Waste characterisation and review of the waste management practices at Phinda Private Game Reserve (KZN)

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ABSTRACT
South Africa is a truly unique and majestic country that attracts visitors from around the globe and as a result tourism in South Africa is growing at a rapid rate with recent years providing some of the greatest tourism arrivals the country has ever seen (South African Tourism 2014). Tourism being a large contributor to the South African Economy is however also a threat to wildlife and the natural heritage it is therefore important to develop sustainable tourism practices. This study attempts to characterise the waste generated at Phinda Private Game reserve located in Northern Kwazulu-Natal. The purpose of this paper is to provide an accurate overview of the current waste practices, in order to characterise the waste stream and so doing determine the recyclable component of the waste stream. Current waste management strategies were assessed and possible mitigation strategies recommended to assist Phinda further their sustainability quest.

1. INTRODUCTION

South Africa is a truly unique and majestic country that attracts visitors from all around the globe and as a result tourism in South Africa is growing at a rapid rate with recent years providing some of the greatest tourism figures our country has ever seen. Statistics show that the tourism sector is a large contributor to South Africa's GDP as well as a large generator of employment adding 93.3 billion rand to the country's economy in 2014. During 2013, 14.3 million non-resident visitors visited South Africa, increasing from 13.1 million in 2012 (Statssa, 2015).

Tourism is a large contributor to our economy but is also a threat to our wildlife and natural heritage thus it is important to identify a balance between increasing tourism and sustainable tourism practices (Statssa, 2015). A large contributor to South African tourism is our abundance of game reserves, national parks and pristine coastlines. In order for these to remain valuable resources for our economy they need to be managed accordingly and protected to ensure these valuable attractions are conserved for many future generations to utilise and appreciate. Larger volumes of tourists equate to a larger volume of waste being generated per tourist (South African Tourism 2014). If tourism is to remain an economic driving force, tourism management procedures need to be addressed to ensure that correct waste management strategies are followed (Pirani & Arafat 2014).

Pirani and Arafat (2014) indicated that waste generation is considered by some to be the most noticeable effect which the hospitality sector has on the environment, especially due to the fact that many of the establishments which make up this sector, such as hotels, use large quantities of consumer goods as part of their operations.

The issue at hand that requires further research and the primary objective of this project is to conduct a waste characterisation report within Phinda, a private game reserve located in KwaZulu-Natal. This study aims to assess quantities and types of waste produced to identify the sustainability of operations. It is important to note that Phinda already has an active waste management strategy, which sees the collection of waste from Phinda three times a week. It is, however not clear what the precise types and quantities of waste are.

2. MOTIVATION

Phinda is a world-class game reserve that adheres to the highest sustainability standards, both passion for wildlife and conservation keeps this game reserve pristine and attractive to tourists. Sustainability is only achievable if responsible resource use is adhered. A reserve of this nature needs to stay attentive to all aspects of sustainable practices, especially waste management and waste minimisation.

3. RESEARCH PROBLEM

Phinda Private Game Reserve is currently unaware of how much waste they have for recycling and reusing or how much is disposed to landfill. Improper recycling and reusing of waste can cause waste to take up more space than would be required in a landfill. Disposing of waste without taking into consideration what the possible effects on the environment might be can lead to soil, surface and groundwater contamination. Waste such as paper, plastic, metal and glass that can be recycled and taken out of the waste stream and organic waste can be used for composting. It is therefore necessary to determine if the current waste management strategy at Phinda Private Game Reserve is effective and to identify areas for improvement.

4. RESEARCH AIM

To generate a waste characterisation report for Phinda to identify what types and volumes of waste are generated. A study such as this will result in fact-based decisions and will reflect the possibilities of recycling of dry waste and wet waste reuse potential.

5. LITERATURE REVIEW

Pirani and Arafat (2014) provided a study that focused on solid waste management in the hospitality industry. They examined the increase in production of Municipal Solid Waste as a by-product of increased tourism traffic (Pirani & Arafat 2014), focusing primarily on hotels and restaurants within the United Arab Emirates attention was directed towards global practices put in place to reduce waste volumes from this growing sector. Data was collected by means of separation and weighing waste from the selected hospitality sectors, was then characterised and quantified to provide a conclusion that suggested that the dominate form of waste generated was food waste, being approximately 40% of the waste from hotels and 60% of the waste from restaurants. This study concluded that the two best initiatives for reducing solid waste were waste mapping and waste hierarchy with composting being a viable means to reduce food waste volumes.

