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Composition of Solid Waste in Doodhpathri (Budgam), Jammu and Kashmir, India

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Abstract

The study reports the composition of solid waste generated at Doodhpathri (Budgam) with the intention of providing base line data for development of solid waste management system by selecting three different sites. Overall the waste had the largest proportion (%) of biodegradable component ranging from 67.27 to 74.85 whereas non-biodegradable varied from 25.15 to 32.73 among the sites. Food waste contributed 44.37-48.53%, cardboard (10.44-11.61%), paper (7.36-7.86%), woodchips (2.57-3.26%), rags (1.94-3.10%), glass (7.21-8.72%), styrofoam (7.26-7.63%), metal ferrous (5.69-7.17%), plastic (3.96-6.19%), polythene (1.17-1.33%) and metal non-ferrous (0.74-1.23%). Food waste exhibited significant variation within the sites ($F_2 = 9.91$, $P < 0.05$), paper among the seasons ($F_3 = 5.20$, $P < 0.05$), woodchips among the seasons ($F_3 = 7.91$, $P < 0.05$), plastic within sites ($F_2 = 22.69$, $P < 0.05$) and among the seasons ($F_3 = 5.10$, $P < 0.05$) whereas metal non-ferrous within the sites ($F_2 = 4.74$, $P < 0.05$). Thus the study revealed the presence of large proportion of biodegradable and recyclable which can be managed by using composting/vermicomposting and recycling.

Keywords: Biodegradable, Budgam, Doodhpathri, Non-biodegradable, Seasons, Solid waste.

Introduction

Solid waste generation has become an issue of concern everywhere in the world, particularly in urban centers[1] especially in tourist areas. Generation of waste is influenced by economic conditions, living standards and population[2-4]. Due to the fast economic development and urbanization, the generation of solid waste has rapidly increased worldwide and the composition of waste has also changed significantly. These changes bring more pressure on the existing environment, human health and also to the waste management system[5]. Generally, increased population growth and rising consumer choices have resulted in a larger production of waste worldwide with varied composition[6]. The characteristics and composition of solid waste depends on the topography of the area, seasons, food habits and commercial status of the area[7]. Solid waste needs to be characterized for source, generation rates, type of wastes produced and composition, in order to monitor, control and to improve prevailing waste management systems[8].

Tourism is one of the fastest growing industries in both developed and developing countries as a tool for economic development. Developing countries see tourism as the opportunity to earn scarce foreign exchange and to generate employment but nobody gave any thought to environmental damage resulting from tourism. Among different problems, one of the biggest problems arising out of tourism activities is the solid waste problem (scientific management and disposal) even in sensitive areas of Himalayas and other similar mountainous tourist spots at the global level. Lack of waste management programs within tourist destinations leads to illegal dumping of the majority of generated solid waste, thereby creating a threat to human safety, disrupting habitat and reducing recreational value of destinations[9]. The solid waste contains a high proportion of organic component that attracts the flies and rodents. Further the high temperature and humidity favor rapid bacterial growth and decomposition of waste that causes odor nuisance and also results in spread of different diseases as well as disturb the aesthetics of the area[9-11] and its tourism potential. Increase in tourist flows and the rapid development of tourism infrastructure further increases the quantum of waste generates that accelerates the magnitude of problem in tourist destinations with adverse impact on the environment and that is why the problem of sustainable waste management is becoming increasingly relevant in many tourist destinations[12]. Therefore, the study on quality of solid waste generated will help in deciding a better solid waste management practices for the sensitive areas. Keeping this in view, present study was carried to study the composition of solid waste generated at Doodhpathri (Budgam).

