Study on Municipal Solid Waste Characterization and Management in Gazipur City Corporation

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STUDY ON MUNICIPAL SOLID WASTE CHARACTERISATION AND MANAGEMENT IN GAZIPUR CITY CORPORATION

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APPROVAL

The thesis titled "Study on Municipal Solid Waste Characterization and Management in Gazipur City Corporation" submitted by Md Mohiuddin (Student ID 115419), Syed Ishraq Hossain (Student ID 115427) and Farhan Nafis Hridoy (Student ID 115404) of Academic Year 2011-15 has been found as satisfactory and accepted as partial fulfillment of the requirement for the degree of Bachelor of Science in Civil Engineering.

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DECLARATION

We hereby declare that the undergraduate project work reported in this thesis has been performed by us and this work has not been submitted elsewhere for the award of any degree or diploma.

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DEDICATED
TO
OUR BELOVED PARENTS

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Abstract

Generation of huge amount of solid waste and its mismanagement has become one of the major concerned social and environmental issues in both urban and rural areas. Although municipal authorities are concerned about the importance of solid waste collection and disposal and recycling but it is difficult to deal effectively with the growing amount of solid waste generated with the increase of population. Therefore, solid waste is dumped on roads and into open drains which leading to serious health risk and degradation of living environment for millions of urban people. With the advance of time special consideration for municipal solid waste is being required. Evaluation of characteristics of MSW is necessary to develop a sustainable management system. This study identified the generation rate, composition of solid waste by component, recyclable components and their importance of separation in Gazipur City Corporation.

Gazipur is the largest city corporation of Bangladesh. The area of this city corporation is about 329.53 square kilometer and its population is about 2500000. To conduct our study Gazipur was divided into 5 zones. Wastes were collected from each zone for two seasons- dry and wet to determine seasonal comparisons. From each zone sample wastes were collected thrice. Household wastes are primary sample source. Then from a secondary and final dumping site sample wastes were collected.

The main objectives of our study were to determine waste generation rate (per capita per day) and to determine the solid waste composition in houses, secondary dumping site and final dumping site based on the composition to compare the percentages of recyclable wastes and non-recyclable wastes and to assess possible mass reduction. Then to suggest some environmental management initiatives with the increasing population

A questionnaire survey was done during the collection of household wastes. From the survey information gathered from the people were about socio economic level, existing and preferable waste collection system, generation rate. After the survey was done wastes from all sources were collected and dried in sun for 24 hours separately after drying for 24-hours wastes was sorted into various components according to physical properties. Then percentages of mass of each component were determined. From the dry sample moisture content of waste and composition analysis were prepared.

From our study it has been determined that waste generation rate differs from 0.25 to 0.45 kg/capita/day depending on season and socio economic level. In dry season waste generation rate is little lesser than wet season due to production of more food in wet season. Again high socio economic people generate more wastes than low socio economic people. Another major finding from our study is that Food and vegetable waste i.e. organic waste is the predominant component in each sampling source. Non organic recyclable components are mainly paper and plastic and others include wood, leather, glass, metal, polythene, bricks and their range by mass varies between 25% and 35% in each source. Volume of recyclable waste among total wastes is nearly

50% and this amount indicates the possible reduction in landfill required to dump wastes if recyclable components can be separated before dumping.

Our study recommends that mass and volume of recyclable components are key factor in developing a healthy and economical waste management system. Recyclable wastes should be separated and only organic and non-recyclable inorganic wastes should be brought to final dumping site. Recycling at the same time can reduce landfill required to dump and produce resource. Only non-recyclable inorganic components should be dumped in earth and other organic wastes should be used for compost manufacturing.

As Gazipur is a large and densely populated city corporation, feasible and healthy management system is an obvious to employ as soon as possible. During our study another fact that was revealed is that administrational and financial framework for managing wastes in this area is inadequate and inconsistence due to new establishment of this city corporation.

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CHAPTER ONE

INTRODUCTION

1.1 General

Solid wastes are all the solid materials which are discarded as useless or unwanted generated from human and animal activities. Municipal Solid Waste (MSW)—more commonly known as trash or garbage—consists of everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. This comes from our homes, schools, hospitals, and businesses. Composition of municipal waste varies from municipality to municipality and changes with time.