A study was conducted by Gu et al. (2015) that characterized the types of household solid waste, determined what quantities of each type of waste is generated and suggested ways to manage the solid household waste in Suzhou, China. A field tracking survey method was used to determine the characteristics of the household solid waste. Each of the 240 families in the study was considered a basic unit, using one year as the macro cycle and one week in a micro cycle in differing seasons. From the two communities selected (Erlangxiang and Linglongwan) for the study in Suzhou families of different sizes were chosen. Each household was assigned a unique identification code so that their waste could be easily identified. The waste was classified according to three criteria, firstly it was classified according to its physical characteristics, secondly the compostable and recyclable material and lastly it as packaging and containers, products, multi-use and service waste. The weighing was done by two people to ensure that no errors occurred. The daily household solid waste generation rate was determined to be 280.5 g/cap/day and the annual generation rate 586 000 tons. The household solid waste consisted of the following categories food waste 65.7 %, paper 14.3%, and plastic 8.9%. The 89.3% of the solid waste was classified as compostable or recyclable material. Recommendations were made that more attention should be given to source separation, educating the households and flexibility of the frequency of household solid waste collection (Gu, et al. 2015).

Zorpas et al. (2015) performed a waste compositional analysis study in Cyprus. The waste characterization was done for two weeks of each season, summer, autumn, winter and spring. Waste was collected from 80 – 100 households each day and separated into the following categories, PMD (Plastics, Metals and Drink Cartons), plastic film, non-recyclable plastics, aluminium packages, papers, glass, toilet paper, food waste, compostable material, stationary, yard waste fruit and vegetables and others. Each category was weighed individually using a scale and the results were recorded. The compositional analysis yielded the following results: PMD 9.41%, plastic film 4.42%, non-recyclable plastic 2.26%, aluminium 0.84%, paper 10.56%, glass 5.33 %, toilet paper 11.89%, food waste 19.85%, others 8%, yard waste 13.06% and fruit and vegetables 13.06%. Up to 30% of the waste disposed to landfill can be recycled according to the waste compositional analysis. It was recommended that the sustainability of solid waste management, public awareness, funding, expertise and facilities be improved immediately (Zorpas et al. 2015).

A waste characterization study was performed by Al-Jarallah and Aleisa (2014) that focussed on the municipal solid waste at the Seventh Ring Road waste dumping site in Kuwait. The seasons that were selected to perform the waste characterization were summer and winter, choosing 74 dumping trucks at random for the study. A quarter of each load was then selected and sorted and weighed by 6 workers into

the following categories sanitary, paper, corrugated fibres, PET bottles, plastic film, organic waste, wood, metal and glass. The main components were found to be organic waste at 44.4%, plastic film at 11.2% and corrugated fibres at 8.6%. It was found that seasons do play a role in the composition of municipal solid waste and the statistical comparison revealed that the composition of municipal solid waste has changed since the previous study. They recommend that a further study be conducted before selecting treatment and recycling options to determine the feasibility of such options (Al-Jarallah & Aleisa, 2014).

A household waste characterization study was performed by Dangi, Urynowicz and Belbase (2013) in Nepal by making use of cluster sampling techniques. 40 students were selected to help with the study, divided into 20 teams. The students were assigned mentors, and together they selected 100 households for the study by using cluster sampling techniques. Each household was visited and provided with 2 plastic bags for their waste, the one was for kitchen waste and the other for garden waste. The bags were then collected 24 hours later. The equipment used during the sorting process included overalls, face masks, eyeglasses, nitrile gloves, closed toe shoes, scales, pencils and data collection sheets. The waste was separated and weighed into the following categories organic waste, plastic, paper, metal, glass, rubber and leather, textiles, construction debris, hazardous waste and other waste. The results showed that the 100 households produce 330.4g/Capita/ day of household solid waste. The main components of the household solid waste were 46% organic waste, 10% plastic, 6% paper, 5% metal, 7% glass, 11% construction debris and 1 % hazardous waste. The recommendations made were that the organic waste could be used for composting, the paper, plastic and metal could be recycled, the construction debris could be used to fill up subsidence and the hazardous waste should be collected and managed separately (Dangi, Urynowicz & Belbase, 2013).

Food waste is normally disposed along with municipal waste. The advantage of landfilling food waste is that it is much cheaper than alternative disposal methods, but leads to secondary pollution. An alternative to landfill disposal is the recycling of food waste. Two alternative uses for food waste is animal feed and composting (Jiang et al. 2015). Feeding food waste to pigs is a practice that has been around for a long time. One of the problems is however that anaerobic decomposition and degradation of food waste can start to occur in a very short period of time after the waste has been disposed to the elements. If food waste is left to the elements without proper preservation or processing, the waste will start to spoil and pathogenic microorganisms will start to grow in the waste. Food waste used to feed pigs should therefore be properly preserved. Before pigs are fed with food waste it is recommended that the food waste is processed to remove any pathogens (Kwak & Kang, 2006).

