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# THE FEEDING OF BIRDS ON SOLID DUMPS IN LIMBE MUNICIPALITY, SOUTHWEST REGION, CAMEROON

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**ABSTRACT:** *Solid waste management has become one of the most crucial issues facing authorities in the fast-growing cities in developing countries. However, rubbish dumps constitute appropriate feeding sites for many bird species, serving as stop over sites and a source of food for many species of birds, especially in those altered or heavily human transformed areas. The study of bird urban ecology has recently grown as a research area, because urban environments can, like nature reserves, help to preserve bird species. The main objective of this study was to examine the feeding activity of wild birds on solid-dumps in Limbe municipality. The research area was divided into four zones, north, south, east, and western zone. Four dump-sites were randomly selected from each zone and were visited twice a week for research data collection. Observations were done on the dumps from 6:00am – 6:00pm, and the activities of all the birds were recorded during this period. More so, the ecological conditions like weather type, photo-period, weight estimate of dumps, proximity of dump to residential homes, major dump materials, and the land scape were recorded. This study observed that the activity of Passer griseus (27%) and Ploceus cucullatus (49%) were higher as compared to Ploceus luteolus (4%), Lanius collaries (5%), Corvus albus 8%), Bubulcus ibis (5%), and Pycnonotus barbatus (2%) respectively. Moreover, the study revealed a significance between bird feeding activity on waste type, photo-period, and weather condition, $r = 0.170$ $P=0.013$, $r = 0.146$ $P=0.034$, and $X^2 = 6.343$ $df=4$ $P<0.05$ respectively. Additionally, the major solid waste materials on the dump-sites were household waste (68%), market waste (29%), medical waste (2%), and office waste (1%). The implication of birds in recycling tropical pathogens such as salmonella species and related micro-organisms has been documented in many countries, hence, proper waste management strategies needs to be implemented by the authorities to reduce the activity of birds and other vectors.*

**KEYWORDS:** solid waste, wild birds, urban environment, residential homes, household waste

## INTRODUCTION

Municipal and metropolitan solid waste management is one of the most sensitive development issues plaguing developing nations around the world. It can be emphasized that solid-waste generation rates are a function of both population and prosperity (Mane and Hingane, 2012). Majority of developing countries are experiencing exponential growth in population, coupled with other issues associated with urbanization. This increased urbanization associated

with growing economies has posed a significant stress on the environment. With the increasing industrialization globally, people are introducing new and complex chemicals into the environment without any rigorous bio-assessment of their toxicity (Mane and Hingane, 2012). Solid waste management has therefore become one of the most crucial issues facing authorities in the fast-growing cities in developing countries (Monney et al., 2013). In Africa for instance, the World Health Organization (WHO) has noted solid waste as the second most important environmental health concern apart from water quality (Zerbock, 2003; Monney et al., 2013). The problems caused by solid waste in urban Africa is largely due to the explosive growth rates, particularly in sub-Saharan Africa, which eventually translates into generation of huge amounts of solid waste (UN-HABITAT, 2010; Taiwo, 2011).

The study of bird urban ecology has recently grown as a research area (Mörtberg, 2001), because urban environments can, like nature reserves, help to preserve bird species (McKinney, 2006). Normally, a greater diversity of species is found in large urban reserves due to greater plant diversity (Donnelly and Marzluff, 2004); however, depending on the combination of anthropogenic and biological processes, species diversity may be low. Given the ecological and conservation importance of urban populations of birds, it is important to study how an urban environment may affect diet, especially in birds, as they frequently consume anthropogenic food, which may have positive or negative consequences for the species concerned (O'Leary and Jones, 2006). On the positive side, some studies have reported that urban feeding of birds increases population sizes and reproductive rates; whereas, on the negative side, urban feeding may encourage the spread of disease and create dependency on supplemental feeding. Along with, human preffered food birds resident in cities may also feed on human food waste (e.g., from rubbish dumps) the consequences of which are varied for the birds concerned (Auman *et al*., 2008). Some studies have shown that birds feeding on food waste are heavier than their counterparts in natural environments but that their diet is nutritionally poorer and their reproductive output lower (Iris *et al*., 2oo8).

