionnaire), as well as the presentation of the experimental tools – the dust bins), to encourage the proper sorting of solid waste on campus, and to document repeated behaviour. The self-constructed questionnaire on Campus Residents' Waste Management Practices (QCRWMP) was a 9-item structured closed-ended set of Likert-type questions to obtain information on campus residents' waste management practices. The Observation Schedule, which consisted of inspection of the contents of the provided waste disposal bins, was recorded in a chart and converted to approximate percentages.

Validation of instruments: The instruments were duly validated by three experts from the fields of Environmental Sciences and Adult Education. The reliability quotient of the questionnaire and interview were obtained with the yield of a test-retest reliability coefficient value of 76.4 and 84.5 respectively, at three weeks interval, using Crombach's Alpha Coefficient, and were deemed adequate. For the Observation, it was planned that a higher than fifty percent rate of change and adherence to solid waste sorting by campus residents would be deemed a success for the observation.

Procedure of data collection: A bottle-shaped dust bin was specifically designed and used for this study to see if the symbolic bin would automatically translate into people disposing of only bottle shaped items in the bin. The intervention consisted of a combination of interviews and intervention, using an intense week long Sensitization Awareness Campaign mounted around campus living quarters. This was followed by the presentation of three well labelled dust bins – one for paper waste, the other for plastic and nylon while the bottle-shaped bin was meant for bottle waste only, to encourage the proper sorting of solid waste on campus, and to document repeated behaviour. The post treatment involved the twice daily inspection and recording of the contents of the supplied bins. The Interviews were partly to establish the general attitude towards waste disposal. The experimental tools were placed in strategic locations around the living quarters. The observation and recording of occurrence were to document the behaviour, and see if there were any changes. The pre-treatment consisted of inspection of the contents of

the garbage disposed from each apartment. This was done for a week twice a day, in the morning and evening. The one-week campaign was then mounted as the treatment and the well labelled bins placed in strategic locations in the residential areas. The post-treatment was applied in the form of another systematic twice daily inspection of the contents of the provided bins, twice daily for two weeks, with a scaled down continuation of the campaigns. The Observation was used to document repeated behaviour, as well as to corroborate the other methods. The questionnaire was also administered and retrieved immediately with hundred percent success rates, along with the recorded Interviews. The Research was conducted with the help of Graduate Students of Environmental Adult Education, who helped to administer the questionnaire, conduct the Interviews, Rallies and Campaign, as well as monitoring, recording and reporting the contents of the provided bins.

Data analysis tools: Data collected were analyzed quantitatively. The questionnaire was analysed using frequency counts and percentages. The observations were recorded, tabulated and translated into percentages while other findings were presented pictorially, along with the other reports.

Findings and Discussion

There are a total of 380 living quarters for the staff on campus including different building types like the Duplex, Triplex, High Rise, etc. There are various forms of pollution on campus – generator and car fumes, waste, visual and noise pollution, among others, but the study concentrated on the solid waste in relation to the 3Rs. Responses from the survey questionnaire/interview sessions revealed the following data:

- The nature of typical solid waste generated within the University community was found to be used paper, discarded cans and bottles, food wastes, nylon and plastic materials, clothing, and other items. The Masterplan of the university puts the daily solid waste generation of the residents per person in a day at 0.75kg. This is similar to the findings of Jubril et al (2012) on waste generated within a Malaysian University environment.
- The University Health Care Centre is in charge of the sanitation on campus. (Waste management has since been outsourced to two private firms under the public/private partnership initiative). The UHCC arranges for big and small vans to collect refuse around campus 2 or 3 times in a day. There are equally secondary collectors (cart pushers) who operate about 9 trucks to collect garbage as assigned to different areas like Faculties etc. There are also casual workers under the General Administration Department who are in charge of general sweeping and keeping the environment clean on campus. All the collected refuse are finally taken to the general landfill located opposite the Social Sciences Faculty of the University. Sometimes when ferrying trucks break down, the Lagos State Waste Management Authority (LAWMA) services are used occassionally. However, when waste gets to the terminal point, the garbage, which is all mixed up at the source, is usually sorted out at this point by the packers, and sometimes scavengers from outside the campus. Useful items like bottles, plastics, etc, are sold to buyers who need them, for a stipend. This sequence of activity is again similar to the observation of solid waste management by Jibril, et al (*op cit*).
- Responses from the Interview sessions reveal that typical challenges encountered in waste management (WM) within the University community include the following: (a) The University does not provide separate bins for separating waste (b) Packers do not pick up as regularly as they should (c) The secondary disposal locations are sometimes