Maximum waste is not collected and all are throw on open air. This result is uncollected waste on roads, canals, river and other public places. This human practice is making our urban life truly vulnerable. At this moment we are concerned and have to make sure the proper utilization of waste and we have to recycle all types of waste. Recycle is the intellectual salutation of urban waste problem. Because of, if we can recycle our waste we will also financially get benefits. Maximum people are not concerned about waste management. This is an important cause of mismanagement of waste. In Dhaka city household waste are thrown in the roadside and open areas. Clinical wastes also are thrown in the open dustbin. These types of human practice create huge environmental pollution. The sources of solid wastages are garbage, refuse, sludge and discarded material and the wastages are produce by industry, hospital, or household community activities. (DU Journal, Office of land quality-2000). Waste management is a tactic used to waste collection largely from different sources, including recycling and re-use of materials.

Wastes are not avoidable. Human activities Economic development, urbanization and improving living standards in city life have led to an increase in the quantity and complexity of waste generation rapid growth of population and the development of civilization, urbanization are degrading the urban environment and creating serious stress on natural resources. We live in a world of increasing scarcity. Raw materials from natural resources are limited financial resources are often insufficient, and securing land for final disposal is getting more difficult. So it is essential to set policy directions aiming for resource efficient, recycle-based management system to provide a clean, healthy and pleasant living environment to the citizens of the city and for current and future generations.

Rapid urbanization has made solid waste management a serious problem today. The urban area of Bangladesh generates approximately 16,015 tons of waste per day, which adds up to over 5.84 million tons annually. It is projected that this amount will grow up to 47,000tons/ tons/day and close to 17.16 million tons per year by 2025, due to growth both in population and the increase in per capita waste generation. Based on the present total urban population, per capita waste generation rate is found at 0.41 kg/capita/day in urban area of Bangladesh. Existing infrastructure for waste management showed that waste collection efficiency in different urban areas varies from 37% to 77% with an average of 55%. The overall waste collection situation is not very satisfactory. Huge amount of uncollected waste, a high proportion of which is organic, makes nuisance and pollutes the local environment rapidly. Solid waste disposal poses a greater

problem because it leads to land pollution if openly dumped, water pollution if dumped in low lands and air pollution if burnt. Dhaka, the capital city of Bangladesh is facing

Municipal solid composition and quantity therefore depend on population density, source diversity and the income of the people in the locality. With the increase in population, economic activities and the income the municipal solid waste quantity and composition including the non-biodegradable and hazardous waste is bound to increase. The evolutionary waste quantity and characteristics accordingly challenge the municipal authorities in management, demanding more and more resources and technological capability. In developing countries where resources and capacity is constrained, the challenges thus become serious (Penjor, 2007)

Gazipur City Corporation is the largest city of Bangladesh having an area of 329.53sq.km and a population of 2500000.Population is increasing rapidly for the industrialization of Gazipur City. Generation of solid waste is also increasing with the rapid growth of population. Many studies have been done previously on the management process and system of solid waste of different major cities but none on Gazipur city. Now a-days it becomes an essential need.

1.2 Objectives of the Study

The study includes the following objectives

1) To determine waste generation rate (per capita per day)

2) To determine the solid waste composition in houses, secondary dumping site and final dumping site.

3) Based on composition to assess the mass reduction and suggest some environmental management initiatives with the increasing population.

1.3 Study area

The research work is carried out in Gazipur City. Gazipur is the largest city corporation of our country. Average waste generation of Gazipur city is around 700tons.There is no permanent dumping site in Gazipur city so solid waste management is a major problem in Gazipur city.

1.4 Scope of the Study

This study will provide a sample data about solid waste composition, waste generation rate (per capita per day), sorts of waste components, moisture content of the waste, variation of waste generation among the people of low income and high income. This study will also determine the seasonal variation of waste generation. Sorts of waste will be required to reduce the volume of

waste in dumping site by separating the recyclable waste from organic waste and waste generation rate will be required to develop waste management system for the increasing population.

1.5 Limitations of this Study

• Some people had shown less interest during survey.it was difficult to convince general people about our work.

• Lack of administrational framework in conservancy sector which made our work harder for initial planning.

• Gazipur City Corporation is a newly established city there was not adequate data about the city which made our work harder for initial planning.

• Due to less manpower our sampling range is not sufficient whereas Gazipur is a huge city.

CHAPTER TWO

LITERATURE REVIEW

2.1 General

In our rapidly urbanizing global society, solid waste management will be a key challenge facing all the world's cities. The struggle for achieving the Millennium Development Goals and related targets for water and sanitation are being waged in our cities, towns and villages where solid wastes are generated. It is at this level that policy initiatives on solid waste management become operational reality and an eminently political affair: conflicts have to be resolved and consensus found amount competing interest and parties.