Birds are attracted to the landfill site for three main reasons: the presence of food sources in the waste stream; available habitat for food, shelter, water, and nesting areas; and the physical layout of the facility, which provides perching sites and thermal and orographic lift. The primary species of concern are: canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), turkey vultures (*Cathartes aura*), red-tailed hawks (*Buteo jamaicensis*), american kestrels (*Falco sparverius*), great blue herons (*Ardea herodias*), ring-billed gulls (*Larus delawarensis*), rock doves (*Columba livia*), mourning doves (*Zenaida macroura*), american crows (*Corvus brachyrhynchos*), european starlings (*Sturnus vulgaris*), and red-winged blackbirds (*Agelaius phoeniceus*).( Russell 2007).

The importance of wild birds as potential vectors of disease has received recent renewed empirical interest, especially regarding human health. Understanding the spread of bacterial pathogens in wild birds may serve as a useful model for examining the spread of other disease organisms, both amongst birds, and from birds to other taxa. Information regarding the normal gastrointestinal bacterial flora is limited for the majority of wild bird species, with the few well-studied examples concentrating on bacteria that are zoonotic and/or relate to avian species of commercial interest.

The emergence of new infectious diseases in wildlife (Alexander, 2003), and their potential threat as zoonoses, has increased general interest in birds as vectors of pathogens and their role in disease epidemiology. Birds are susceptible to many bacterial diseases common to humans and domestic animals (Broman, et al., 2002), and also to other potentially infectious microorganisms, including protozoa and viruses, such as the influenza A virus. Various wildfowl species serve as natural reservoirs for this virus, and have been the source of highly virulent strains that have caused a number of major pandemics over the last century. The virus can pass from infected birds to pigs, and on to humans (Trampuz et al., 2004), though direct transfer from birds in close proximity to humans can also occur (Webster, 2004).

Similarly, wild birds may act as natural reservoir hosts for west nile virus, infecting mosquitoes, which in turn may infect other birds, horses and humans (Rappole & Hubalek, 2003), causing fatal encephalitis (Reed et al., 2003). Although viral transmission differs from bacterial transmission in a number of important ways, understanding the spread of avian bacterial pathogens may serve as a useful model for examining the spread of other disease organisms, both amongst birds and from birds to other taxa. Using bacterial pathogens as model organisms has the key advantage that they are often safer to work with than viral pathogens. Empirical studies documenting bacterial intestinal flora of wild birds are sparse; the majority have determined the prevalence of specific strains of bacteria that may present a potential health threat to humans or domestic animals (Daniels, Hutchings & Greig, 2003).

Studies of enterobacterial infections and carriage rates in wild birds have so far concentrated on those avian species most likely to acquire bacteria from human sources, especially gulls (*Larus spp*.), with salmonellae, campylobacters and escherichia coli being the prevailing causative organisms of interest (Broman et al., 2002). Avian feeding ecology appears to be a key determinant of enterobacterial acquisition. The role of birds as vectors of disease could be underestimated, as many individuals may asymptomatically harbor sub-lethal levels of potentially pathogenic bacterial species. Due to the general lack of interest in wild birds as zoonotic vectors of disease, combined with their relatively low commercial value, few studies have examined their normal gastrointestinal flora. However, bird feed manufacturers have increased the economic value of wild birds, and concurrently drawn attention to their potential as vectors of disease. Identification of the normal microfloral components of the avian gut is important if we are fully to understand the complexities of enterobacterial interactions within the bird, and to appreciate how inherent gut bacteria may influence the susceptibility of the host to pathogens acquired from the environment. Likewise, a sound understanding of non-enteropathogenic infections can provide insight into the transmission dynamics of other types of avian pathogen (Clare et al 2009).