Materials and Methods

Study area and study sites: Doodhpathri (Budgam) is known for its lush green pastures and forest. It is at a distance of 42 Km from Srinagar and 15 Km from Khan Sahib, Budgam[13]. It is one of the most beautiful and unexplored area of Budgam, Kashmir, Jammu and Kashmir (Figure-1). It is located within the geographical coordinates of 34°42'00″ - 34°50'00″ N latitude and 74°24'00″ -74°54'00″E longitude, with an area of 1291 km²

[14]. Climate is temperate and receives heavy snowfall during winter[15,16]. As Sukhnag and Shaliganga flows within the area makes the destination further attractive for local as well as national tourists. Doodhpathri is not just meadow but also a series of interconnected meadows like Parihas, Sotzalpathri, Doodhpathri, Reshkhal and Sherawali camouflaged in deep forests in the lap of Pir-Panjal mountain range. For the present study, three different sites were selected and details of each sites are as:

Site-I Dobiwan: The site lies in the center of the study area at an altitude of 2611 m above sea level, within the geographical coordinates of 33°52′06″N and 74°34′43″E. The area is visited by local as well as foreign tourists.

Site-II Doodhpathri: The site is a meadow spreads over 240 km^2. It is located at 2543 m above the mean sea level, within geographical coordinates of 33°53′00″N and 74°34′05″E. It is the main commercial hub, with some local shops and a fenced park where most of the tourist related activities take place. The shops remain active seasonally with most activities taking place in summer season.

Site-III Parihas: It is a lush green meadow covered by lofty pine trees and a magnificent view of snowcapped mountains. The site lies at an altitude of 2611m above the mean sea level within geographical coordinates of 33°52′27″N and 74°34′33″E. least tourist activities are taking place at this site.

Collection of samples: Solid waste samples were collected from dustbins, placed by the Doodpathri Development Authority (DDA) at different locations. The samples were collected from dustbins every month at the end of the day in 5 kg polybags. The estimation of generated solid waste was done by weighing of waste using digital balance. After estimation of total waste generated separately at each site, the composition analysis was carried out. The determination of the mean composition of the waste was based on spreading, manual sorting and segregation of samples on ground into individual waste components. All the waste components were then weighed separately and the total weight of each waste component was recorded. Finally the observed components were categorized into biodegradable and non-biodegradable.

Statistical analysis: With the objective of evaluating significant differences within and among the sites in solid waste components, data sets were analyzed by using two-way analysis of variance (ANOVA) at 0.05 % level of significance. All statistical analyses were performed using SPSS statistical software.