A good solid waste management system is like good health: if you are lucky to have it, you don't notice it; it is just how things are, and you take it for granted. On the other hand, if things go wrong, it is a big and urgent problem and every- thing else seems less important. Managing solid waste well and affordably is one of the key challenges of the 21st century, and one of the key responsibilities of a city government. It may not be the biggest vote-winner, but it has the capacity to become a full-scale crisis, and a definite vote-loser, if things go wrong. This note to decision-makers introduces UN-Habitat's Third Global Report on Water and Sanitation in the World's Cities: Solid Waste Management in the World's Cities.

2.2 Solid Waste Management in Asian Countries

The urban areas of Asia now spend about US$25 billion on solid waste management per year; this figure will increase to at least US$50 billion in 2025. Today's daily waste generation rate is about 760,000 tons. By 2025, this rate will be increased to about 1.8 million tons per day. Japan spends about ten times more for waste disposal than collection costs (mostly incineration costs). Total waste management costs in low income countries are usually more than 80 percent for collection costs. Lower cost landfilling is usually a more practical waste disposal option than incineration. Municipal governments are usually the responsible agency for solid waste collection and disposal, but the magnitude of the problem is well beyond the ability of any municipal government. They need help. In addition to other levels of government, businesses and the general community need to be more involved in waste management. Generally, solid waste planners place too much emphasis on residential waste; this waste represents only about 30 percent of the overall municipal waste stream but often receives the lion's share of attention. The waste components requiring priority attention in Asia are organics and paper.

2.3 Solid Waste Management in Developing Countries

For a variety of reasons, poor waste management practices and associated public health implications remain severely problematic in many developing countries a century and a half after the European sanitary revolution, despite increasing globalization (**Konteh, 2009**). In industrialized nations, the health benefits from solid waste and sanitation systems are largely taken for granted, and the focus has moved from sanitation-related communicable diseases to 'diseases of affluence' (cancer, cardiovascular disease, drug and alcohol abuse) and "sustainability" **(Konteh, 2009, Langeweg et al., 2000 and McGranahan,2001)**. Meanwhile, many developing countries are currently affected by the 'double burden' of the combined effects

of the diseases of affluence and communicable diseases **(Boadi et al., 2005 and Konteh, 2009). Wilson (2007, p. 204)**points out that "[i]n some countries, simple survival is such a predominant concern, that waste management does not feature strongly on the list of public concerns". When SWM is on the public agenda in developing countries, it is driven by the same concerns as industrialized countries, although it tends to be driven most strongly by public health; the key priority is still getting the waste out from underfoot, as it was for the Europe and the United States up until the 1960s (**Coffey and Coad, 2010, Memon, 2010, Rodic et al., 2010 and Wilson, 2007).** Environmental protection is still relatively low on the political and public agendas, although this is starting to change (**Wilson, 2007).** Though legislation is often in place requiring closure and phasing out of unregulated disposal, enforcement tends to be weak (**Wilson, 2007).** The resource value of waste is an important driver in many developing countries today; informal recycling provides a livelihood for the urban poor in many parts of the world **(UN-HABITAT, 2010 and Wilson, 2007**). Climate change is an important driver worldwide – the clean development mechanism under the Kyoto protocol, in which developed countries can buy 'carbon credits' from developing nations, can provide a key source of income to encourage cities in developing countries to improve waste management systems (**Wilson, 2007).**
Many similarities exist between the historical SWM development trajectories of industrialized countries and the current trajectories of developing countries. Many cities in lower income nations are experiencing similar conditions to those of the 19th century in high income countries: "high levels of urbanization, degrading sanitary conditions and unprecedented levels of morbidity and mortality, which affected mostly the working class population" (**Konteh, 2009, p. 70).** Indeed, increasing urbanization and socioeconomic disparities, inadequate provision of sanitary and environmental amenities, social exclusion and inequalities related to existing SWM systems, and high levels of morbidity and mortality linked to inadequate sanitation, waste disposal, and water supply provision were common then as they are today, particularly in poorer urban neighborhood's in lower income countries (**Konteh, 2009).**

As urbanization continues to take place, the management of solid waste is becoming a major public health and environmental concern in urban areas of many developing countries. The concern is serious, particularly in the capital cities, which are often gateways to the countries for foreign diplomats, businessmen, and tourists. Poor visual appearance of these cities will have negative impacts on official and tourist visits and foreign investment. Recognizing its importance, a number of developing countries have requested collaboration of external support agencies, both bilateral and multilateral, in improving solid waste management in their cities in the last 20 years or so. Although some projects succeeded in providing lasting positive impacts on the management of solid waste in the recipient countries and cities, many failed to continue

activities after the external support agencies ceased their support. This unsustainability of collaborative projects is due to various technical, financial, institutional, economic, and social constraints faced by both the recipient countries/cities and external support agencies.