## MATERIALS AND METHODS

### Description of the Study Area

Limbe is found in southwest region of Cameroon, with an estimated population of 118,470 inhabitants, it is located between longitude $9^0$ and $13^0$ east, and latitude $4^0$ and $9^0$ north. Climatically, Limbe is dominated by equatorial climate of high rainfall and high temperature. Average monthly temperatures are like any other part of fako division, with the hottest month

recording a monthly temperature of 33°C (February and March) and the coldest months recording as low as 23°C (June–October) (Limbe City Council 2014). Two major seasons exist in the area, the rainy and the dry seasons. In the past, the rainy season occurred from March, extending to October and the dry season from November to February each year. But due to the present climatic change problem, the rainy season extends up to October and December. The primary and secondary forests are rich in flora species in the municipality. However, over 80% of the primary forest had long been exploited by timber companies. The area is also rich in wildlife species, antelope, monkey, elephant, pangolin, chimpanzee, gorilla, bush baby and squirrel. Moreover, the wild birds include, grey-headed sparrows, swallows, hawks, weaver birds, sunbirds, owls, bats, kingfishers and parrots (Limbe City Council 2014).

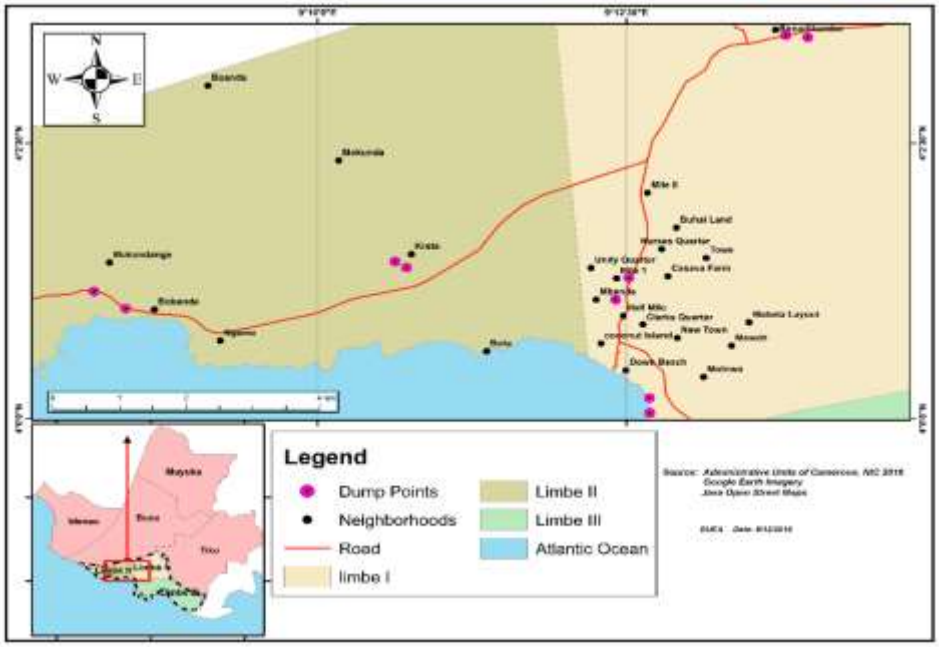


***Fig 1: Map of Limbe City***

**Methods of Data Collection**

The field research started with a pilot study to test the methods to be used in the process. The exercise witnessed adjustment of some variables in the check-sheet not feasible in the field. Hence, the data collection program started in the month of March and ended in July. The research area was divided into four zones, north, south, east, and western zone. The zonation was based on a sampling method that would reduce bias in the data collection program. Also, four dump-sites were randomly selected from each zone and were visited twice a week for research data collection. On the dumps, observations were done from 6:00am – 6:00pm, and the activities of all the bird species observed were recorded during the period. More so, the ecological conditions like meteorology, photo-period, weight estimate of dumps, proximity of dump to residential homes, major dump materials, and the land scape were recorded.

**Research Data Analysis**

The data was analyzed by using chi-square ($X^2$) and correlation (r) statistical models. The inferential and exploratory statistics helped to examine the variables against each other, and to understand their degree of association. The birds' feeding activity was examined on waste type, photo-period, and weather changes respectively. Also, there was an examination of dumps on different landscapes.