The most environmentally friendly method of managing wet/food waste is composting. Composting can either be done on an industrial scale or a smaller scale at home. Industrial composting refers to composting plants and home composting to individuals and communities that do composting on a smaller scale. Composting has many advantages, including that it eliminates the need for chemical fertilizers, increases soil structure and promotes the sequestration of carbon in soils (Barrena et al. 2013).

6. RESEARCH METHODOLOGY

6.1 Study Area

Phinda Private Game Reserve is a reserve of 14000 hectares located on the north coast of the Kwazulu-Natal region. The reserve is made up of 6 main tourist lodges of various sizes, Phinda Forest Lodge (16 units), Phinda Vlei Lodge (6 units), Phinda Mountain Lodge (25 units), Phinda Rock Lodge (6 units), Phinda Homestead Lodge (4 suites) and Zuka Lodge (4 cottages) (AndBeyond, n.d.).

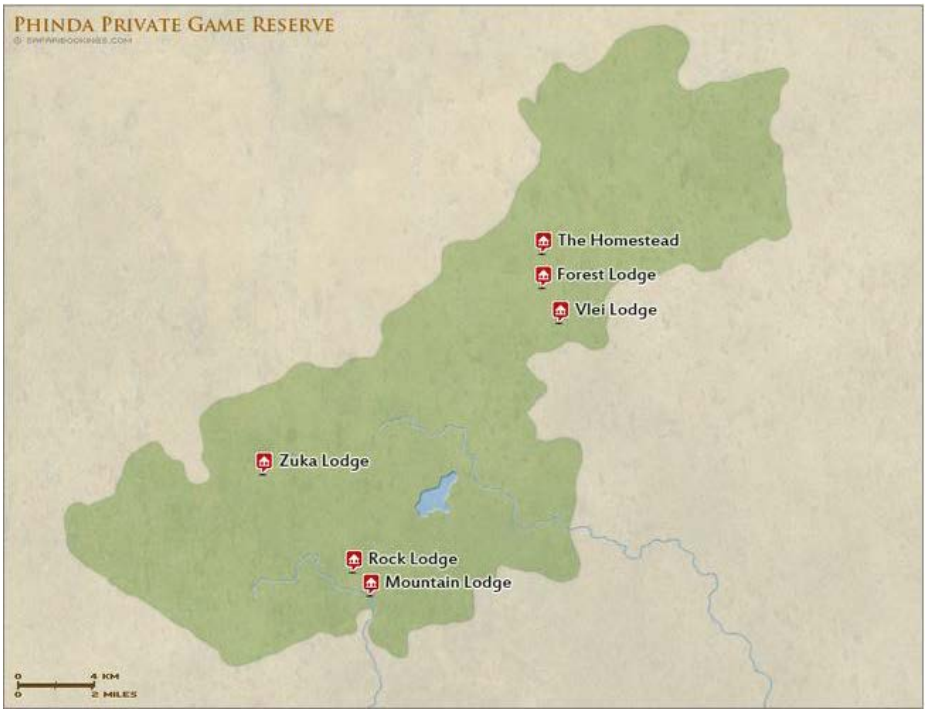

Figure 1. Map of Phinda Private Game Reserve

6.2 Methodology

6.2.1 Data Collection

Data was collected during two site visits to the Phinda Private Game Reserve. The first site visit was a pre-assessment of the site and was conducted 20 – 23 July 2015. During this visit an interview was held with the Sustainability Manager of &Beyond, Jonathan Braack to determine what the current practise of waste management entails. One lodge in the South and one Lodge in the North of the park were visited (Forest Lodge and Mountain Lodge). During the visits to the lodges the typical waste that each lodge produces was determined on sample basis. The sampling technique consisted of logging and photographing the waste present in the kitchen bins and the waste present in the waste storage areas. A trial waste characterisation of the office complex done during this trip helped determine the methodology of the study.

During the second site visit the bulk of the data was collected which took place in the last week of August-2015. Interviews were held with the waste contractor, the kitchen staff, lodge manager, game rangers, trackers and other key staff members. A waste characterisation was done at Mountain Lodge. This lodge was selected as the largest of the lodges in Phinda, and it serves as collection point for the waste from Zuka and Rock Lodges.