2.4 Solid Waste Management in Bangladesh

Current waste generation in Bangladesh is around 22.4 million tons per year or 150 kg/cap/year. There is an increasing rate of waste generation in Bangladesh and it is projected to reach 47, 064 tons per day by 2025 (**Wikipedia).** The Waste Generation Rate (kg/cap/day) is expected to increase to 0.6 in 2025. A significant percentage of the population has zero access to proper waste disposal services, which will in effect lead to the problem of waste mismanagement

The total waste collection rate in major cities of Bangladesh such as Dhaka is only 37%. When waste is not properly collected, it will be illegally disposed of and this will pose serious environmental and health hazards to the Bangladeshis.

Bangladesh has minimal waste collection coverage which forces majority of the waste to be dumped in open lands. These wastes are not disposed of properly, where general wastes are often mixed with hazardous waste such as hospital waste. In a report on solid waste management in Asia, the data showed that, in Dhaka, only about 42% of generated waste is collected and dumped at landfill sites, and the rest are left uncollected. As much as 400 tons are dumped on the roadside and in open space. As such, these improperly disposed wastes poses serious health implications to the people where it may have the potential of transmitting diseases (**Bhuiya. G.M.J.A(2007).**

Due to the lack of funding, there are also insufficient subsidies put in place for the issue of waste management in Bangladesh. Hence, there are essentially no proper disposal facilities to cater to the rapid creation of waste.

Due to some reasons solid waste management system is not satisfactory in our country. Some reasons are Technical Constraints, Financial Constraints, Institutional Constraints, Economic Constraints, Social Constraints, and Social Constraints.

There have been recent developments in Bangladesh to improve waste management, especially in urban cities. In Dhaka, Dhaka City Corporation with support from the Japan International Corporation Agency (JICA) has a master plan underway to better handle the solid waste management in Dhaka. For instance, Social Business Enterprise Waste Concern has sprung up

to tackle the municipal waste accumulation problem through working with the households. UNICEF has also initiated recycling programs and waste control with the city corporations and municipalities. However, currently, there are still insufficient incentives to improve the standard of waste management across all relevant sectors, especially for industrial waste and medical waste.

Gazipur City Corporation is the largest city corporation of Bangladesh. It is considered as one of the most important industrial zone of our country. Because of rapid population growth and increase of industrialization the amount of waste generation in this area is increasing at an alarming rate.

As the city corporation is formed newly, corporation authority is struggling to cope with the existing situation. Inadequate management practices and unrolled waste dumping are creating numerous environment problems. This study revealed that the existing waste management practices in Gazipur city is behind the satisfactory level due to poor infrastructural facilities in waste management ,lack of trained workers, lack of technologies and lack of proper planning's and monitoring activities.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This study is a combined study of waste character and generation analysis as well as developing a management system for future. For this some steps are followed serially. General hierarchy is likely as following:

- Study area selection.
- Questionnaire survey.
- Data collection; from houses and dumping sites.
- Waste sampling; includes collection, drying, sorting by components.
- Analysis of result by taking weights, making charts and discussions.

3.2 Study area

The research work is carried out in Gazipur City. To conduct this study firstly the entire Gazipur city was divided into five zones to facilitate and to ease the work.

These zones are:

- Board bazar zone
- Kaliakair zone
- Kaliganj zone
- Sripur zone
- Kapasia zone

Figure 3.1 shows the map of Gazipur city corporation with five zones.

Figure 3.1 Map of Gazipur city corporation

3.2.1 Zone description

A. Boardbazar

This is known as Gazipur upazila. it occupies an area of 457.67 sq. km. including 0.31 sq. km. river area and 54.52 sq. km. forest area. It is located between 23°53' and 24°11' north latitudes and between 90°20' and 92°30' east longitudes. The upazila is bounded on the north by Sreepur upazila, on the east by Sreepur and kaliganj upazila and Rupganj of Narayanganj, on the south by Uttara thana and Mirpur thana of dhaka megacity and on the west by kaliakair and Savar upazilas.