## RESULTS

This study observed that the activity of *Passer griseus* (27%) and *Ploceus cucullatus* (49%) were higher as compared to *Ploceus luteolus* (4%), *Lanius collaries* (5%), *Corvus albus* 8%), *Bubulcus ibis* (5%), and *Pycnonotus barbatus* (2%) respectively (fig. 2). The disparity in activity frequency might also be an indication of the population concentration of each bird species in the area.

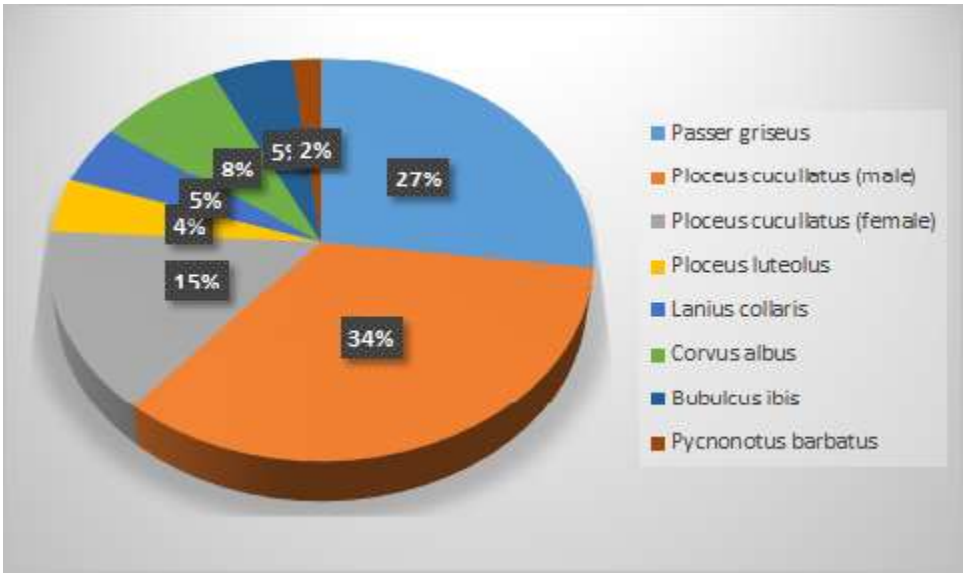


***Fig. 2: Bird species feeding activity frequency***

The study revealed a significance between bird feeding activity on waste type, photo-period, and weather condition, r = 0.170 P=0.013 (fig.3), r = 0.146 P=0.034 (fig.4), and $X^2$ = 6.343 df=4 P<0.05 respectively (fig.5). Human-generated waste accounts for both hygiene and environmental contamination problems to city inhabitants since they contain pathogenic and poisonous materials that can be recycled to humans by vectors such as birds, insects, and rodents.