6.2.2 Waste characterization

During the course of one week the waste generated was sampled. Waste consisted of wet and dry waste. Wet waste is produced in the kitchen and consists of waste generated before meals during preparation, like vegetable peals, and waste generated after the meals (food plate waste). Packaging of food products is collected separately as dry waste.

Dry waste is produced by all practices within the lodge and is collected throughout the lodge and staff quarters in black refuse bags (60L) and taken to the central lockable waste storage cage where the wet and dry wastes are stored to prevent animals from entering and eating waste.

Firstly each black bag was weighed before being opened and its weight was recorded, after the bag was weighed the waste was spread out on a plastic sheet. The waste was then sorted into the following categories Glass, Plastic, Tins, Landfill and Paper. Each category of waste was placed in a different plastic bag. Landfill waste consisted of anything that cannot be recycled, this included recyclable material that was contaminated with wet and other waste that rendered the material unrecyclable. Each category of waste was then weighed and its weight was recorded. Cardboard and wet waste was not stored in the black bags along with the rest of the waste and therefore did not need to be separated in order to be weighed. The average weight of a bag was then determined. For wet waste only the average weight of a wet waste bag determined. Each category of waste's weight in each bag was then converted to a percentage.

Figure 2. Weighing and sorting of dry waste wearing PPE, poor sorting of wet waste

6.2.3 Amount of each category produced in a week

The total amount of wet and dry waste plastic bags produced in a week was calculated. To calculate the total for the week, the total was multiplied by 3, since collection is three times per week.

6.2.4 Recycling potential of waste

To determine the portion of dry waste that is recyclable the waste generated waste produced over a weeks' time was analysed. The recyclable categories selected were plastic, tins and glass. Using the results from the waste characterization Mountain Lodge produced, the percentage of waste that is recyclable was calculated.

6.2.5 Reuse potential of wet waste

To determine the alternative reuse for the wet waste produced at Phinda Private Game Reserve the typical wet waste produced in the kitchens were observed to determine what it consists of and what other possible uses there could be for the unwanted food and food waste. Staff members and the waste collection contractor were interviewed to establish what is the current practice of disposing and or reusing of wet waste at Phinda Private Game Reserve.

7 DATA ANALYSIS AND DISCUSSION

Interviews with key staff members and the waste contractor responsible for removal of all waste from Phinda Private Game Reserve indicated that the current practice is that all waste from Vlei Lodge and Homestead is taken to Forest Lodge and all waste from Zuka Lodge and Rock Lodge are taken to Mountain Lodge for collection.

7.1 Characterisation of Waste

Five waste bags of dry waste were collected on the sample date and these were categorised into landfill waste, glass, tin and plastic. (The average weight of the 5 bags was 6.8514kg). The results in Figure 3 indicate the resultant categorisation 3.138kg-landfill, 17.751kg of glass, 9.323kg of tin and 4.045kg of plastic waste. This indicates that 9.16% of the dry waste collected is landfill waste while the other 90.84% is recyclable waste (made up of 51.82% glass, 27.21% tin and 11.81% plastic waste by weight).

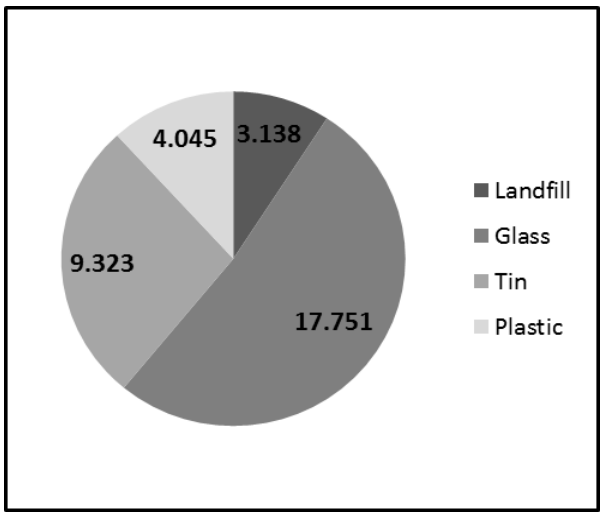

Figure 3. Categorisation of Dry waste (kg)

From the above discussion the dry waste at Mountain Lodge storage area (coming from Zuka, Rock and Mountain Lodges) is primarily cardboard, then glass, tin and plastic. While the percentage of landfill waste being very low at 9.16%. During the sample period 4 bags of wet waste were collected at Mountain Lodge. The 4 bags of wet waste were weighed and the average Weight of the wet waste was 13.28kg.