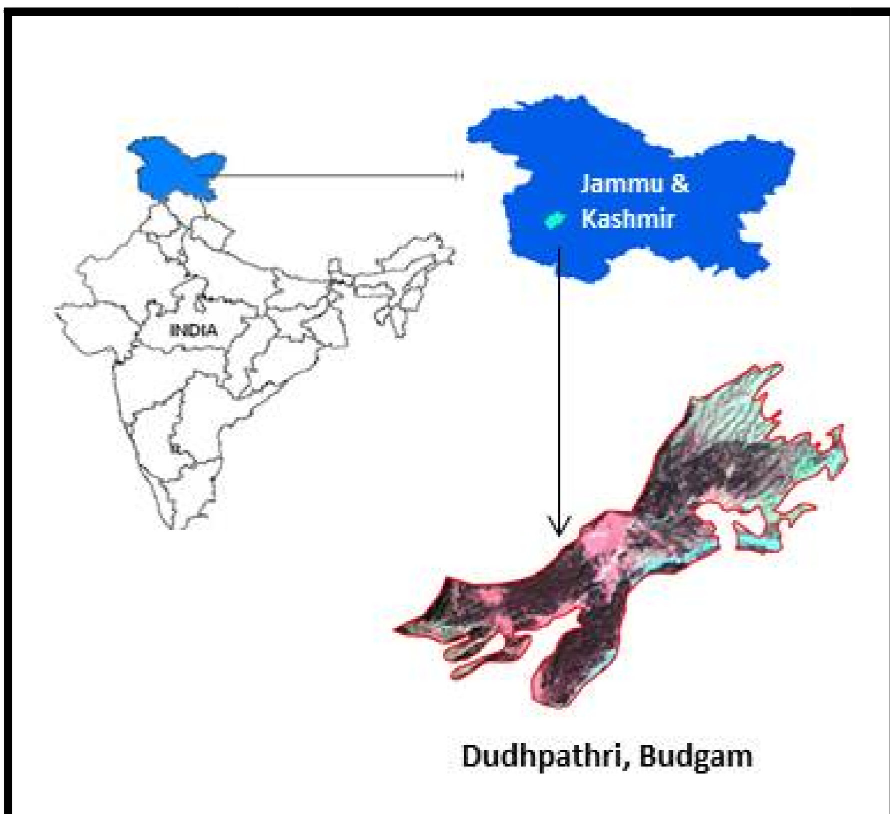

Figure-1
Outline map of study area

Results and Discussion

Solid waste generation is inextricably linked to socio-economic development, urbanization, population density and resource consumption. Greater the economic prosperity or higher the population density, greater be the quantum of waste generated. The composition of solid waste is varied and diversified by external factors such as life style, economic conditions, culture, social activities and weather. The solid waste is composed of two main categories- biodegradable and non-biodegradable and their proportion (%) at different sites is given in Figure-2. The highest quantity of biodegradable waste was recorded at site-II throughout the study with maximum value recorded during winter (74.85%). The highest percent of non-biodegradable was recorded at site-III throughout the study with maximum value recorded during winter (32.73%). The lowest quantity (25.15%) of non-biodegradable waste was also generation in the winter at site-II. The reason might be that when the proportion of biodegradable waste increases the proportion of non-biodegradable decreases thus exhibiting an inverse relation between the two. The biodegradable waste comprised of food waste, paper, cardboard, rags and wood chips. The non-biodegradable waste comprised of plastic, glass, styrofoam, polythene and metal (ferrous and non-ferrous) waste and could be attributed to the buying of foodstuffs readily available in containers- plastic, metal, glass, paper board and or carried in polybags by tourists visiting the area. According to Kamran et al[17], major component of municipal solid waste corresponds to organic residues followed by plastic, paper and glass. Abdoli et al.[18] reported 60.4% biodegradable content of the total solid waste generated.