exposed and can attract flies, rodents and other vermin. Other challenges regarding waste management include some form of apathy exhibited by campus residents, as many believed that the authorities should supply more incentives for waste separation, while several could not be bothered. One limitation of the study was that, because the bins supplied for the experiment were limited, they were only placed in strategic locations, and the logistics were almost impossible to get people from the high rise buildings, who would normally drop their waste through the chute, for example, to bring down their garbage and sort them out into the proper containers. The study buttressed the efficacy of sensitization and adequate awareness education as emphasized by UN (1992).

More of the findings are documented pictorially below:

Fig. 3: University-supplied containers

fig. 4: Garbage mixed at source

Fig. 5: Packers from the dumping site

fig. 6: Bottles sorted at the terminal for sale

Results from the questionnaire and interview sessions further revealed the following:

Table 1: Solid waste management on the university campus (3Rs)

Items	Yes I do	Sometimes	I do not

Use of bin liner for the dust bin	24 (9.6%)	56 (22.4%)	170 (68%)
Separate containers for waste	5 (2%)	25 (10%)	220 (88%)
Reuse of nylon and bottles	54 (21.6%)	153 (61.2%)	43 (17.2%)
I think of how my actions affect the environment	36 (14.4%)	63 (25.2%)	151 (60.4%)
I think of the health implications of my WM actions	50 (20%)	125 (50%)	75 (30%)
I am concerned about my WM practices	54 (21.6%)	121 (48.4%)	75 (30%)
I believe the campus WM practices are linked to University overall progress	25 (10%)	50 (20%)	175 (70%)

- Most (170 - 68%) of the respondents said that they did not use bin bags to line their dust bin, which means that the contents of the dustbin (including the ones thrown down the waste chutes in the High Rise buildings) from individual households, got upended directly into the collection site (the outcome of this is that the waste dumped in the collection site often creates an eye-sore as it is all scattered and can breed scavengers or get blown around, thereby adding to environmental, visual and smell pollution), while 32% did sometimes.
- Majority of the respondents (220 - 89%) agreed that they did not have separate containers in their homes for their waste (this is corroborated by the observation of the waste output measurement which indicated that all wastes were mixed at the source). Only 2% claimed to sort out waste from the source; majority do not try because of the collection system, which did not make any provision for this; and even those who tried to sort at the source were frustrated at the collection point where everything got mixed together anyway.
- 153 (61.2%) claimed they reused their nylon and bottle waste sometimes, while 54 (21.6%) did it all the time and 43 (17.2%) did not. (Some of the respondents said they recycled their paper waste in their offices).
- Even though 245 (98%) claimed they were familiar with recycling, they seldom actually practised it.
- Many of the respondents 151 (60.4%) did not consciously consider the effect of their waste management (WM) actions on the environment. Half of the respondents were only sometimes conscious of the health implications of their WM actions. Majority of the respondents 121 (48.8%) were only sometimes concerned about their WM practices.
- Majority 175 (70%) also did not link campus WM practices to overall development of the University.

The implication of these findings is that campus residents do not appear to be paying enough attention to their WM practices. These responses are somewhat disturbing. If they are not conscious of their effect on the environment, do not link their WM practices to health and overall progress, then they will not face environmental issues with the deserved import and overall development efforts will be hindered, along with environmental sustainability. This is further illustrated in the Interview responses as shown in figure 7.