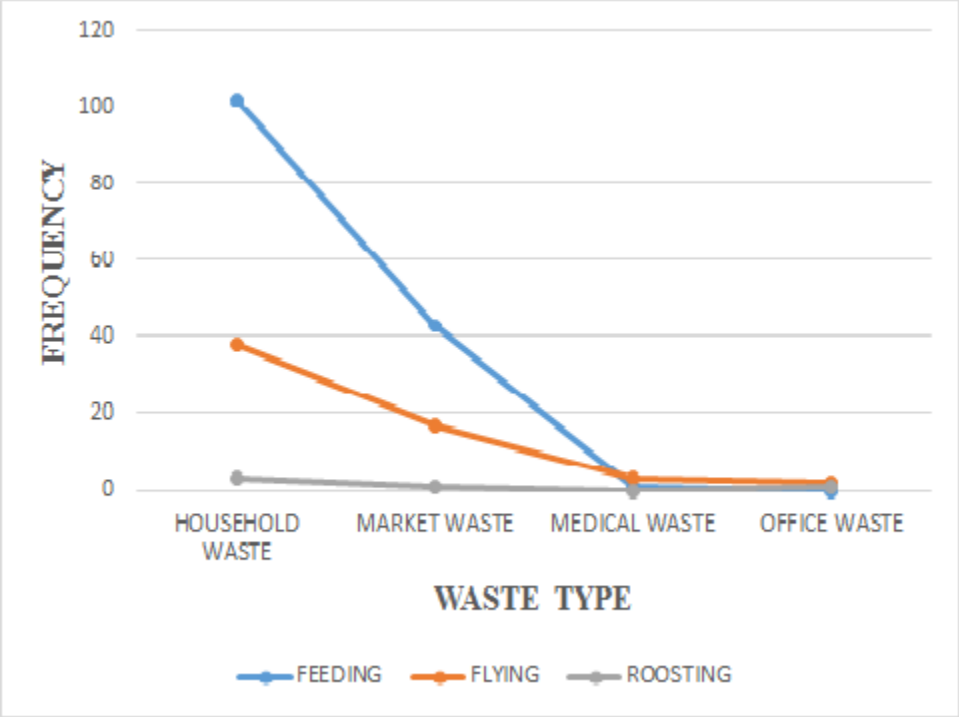


***Fig.3: Bird activity and waste type***

The implication of birds in recycling tropical pathogens such as salmonella species and related micro-organisms to humans has been documented in many countries. Though, little or no research has been carried out in Cameroon to determine this, the high frequency of typhoid disease in most communities in Cameroon is raising questions on the feeding activity of birds on dumps. Additionally, the poor waste disposal is an attraction to insects such as mosquitoes, well known in spreading plasmodium that causes malaria disease, one of the most deadly tropical diseases seriously claiming human lives and household income for treatment. Today, the combination of malaria and typhoid in patients is a common medical diagnoses in Cameroon. Consequently, human-health misery experienced in some communities and households across the national territory is alarmingly escalating. Though, some government hospitals and offices apply the strategy of waste-incineration, some medical waste and office materials still find their way into road-side-public dumps where they are regularly visited by birds, rodents, and insects that might also visit human homes.

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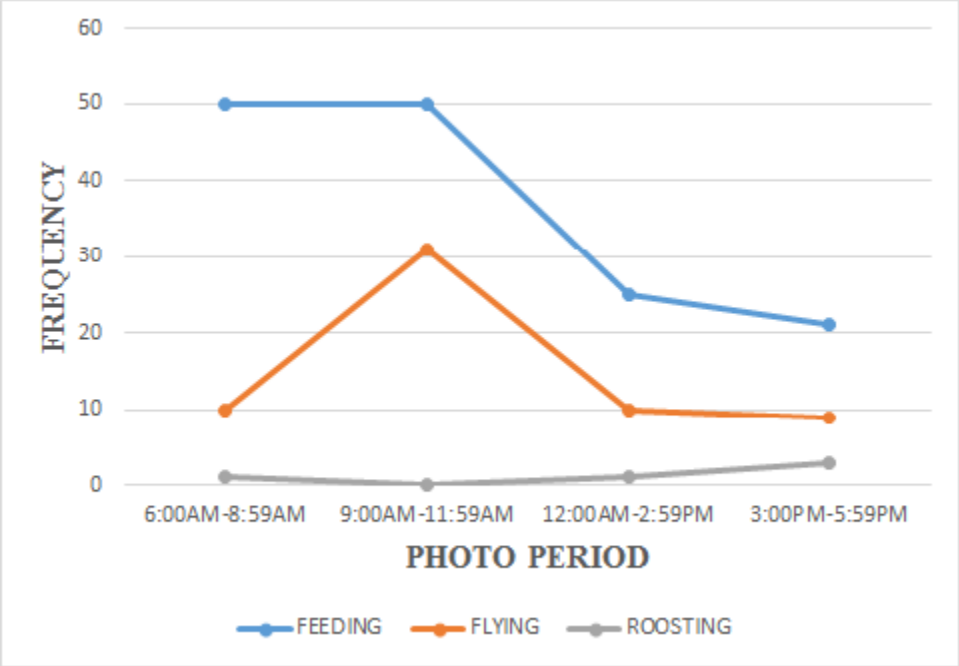