B. Kaliakair

This zone occupies an area of 314.13 sq. km. including 1.22 sq. km. river area and 79.72 sq. km. forest area. It is located between 24°00' and 24°15' north latitudes and between 90°09' and 90°22' east longitudes. The upazila is bounded on the north by Sreepur upazila, on the east by Gazipur Sadar, on the south by Savar and Dhamrai upazila of Dhaka and on the wset by Mirzapur upazila of Tangail zila.

C. Kaliganj

this upazila occupies an area of 214.63 sq. km. including 2.15 sq. km. river area and 0.34 sq. km. forest area. It is located between 23°54' and 24°02' north latitudes and between 90°26' and 92°39' east longitudes. The upazila is bounded on the north by Sreepur and Kapasia upazila, on the east by palash and Shibpur upazila, on the south by Rupganj of narayanganj and on the west by Gazipur Sadar Upazila.

D. Sreepur

The upazila occupies an area of 462.94 sq. km. including 3.16 sq. km. river and 121.44 sq. km. forest area. It is located between 24°01' and 24°21' north latitudes and between 90°18' and 90°33' east longitudes. This upazila is bounded on the north by Bhaluka and gafforgaon of Mymensingh zila, on the east by kapasia upazila, on the soth by Kaliganj and Gazipur Sadar Upazila and on the west by Kaliakair upazila.

E. Kapasia

The upazila occupies an area of 356.98 sq. km. including 10.69 sq. km. river and 17.40 sq. km. forest area. It is located between 24°02' and 24°16' north latitudes and between 90°30' and 90°42' east longitudes. It is bounded on the north by Goffargaon upazila of Mymensingh zila and Pakuakandi upazil of Kishorgonj zila, on the east by Monpohardi upazila of Narsingdi zila, on the south by Kaliganj upazila and on the west by Sreepur upazila.

This zones are selected to divide our whole study into five steps. Wastes are collected from household and dumping sites of each zones.

3.3 Questionnaire Survey

This survey was compiled on 20 houses (randomly selected) from each zone through formal and non-formal interviews of the persons who play effective roles in decision making of the families. Both open ended and closed ended questions were there. This families are asked to provide wastes they generate over one day and information that classify majorly as followings:

i. Number of family member for calculating generation rate

ii. Earnable members with income range

iii. Waste disposing system available at present and costing

iv. Preferable waste disposing system

v. Waste sorting or recyclable system available at present

3.4 Data Collection

To carry out the study, both primary and secondary data sources were used. Primary data were collected through practical observation and field based data collection of generation, collection, transportation of solid waste. Data is collected through questionnaire survey through interviews city dwellers Secondary data was collected from published and non-published sources. Secondary data were collected from GCC (Gazipur City Corporation), Rajuk (Rajhdhani Unnayan Kartipokkha, Dhaka) and BBS (Bangladesh bureau of Statistics, Agargaon, dhaka)

This data are used for evaluation of generation behaviour, future projection with the increasing of population in order to develop a future healthy waste management system for Gazipur city.

3.5 Waste Sampling

Sampling is one of the most important parts of our study. The accuracy of results mostly depends on it.

Collection of wastes is the first task to do. Wastes have been taken from houses, secondary dumping site from each zone and from the final dumping site where all of the city wastes are disposed. Wastes are collected in polythene bag.

Polythene bags are given to the families. After 24 hours bags are collected back from them with full of household wastes generated by the family members over 1 day. Wastes from dumping sites are also collected in separate polythene bags.

After that samples are brought to our experiment site. Initial weights of the bags are measured. The next task is **Drying** the sample waste. Wastes are kept open to sunlight for 24 hours. After

drying the weights are measured again and from the differences of weights moisture content of the sample waste is calculated.

After that **Sorting** the samples by different components is done. It is easier to sort the dry components than wet. Wastes are classified in components as following

Food & veg. waste, paper & paper products, plastic, rubber, leather, wood, glass/ceramic, metal/tin, bricks-concrete (demolition), garden trimming and hazardous waste like battery, aerosol bottoles, hospital residues (if any).

After sorting **Weight** of each components are measured and charts of different comparisons are prepared.

3.6 Analysis

After getting desired measurements analysis is done.