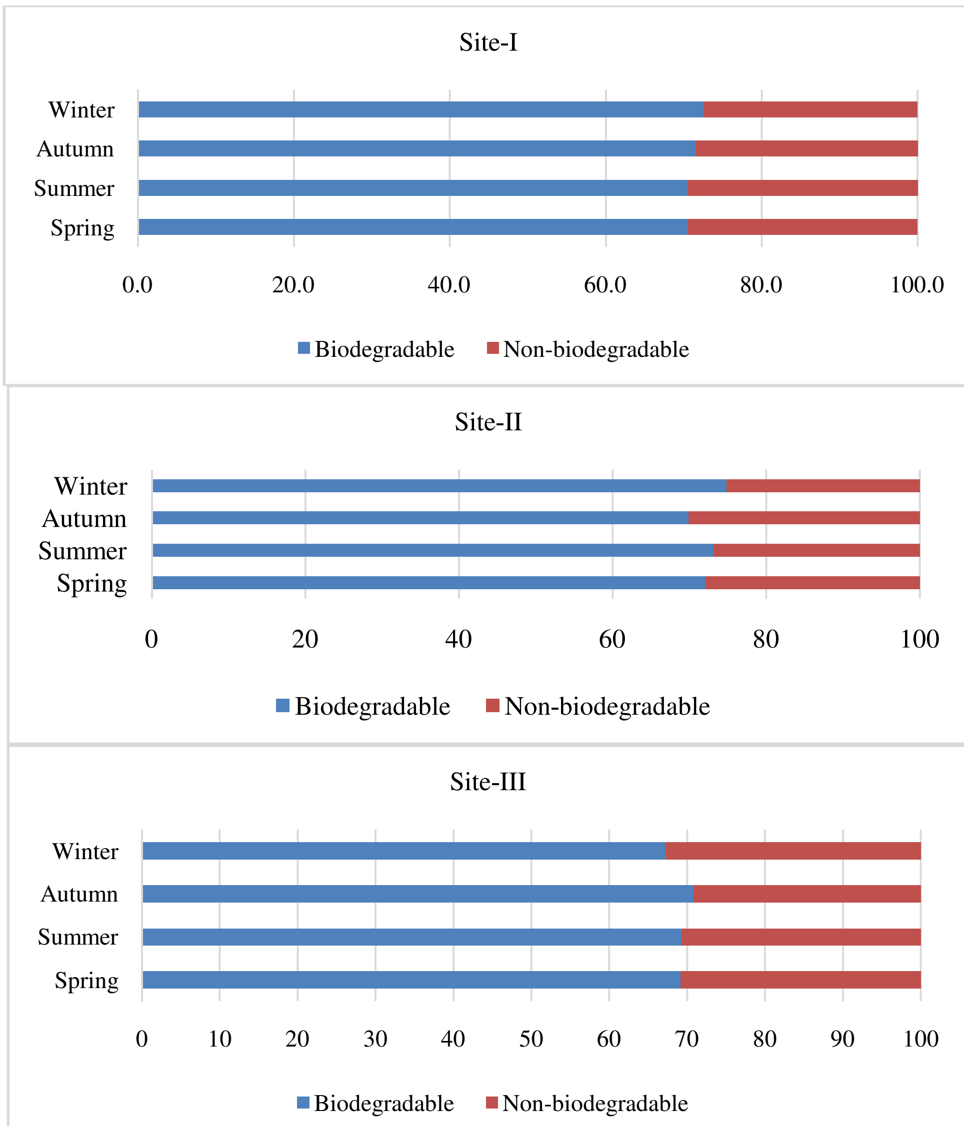

Figure-2

Biodegradable and non-biodegradable component (%) of solid waste at different sites and during different seasons

The fractions of biodegradable component is given in Figure-3 and consists of mainly of food waste, paper, cardboard, wood chips and rags.

Food waste constituted a major fraction of biodegradable portion with significant variation ($F_2 = 9.91$, $P < 0.05$) within the sites but insignificance ($F_3 = 0.33$, $P < 0.05$) among seasons. The value ranged from 43.52 at site-III during winter to 51.02 at site-II during spring (Figure-3a). Study of Kamran et al.[17] also reported that food waste constitute major component of solid waste with a mean range of 69.7 to 78.1%. The present study also indicates that the food waste as prominent component irrespective of seasonal variation within and among the site.

Cardboard ranged from 7.50 to 12.76 at site-II during spring and at site-III during autumn (Figure-3b) respectively with non-significant variation within sites ($F_2 = 0.86$, $P < 0.05$) and among seasons ($F_3 = 1.25$, $P < 0.05$). Paper exhibited significant variation ($F_3 = 5.20$, $P < 0.05$) among seasons where as non-significant ($F_2 = 0.29$, $P < 0.05$) within the sites and contributed 5.28 at site-I during spring to 10.25 at site-II during summer (Figure-3c). The occurrence of paper and cardboard waste is attributed to packaging and serving of food stuff by tourists. The present study is in confirmation of the reports of Pandey etal.[19] that paper contributed to 9-12% of the total solid waste generated whereas Ciuta et al.[20] recorded 6.56% of paper and cardboard. According to Saifullah and Islam[21] 4.29% of solid waste was present in form of paper and cardboard. Proportion of paper was 3.7-5.8% in study of Kamran et al.[17].

Woodchips varied from 1.69 at site-II during summer to 4.60 at site-II during spring (Figure-3d) with significant variation ($F_3 = 7.91$, $P < 0.05$) among seasons and non-significant ($F_2 = 2.30$, $P < 0.05$) within sites. Musa et al.[22] reported the presence of 4.83-10.56% wood chips in municipal solid waste of Kazaure, Nigeria. Ciuta et al.[20] also recorded 1% wood chips in their study.

Non-significant variation ($F_2 = 1.81$, $P < 0.05$) within sites and among seasons ($F_3 = 1.45$, $P < 0.05$) were recorded in rags with minimum value of 1.40 recorded at site-I during autumn and maximum of 4.13 at site-II during winter (Figure-3e). Thitame et al.[7] reported the presence of 2.5% rags in solid waste. Pandey et al.[19] also recorded 0.55% as rags in solid waste.