***Fig.4: Bird activity and photo period***

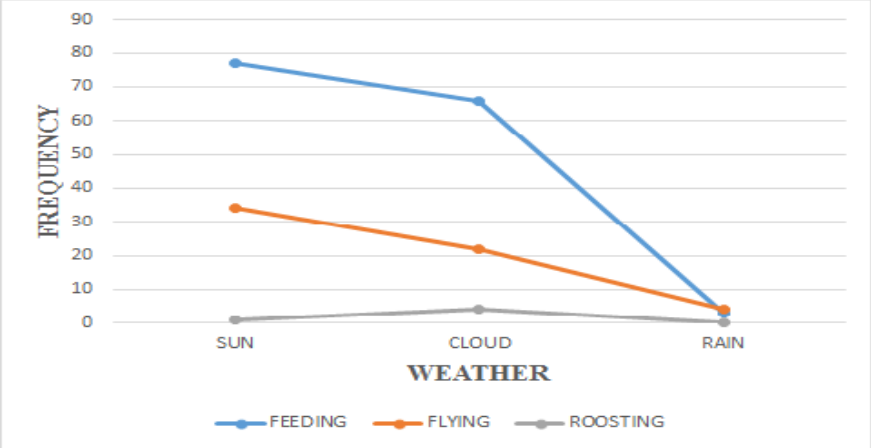


***Fig.5: Bird activity and weather type***

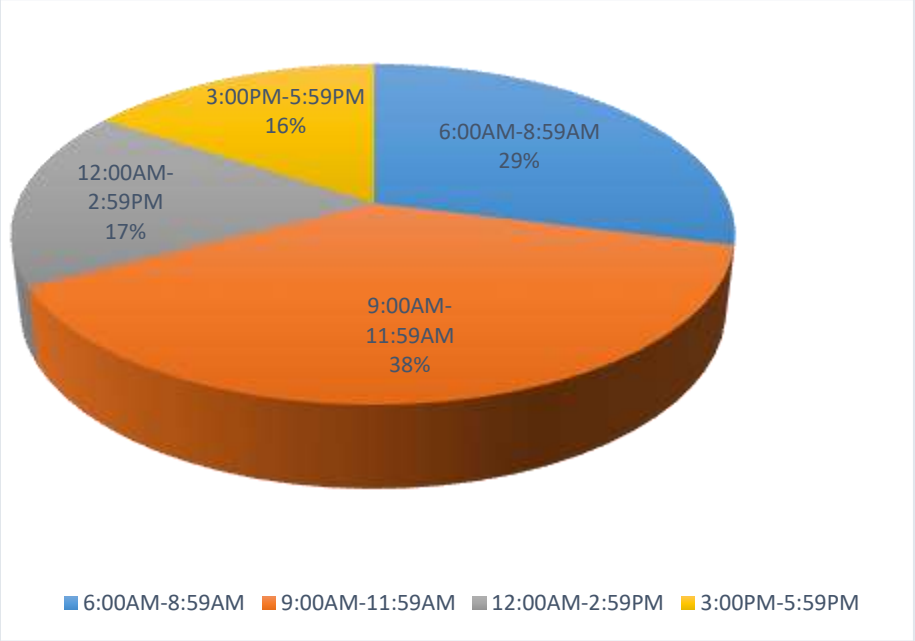


***Fig.*** 6***: Photo-period activity frequency***

The scavenging birds were more observed feeding on dumps during the morning period of the day, with an activity-increase from 6:00am-11:59am, and sharply decreasing from 12:00am -5:59pm (fig.6). The daily feeding activity profile of most wildlife species witness this activity trend in the tropics, especially during a bright sunny day. Limbe municipality is characterized with a warm coastal climate conducive to an increase in activity frequency of wild birds during the morning hours of the day. This period also coincides with a lower human social activity in the city, not deterring the bird population as compared to the afternoon and evening periods with higher human social activities. Office and other human social activities were reluctantly low during the morning period of the day, and for most days the population of birds was observed taking advantage of this situation to increase its activity and presence on the road-side dumps.