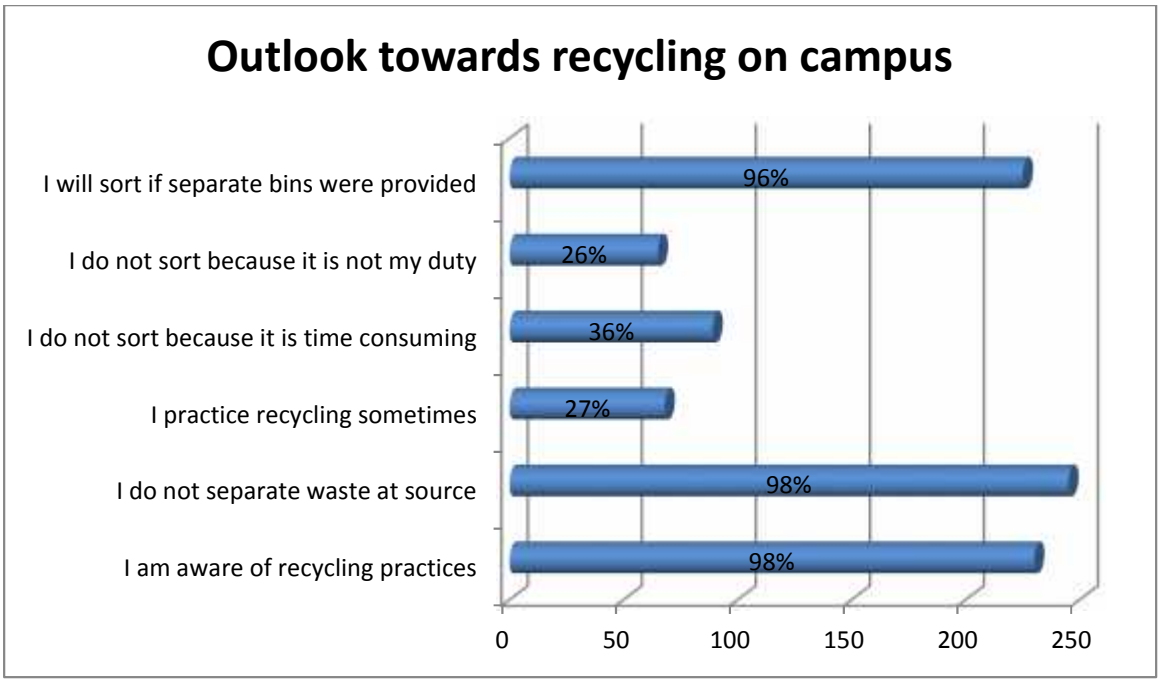

Fig. 7: Recycling practises on campus

In spite of 98% being aware of recycling, only 27% of the campus residents polled claimed that they practiced it, albeit infrequently. Up to 98% of the respondents do not separate their waste at the source, though all agreed that it was a good thing. The reason given by the 35% who said that they fail to sort was because they were too busy, and that it was time consuming, along with the fact that the authorities do not make appropriate provision for waste sorting. Also, 96% said that they were willing to sort if the separate bins were provided by the authorities, while 26% believed it was not their job to sort out garbage. In countries abroad, the sorted waste would be resold to companies. Alternatively, colour-coded bins could be used, like green for recyclable materials. The onus seemed to be on the University authorities to provide these materials; however, the University central waste disposal system currently does not practise recycling.

Result of Observations

Throughout week one, analysis of the contents of waste disposal bins showed that the bin content remained mixed all the time. By week two, the sensitization campaigns were mounted, and later in the week the experimental tools (the clearly labelled bins, along with the bottle-shaped bin) were produced and placed in strategic locations around the residential areas on campus. This was supported by interviews regarding the visibility of the experimental tools, and whether the bins will inspire the respondents to change their outlook on waste disposal. Responses were lukewarm initially, but with the placement of the experimental tools and a continuation of the campaign, it was noted that, by the end of the second week of observation, majority of the respondents were willing to make the extra effort it took to sort their garbage into the respective bins right from their homes. The analysis of the observation and recordings from the inspection of the contents of all the provided bins were then translated into percentages of the ratio of mixture of the garbage in terms of whether it was properly sorted and placed in the correct receptacles. The results are presented in Table 2.

By the tail end of the second week and continued campaign, up to 35% sorting efforts were noted and this increased over the next two weeks.