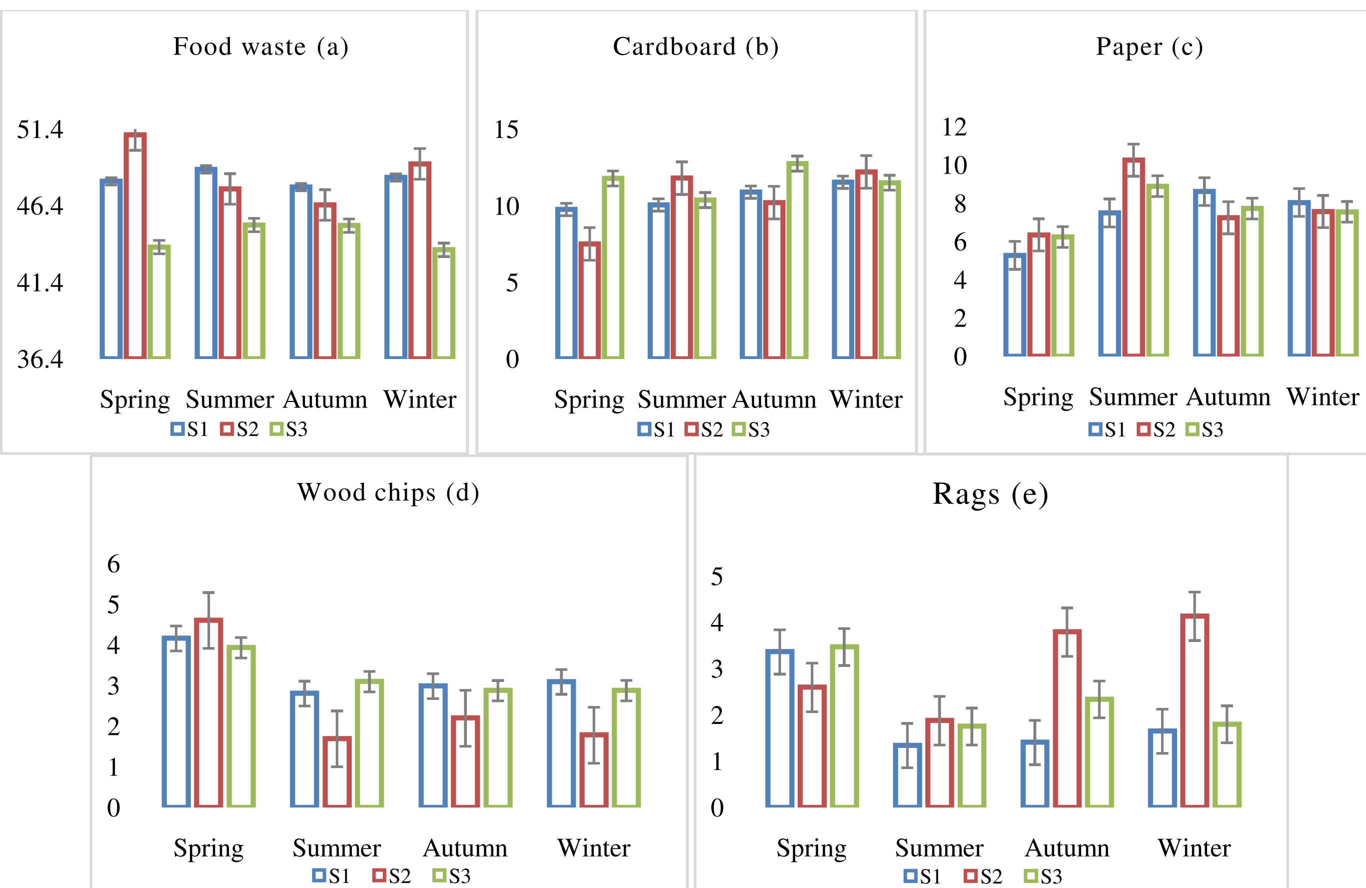

Figure-3
Seasonal variation in biodegradable component (%) of solid waste at different sites

The fractions of non-biodegradable component is given in Figure-4 and is composed of styrofoam, glass, metal (ferrous and non-ferrous), plastic and polythene.