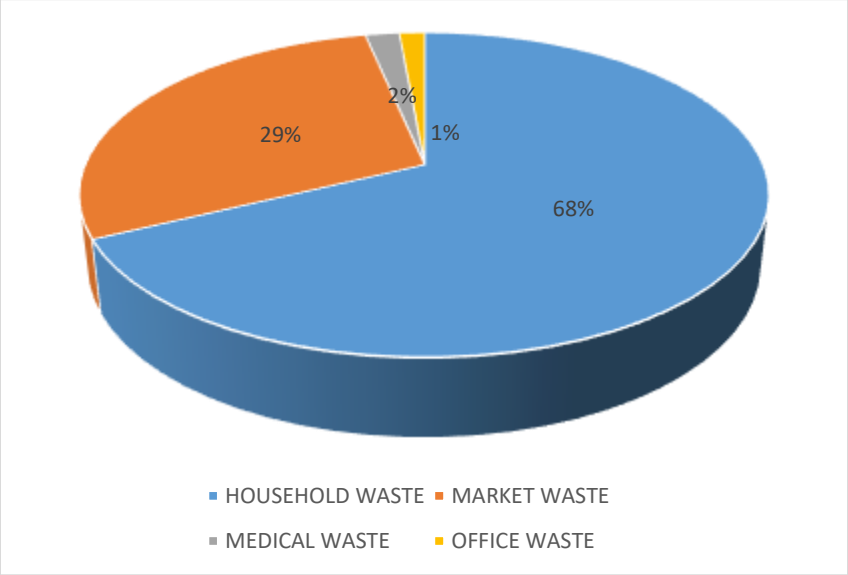


***Fig. 7:*** *Major waste material*

The major solid waste materials on the dump-sites were household waste (68%), market waste (29%), medical waste (2%), and office waste (1%) (fig.7). However, the feeding activity of the birds were observed more on the household and market wastes, since they had human food materials. The incineration of most medical and office solid waste materials in hospital and office premises is believed to be the main reason for their reduction in this location.

## DISCUSSION

However, Rubbish dumps constitute appropriate feeding sites for many bird species, they can serve as stop over sites and a source of food for many species of birds, especially in those altered or heavily human transformed habitats (Birdlife 2015). Super-abundance of organic residues provides bird species with a predictable spatial and temporal food source that greatly reduces the species both foraging time and home range. Within this frame, rubbish dumps have a high carrying capacity. Rubbish dumps in southwestern Europe have been shown to provide key habitats for at least twenty one bird species (Garrido *et al*., 2002a) where they feed directly from organic wastes. An additional twenty two species also use rubbish dumps as a foraging habitat as they indirectly provide food sources such as mice, rats and invertebrates that also concentrate for feeding at these sites. The more food available results in higher survival and productivity rates (Serrano and Cantos 2013). Thanks to the key role of rubbish dumps during the breeding seasons of some of these birds, increasing their distribution range and population sizes. Birds have enough, predictable and ensured food, reducing their movements and improving their individual fitness (Garrido *et al.*, 2002b).

Several studies have demonstrated the key role of rubbish dumps in the expansion of the distribution and demography of the cattle egret (*Bubulcus ibis*) and the white stork (*Ciconia ciconia*) in the Iberian Peninsula over the past 20 years (Molina and Del Moral 2005). The best examples of the importance of rubbish dumps on the conservation of some birds species in Africa,

are the increase of populations of black kite (*Milvus migrans*), red kite (*Milvus milvus*), griffon vulture (*Gyps fulvus*) common raven (*Corvas corax*), carrion crow (*Corvus corone*), magpie (*Pica pica*), white stork, black-headed (*Larus ridibundus*), lesser back-backed (*Larus fuscus*) and yellow-legged (*Larus cachinans*) gulls and cattle egret (Oro & Martínez-Abraín 2007). In India there were large vulture concentrations of genus g*yps* and *Pseudogyps spp* feeding from organic waste sites in certain regions (Satheesan 2000). From the demographic point of view, rubbish dumps provide a resource with nearly unlimited food availability. They represent an adaptive advantage for juvenile and immature birds, less experienced when getting food and also suffering from intra specific competition with adults. Juvenile survival is then higher and results in exponential population growths (Igual *et al*., 2000).