Table 2: Records of contents of the inspected waste disposal bins by weeks 3 and 4

Day	Analysis of observation of the two bins		Analysis of observation of bottle-shaped bin	
	Morning Inspection of bin contents	Evening Inspection of bin contents	Morning Inspection of bin contents	Evening Inspection of bin contents
Wk 3: 1	Content mixed 75%	Content mixed 70%	Content mixed 85%	Content mixed 80%
2	Content mixed 70%	Content mixed 65%	Content mixed 80%	Content mixed 80%
3	Content mixed 65%	Content mixed 65%	Content mixed 75%	Content mixed 70%
4	Content mixed 60%	Content mixed 60%	Content mixed 50%	Content mixed 50%
5	Content mixed 60%	Content mixed 55%	Content mixed 40%	Content mixed 35%
Wk 4: 1	Content mixed 50%	Content mixed 50%	Content mixed 30%	Content mixed 25%
2	Content mixed 40%	Content mixed 35%	Content mixed 20%	Content mixed 15%
3	Content mixed 35%	Content mixed 30%	Content mixed 10%	Content mixed 10%
4	Content mixed 25%	Content mixed 25%	Content mixed 10%	Content mixed 5%
5	Nylon and paper were put in the provided bins up to 75% of the time	Nylon and paper were put in the provided bins up to 75% of the time	Bottles alone were put in bottle shaped bins up to 90% of the time	Bottles alone were put in bottle shaped bins up to 95% of the time

The observations were gauged in percentages in terms of whether the contents contained only what the clear label on the bins indicated or not. Though the contents were still mostly mixed by the end of the second week, results yielded progressively better compliance with the sorting, and, ultimately, up to at least 90% of adherence were noted with the bottle bin alone, and up to 75% for the other two bins and recorded by the end of the fourth week. This implies that, with the applicable form of education, and the provision of appropriate tools, campus residents were willing to practice environmental sustainability that will ultimately promote growth and progress of the University itself, and extend to the outside community as well. This agrees with the UNESCO (2006) recommendation of the efficacy of education in engendering sustainable environment.

Findings from the observation schedule also show that, prior to the campaign, garbage was mixed and dumped indiscriminately. After the campaign and the supply of the three sorting bins, there was a noticeable difference and marked improvement as bottles only were dropped in the designated containers. The result was that the packers were happier, their work was faster and they were able to promptly recycle the items for reuse which signifies progress and well-being for the University community. The study showed a marked improvement after the awareness campaign in the waste disposal patterns as the bins, in the most part, were treated accordingly, especially the appropriately designed bottle-bin which formed the focus of the study. Records of the content of the bins were documented in photographs and in writing and revealed that, by the second week, only bottle waste appeared in the bottle bin. This further corroborates the respondents' response to whether, if appropriate materials were provided, they would sort their garbage, to which there was a 100% positive response. The final destination of the garbage was normally the landfill opposite the Faculty of Social Sciences where they were either pressed down to make way for more waste or incinerated.

Fig. 8: The University Incineration Site

The contribution of adult education was the use of environmental education method, in the form of an intervention that experimented with sensitization and the supply of materials to encourage sorting of garbage. Separating waste from source is the first step towards recycling. The implication of the study is that, if resources were adequately put in place, the principles of the 3Rs could be adhered to within the University environment. The ultimate is to take the idea of the bottle-bin idea to the larger community in order to promote social responsibility, while contributing to environmental sustainability and ultimately, sustainable national development.

Conclusion

The study shows the necessity to be more conscious of the profound effect, as humans, on the environment and take more responsibility for what is done to the environment and how actions affect the environment, in order to right the wrongs being committed. Environmental education can help birth collaborations with the community to favour environmental sustainability. What better place to begin than from the University environment as models and leaders who affect the socio-economic balance of the nation. We must lead by example and charity must begin from home. We need to pay more attention to creating a sustainable environment for the sake of social justice between the rich and the poor; to ensure environmental justice from humans to non-humans and finally to create equity by acceding to the rights of future generations as against the present generation (Weinstein, 2012). Human development hinges on the integration of conservation with development, and practicing the 3Rs can help put us on the right path towards our being kinder to the earth.

Recommendations

- The nature of waste generated within the University campus is typical and will likely remain the same over time, but the management can be influenced with appropriate education and incentives.
- The institution could further outsource waste management on campus. Sorting from source should be encouraged with the necessary incentives by the authorities, like the supply of bin bags; but more importantly, separate (appropriately labelled) bins provided

en masse for different waste products. Probably start with a patent of the signature bottle-bin, as this should appeal to a vast audience and be self-explanatory.