Styrofoam exhibited non-significant variation within sites (F_2 = 0.20, $P < 0.05$) and among the seasons (F_3 = 1.17, $P < 0.05$) with range of 6.11 to 9.14 at site-II during winter and summer (Figure-4a) respectively. The Styrofoam was present in the form of disposal items and packing material. Palanivel and Sulaiman[8] also reported the presence of Styrofoam with a mean value ranging from 2.14-3.24%.

Glass varied from 5.64 to 9.17 at site-II during summer and spring (Figure-4b) respectively with insignificant variation within sites (F_2 = 1.53, $P < 0.05$) and among the seasons (F_3 = 1.10, $P < 0.05$). Glass waste includes beverage bottles and were either partially broken or unbroken. The present study is in confirmation of the report of Ciuta et al.[20]. Glass contributed 4-5% in solid waste as per the study of Tripathi and Shukla[23].

Metal ferrous was 5.21 at site-III during autumn and 9.06 at site-II during autumn (Figure-4c) with non-significant variation within the sites (F_2 = 2.27, $P < 0.05$) and among the seasons (F_3 = 0.38, $P < 0.05$). Metal non-ferrous exhibited significant variation (F_2 = 4.74, $P < 0.05$) within sites and non-significant (F_3 = 0.24, $P < 0.05$) among seasons with mean value of 0.35 at site-II during summer to 1.31 at site-I during autumn (Figure-4d). Kamran et al.[17] and Thitame et al.[7] reported occurrence of 0.9% and 5% metal in solid waste. The study also corroborates the report of Pandey et al.[19] and Musa et al.[22]. According to Ciuta et al.[20] ferrous metals contributed 1.56% of the total solid waste generated whereas non-ferrous metals were 3.10%.

Plastic contribute to 3.42 during spring and 7.10 during summer at site-II (Figure-4e), with significant variation within the sites (F_2 = 22.69, $P < 0.05$) and among the seasons (F_3 = 5.10, $P < 0.05$). Plastic in the form of plastic containers of soft drinks, ice-creams, beverages and disposable items were found at all the sites with varied quantity. According to Thitame et al.[7], Kamran et al.[17]and Ciuta et al.[20] plastic constitute 6%, 3.6-5.6% and 12.50% respectively of the municipal solid waste generated. Gupta and Arora[24] also reported the 4.45% as plastic in their study.

Polythene exhibited insignificant variation within the sites (F_2 = 0.39, $P < 0.05$) and among the seasons (F_3 = 0.56, $P < 0.05$). Maximum value (1.49) was recorded at site-I during autumn and minimum (0.60) at site-II during summer (Figure-4f). According to Tripathi and Shukla[23] polythene contributes to 4% of the total solid waste generated in a municipal area of Bhopal.