Bird species feeding at rubbish dumps during migration or wintering times where there is adequate food resources and an absence of additional hazard may have a mortality rate nearly equal to zero. In addition, individuals would return to the breeding grounds in a supposed good body condition, favoring high clutch sizes and productivity rates (Serrano and Cantos 2013). Waste management may result in positive impacts for birds creating suitable habitats as feeding sources. Food super-abundance and predictability favors generalist and necrophagous species. Furthermore, toxicosis and damage to birds has also occurred by consumption of plastic remains or ropes. An analysis of the diet of egyptian vultures in the ebro valley, northern spain, showed that plastic material appeared in a range of 1.6-51% from the analysed pellets. The highest frequency was found in those roosting sites closely located to rubbish dumps. Plastic ingestion may obstruct the digestive tract causing ulcers and dilution of toxic substances. Birds are also injured by glass pieces, barbed wire and other sharp materials in dumps (Bird life 2015). In addition, negative effects may increase if the concentrations at waste management sites are located close to infrastructures which could cause negative impacts such as power lines and wind-farms. This is normally linked with their movements to and from waste disposal site (Camiña 2012). Large numbers of dead storks have also been reported at poorly managed waste water treatment facilities (domestic and industrial) due to drowning, entrapment in sludge (due to inappropriate pond designs) or from drinking contaminated water (UNDP 2006). Large waste sites pose a particular threat in desert environments where they represent an attractive source of food and water to storks. The solid waste dump at Sharm El Sheikh has been responsible for the death of hundreds of white storks that die every season at the sewage ponds due to water contamination. Entrapment in sewage is known at Suez because of the construction of the tanks, raptors that dropped in to drink were unable to take off from the plant because of the steep sides (Biomap 2005).

The environment has been plagued more than ever before with the widespread effects of human activities. One such problem is the fast growing impact of solid wastes arising from man's activities such as marketing, storing and processing and the manufacturing of all commodities. This waste is created by communities, which include households, businesses, schools, industries and other institutions in an area (Carless, 1992). Therefore it is obvious that the management of solid wastes is one of the most serious problems confronting society. Environmentally and socially unacceptable standards currently characterize many aspects of waste management both in urban and rural areas. Waste disposal is of either poor quality or simply non-existent and in many

instances, services have collapsed as a result of non-payment, poor budgeting and financial planning.

Wastes produced by a community can be a problem in terms of aesthetics and community health. Thus, it is apparent that the effective and economic removal of solid waste material and the final disposal of waste are extremely vital. According to Wentz (1995), waste management can be used to describe several processes, which include: the elimination or reduction of waste; the recycling or re-use of waste materials; the treatment or destruction of waste (physically destroying, chemically detoxifying or otherwise rendering waste permanently harmless) and finally disposal of waste into land, air and sea. Hall and Ball (1989) stated that the aim of waste management was essentially the responsible re-introduction of waste into the environment. This means that waste needs to be put back into use without causing harm to the natural and human environment.

## CONCLUSION

The problems caused by solid waste in African cities is largely due to the explosive human population growth, particularly in sub-Saharan Africa, which eventually translates into generation of huge amounts of solid waste. Waste management is a serious problem faced by the authorities in the developing countries like Cameroon. Any living organism requires considerable amount of energy for its survival and reproduction. Feeding is an essential activity of bird's life which is indispensable for its survival, however, the demands of food acquisition impose significant challenges to both physiology and behavior of birds. Birds do not accumulate enough reserve food in their body and require daily energy expenditure, therefore, a constant food intake is essential on day to day basis to fulfill energy demand. This study revealed that the poor waste disposal and management in Limbe municipality has attracted the feeding of wild birds from the surrounding forest, and from these spots many fly into people's houses perching and feeding on both cooked and uncooked exposed food. The fact that most waste dumps take some days or weeks to be cleared of by the authorities, creates an enabling environment to culture some pathogens that can easily be cycled in the human society.

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