- University Departments can work on recyclable materials and make alternative and innovative use of the garbage, the academic community must look into relevant research that will generate money from recycled garbage.
- Packers should pick up more promptly, the secondary dump site locations should be covered and transportation to the terminal points arranged more regularly.
- Education and reorientation campaigns should be mounted more often to retrain the packers and the campus resident community to embrace the 3Rs so that all can be more conscious of the effect of their WM actions on the environment;
- The University generates a lot of paper waste. Efforts must be made to work towards a paperless community where technology takes over internal and external correspondence, and the virtual library becomes more prominent.

Achievements of the study include the creation of a unique bottle-shaped bin as well as the creation of a model for sustainability. It must however be noted that solid waste management practices on campus have since been influenced by the study and an update review would be appropriate for future studies. The suggested synergic model is shown in figure 9 below.

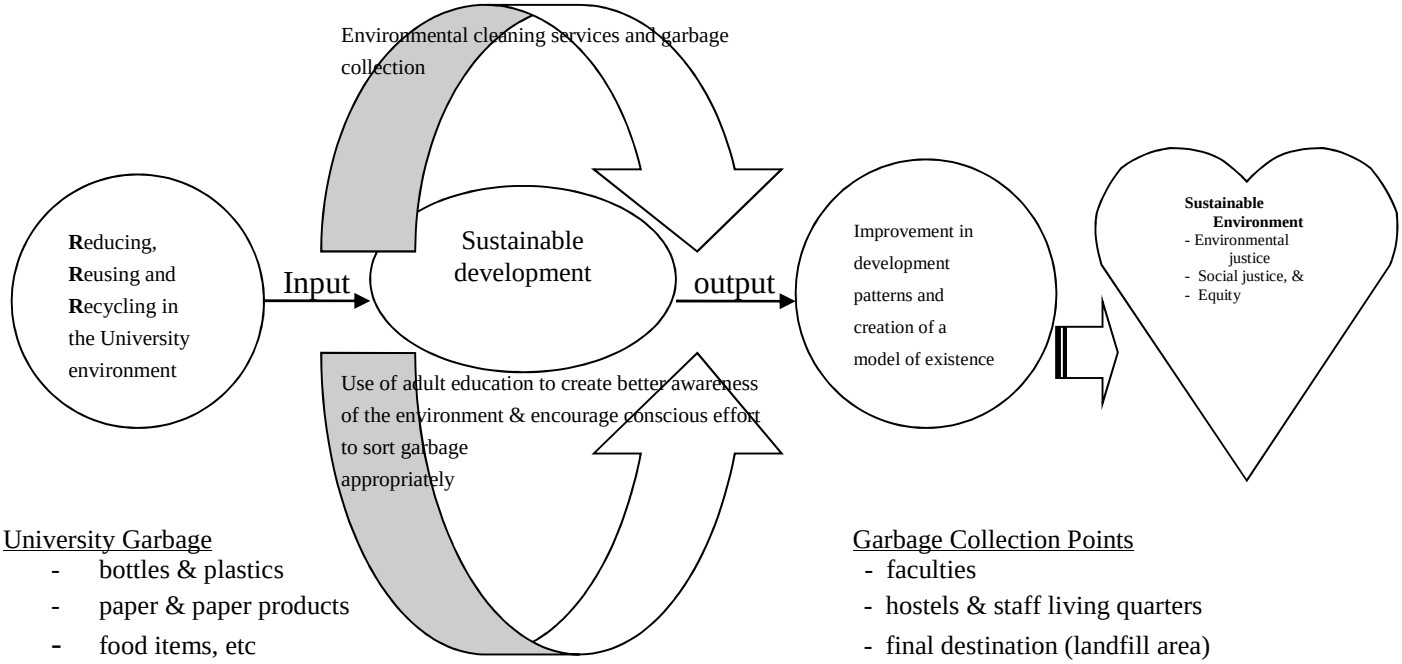

Fig 9: Suggested Model of Sustainability in the University Environment

Bakare (2012) – adapted from Weinstein (2012)

This model shows how adult education can help process the input of the principle of the 3Rs (reduce, recycle, re-use) and change the way garbage is handled within the University environment to encourage environmental sustainability and ultimately development. It is all

about sustainable development but with due consideration for the environment. Development cannot be sustained if the environment is not given its due respect and care.

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