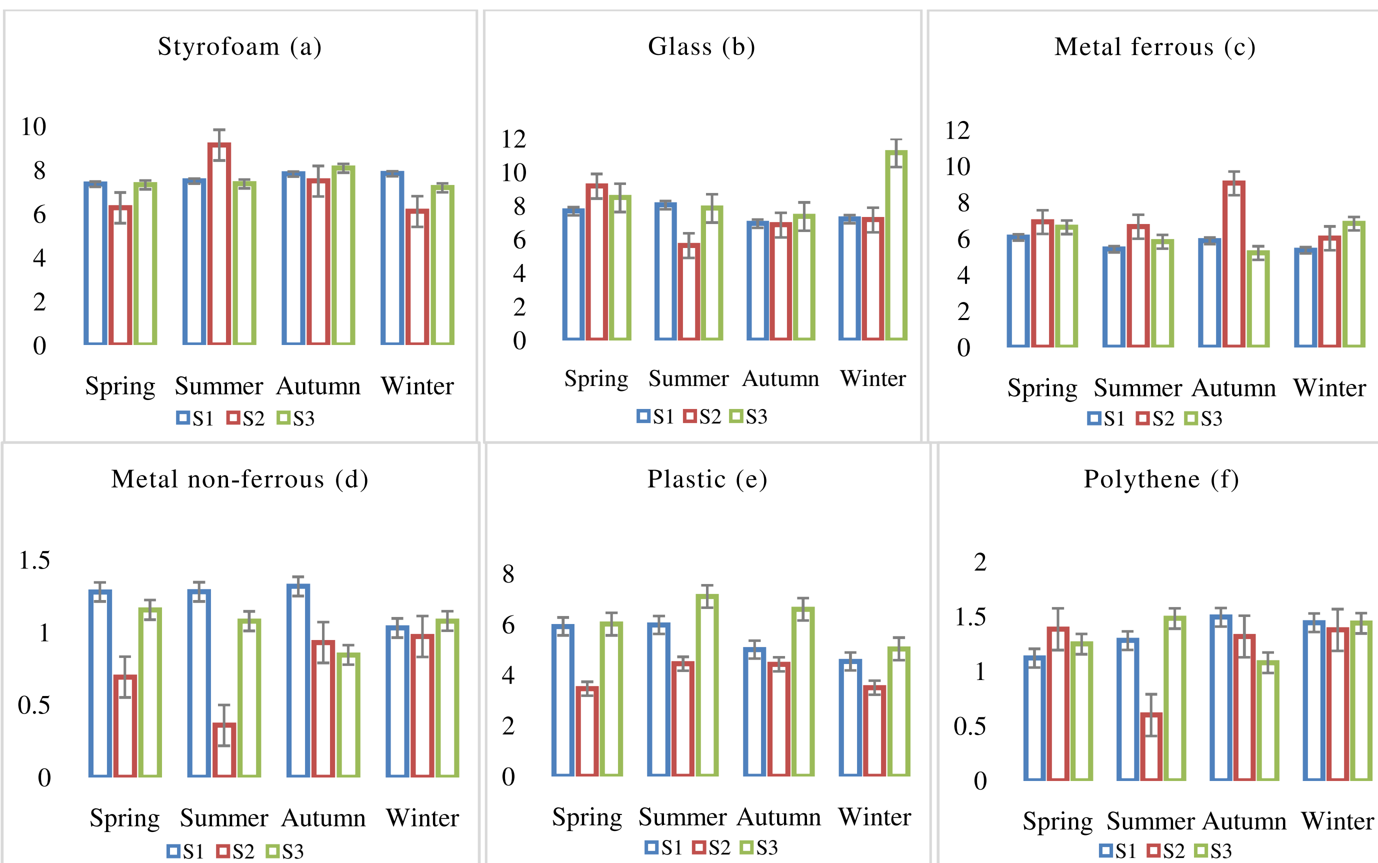

Figure-4
Seasonal variation in non-biodegradable component (%) of solid waste at different sites

The overall composition (%) of solid waste at different sites is given in Figure-5. major component was food (44.31-48.53) followed by cardboard (10.43-11.61), paper (7.35-7.85), styrofoam (7.25-7.62), glass (7.21-8.71), metal ferrous (5.68-7.16), plastic (5.36-6.18), wood chips (2.56-3.26), rags (1.93-2.33) and polythene (1.16-1.33) metal non-ferrous (0.73-1.22). Rotich et al.[25] reported composition of solid waste as 37.8% (food waste), 33.6%, 6.7% (paper), 0.8% (metals), 7.8% (plastics), 1.3% (textiles), 0.7% and (glasses). According to Thitame et al.[7] municipalsolid waste comprised of wood chips (9.4%), paper (6.1%), plastic (6%), metal (5%), rags (2.5%) and glass (2%) but the study of Gupta and Arora[24] reported 3.78% as paper, 4.45% as plastic and 0.10% as metal.