7.2 Amount of each category produced in a week

Bags recorded during a week's site visit [*Note this data was adjusted after consultation with the waste contractors collection team to provide an accurate figure since some of the waste was already collected early on Monday morning before the researchers arrived.]

Table 1. Amount of dry and wet waste bags produced atMountain Lodge during the sample week in August 2015.

Waste collection days	Dry waste bags	Wet waste bags
Monday	50	0
Wednesday	28	26
Friday	31	20
Total	109	46

Weekly amount of waste per category:
Total amount of dry waste bags recorded x Average weight of a bag x (% of category in an average dry waste bag/ 100)

Landfill: 109 bags x 6.8514 kg x (9.16% / 100) = 68.41 Kg
Glass: 109 bags x 6.8514 kg x (51.82% / 100) = 386.99 Kg
Tin: 109 bags x 6.8514 kg x (27.21% / 100) = 203.20 Kg
Plastic: 109 bags x 6.8514 kg x (11.81% / 100) = 88.20 Kg
Total weight of dry waste: 109 bags x 6.8514 kg= 746.80 Kg

Wet waste: 46 bags x 13.58 kg = 624.68 kg

Mountain Lodge produces 746.8Kg of dry waste in a week that consists of 386.99 Kg of glass, 203.2 Kg of tin, 88.2Kg of plastic and 68.41 Kg of landfill waste. Mountain lodge also produces 624.68 Kg of wet waste in a week.

Recycling is currently done by the waste contractor responsible for removing all the waste from Phinda Private Game Reserve. All the waste removed from site by his collection team is taken to a sorting site just outside the Forest Lodge gate where all the waste is sorted into materials that can be recycled and materials that can't be recycled which are disposed of in a landfill.

7.3 Reuse potential of wet waste

Current practise at Phinda Private Game Reserve is to send all wet waste to the pig farmer in the community for pig feed. Wet waste is picked up by the waste contractor and taken to the pig farm. It's a win win situation, Phinda Private Game Reserve has found a way to reuse their wet waste and the pig farmer receives free pig feed.

From interviews with the staff at Phinda Private Game Reserve it was established that sometimes the pig farmer receives more wet waste than his pigs can consume and wet waste ends up rotting in the sun. The waste contractor also said that he had noticed that fresh wet waste delivered to the pig farmer is simply dumped on top of the old wet waste, one should keep in mind that there is a 2 two day period between wet waste deliveries which means the wet waste at the bottom has been lying there for 2 days or longer which is the perfect breeding ground for anaerobic organisms.

During the site visit to the kitchens it was observed that a lot of food that hasn't been eaten by guests that is still intact and not touched by guests are disposed of into the wet waste bins, half used fruits and vegetables are also disposed of into the wet waste bins. There is nothing wrong with the food that wasn't eaten by the guests it's simply a case of too much food was prepared. The half used fruits and vegetables haven't gone bad, the only reason they are disposed of is because the whole fruit or vegetable wasn't required for the number of dishes prepared.

8. CONCLUSION

Phinda Private Game Reserve's dry waste is currently recycled by the waste contractor appointed to remove all waste from Phinda Private Game Reserve. Most of the dry waste at Mountain Lodge is recyclable. 90.845.17%(by weight). The largest constituent of the dry waste is cardboard, glass, tin and plastic, while Landfill waste constitutes only 9.16%.
All wet waste originating at Phinda Private Game Reserve is removed by the waste contractor and taken to a pig farmer in the local community. Mountain Lodge produces 642.68 Kg of wet waste per week. This amount of wet waste may according to the waste contractor be too much for the pigs to consume. If this is the case the excess could as a result then be dumped at the landfill site.

The following recommendations are proposed in light of the above discussions:
Dry waste:

- Colour coded bins can be introduced in kitchens and canteens to help prevent the mixing of wet and dry waste.
- Pictures can be attached to waste bins that portray the type of waste that may be disposed of in each bin.
- The names dry and wet waste can be painted on the corresponding waste bins
- Refresher training courses can be held monthly to help remind staff which bins to use.
- A third category bin for landfill waste can be added to avoid landfill waste from contaminating the recyclable waste.

Wet waste:

- The food that has been prepared but not served to guests could be sent to the staff canteens or local community.
- Half used fruits and vegetables could be used in the staff canteens or given to the local community.
- Excess waste that the community pigs cannot consume can be used for composting.
- Seeds in the fruits and vegetables can be removed before being given to the pigs and provided to the local community to grow their own produce.
- A cycle can be implemented at the pig farm where the old wet waste is removed and used for composting before the new fresh wet waste is deposited.

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