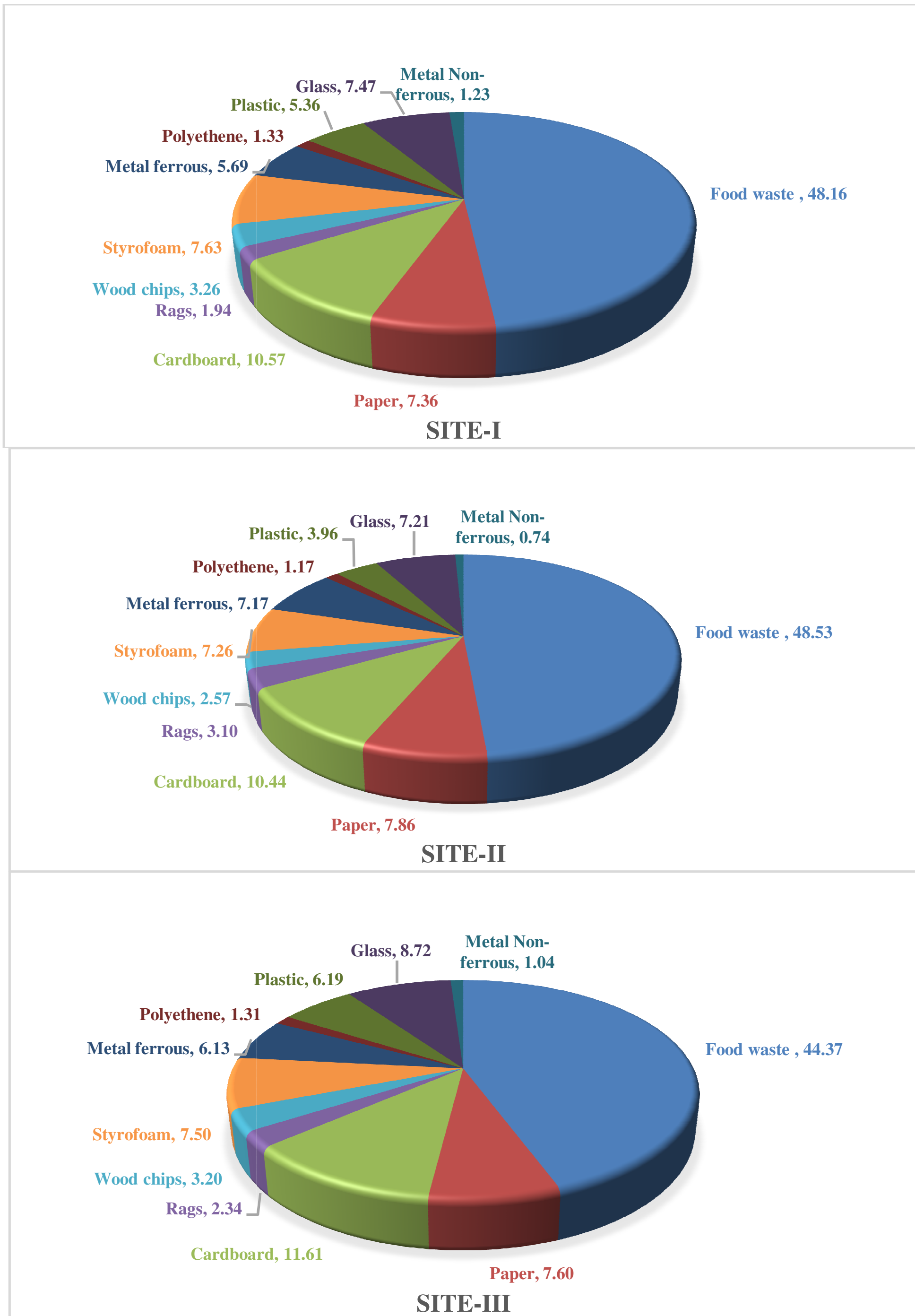

Figure-5
Overall composition (%) of solid waste at different sites

Conclusion

The study reveals that the solid waste has the large proportion of biodegradable and recyclable. If the waste management options such as composting, vermicomposting and recycling are practiced there is greater possibility of reducing substantial quantity of waste generated. Further the fraction of non-biodegradable and non-recyclable like polythene and styrofoam can be reduced by banning there use within the area.

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