Formulas that are used:

- Generation rate = (Weight of waste) / (Person/day) ; Kg per capita per day
- Moisture Content = (Initial or Wet weight - Dry weight) / (Initial or Wet weight)
- Volume= Mass or Weight / Typical Density

Typical density of different components are adapted from *Tchobanoglous et al.*

Figure 3.2 shows the working procedures of our study.

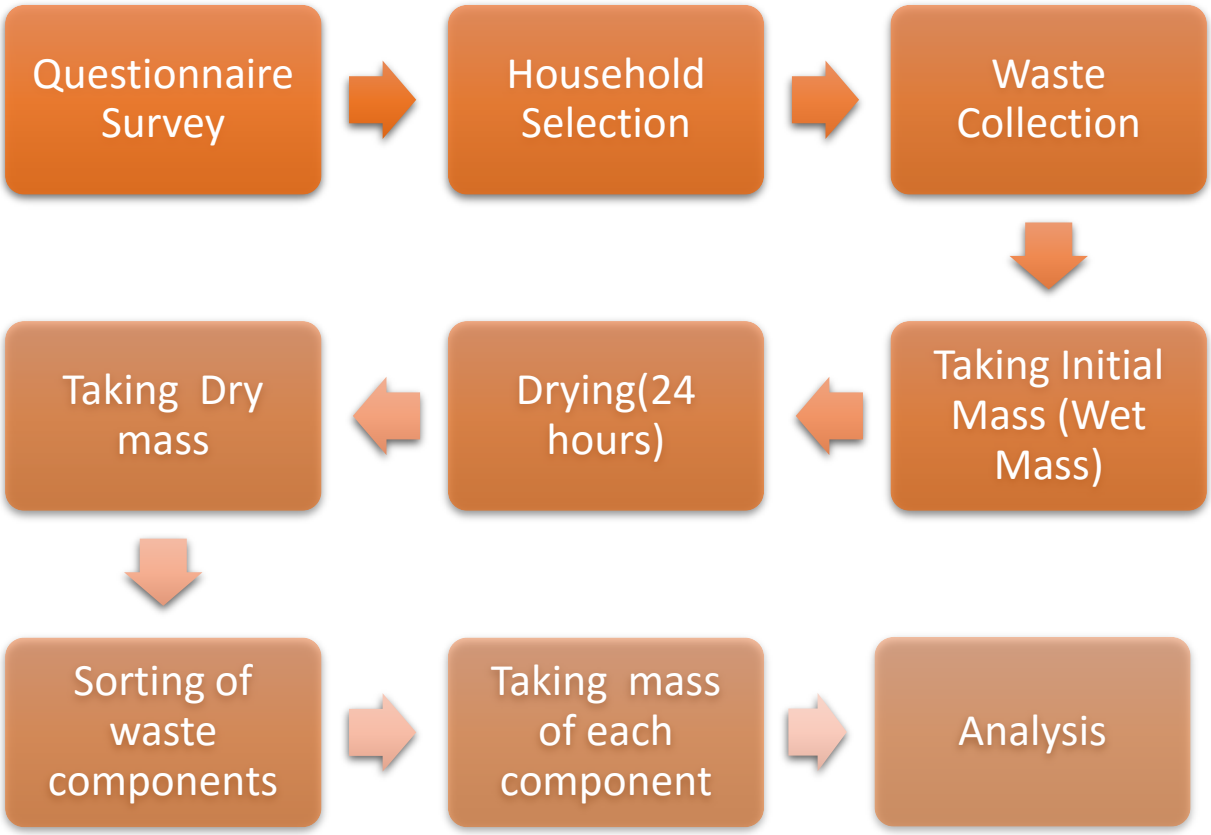

Figure 3.2 Flow chart of working procedures

CHAPTER FOUR

RESULTS AND DATA ANALYSIS

4.1 Zone wise data representation

4.2 Board Bazar zone (Dry Season)

Table 4.1 shows the waste composition data of Boardbazar zone of dry season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages.

Table 4.1 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	9.1	58.2	20	72.1
Paper &Paper Products	2.89	18.47	0.9	3.25
Plastic/Polythene	1.7	10.87	2.8	10.1
Garden & Trimming	0.2	1.3	0.3	1.1
Textiles/Clothes/Rags				
Rubber	0.1	0.64	0.8	2.88
Leather	0.3	1.92	0.4	1.44
Wood	0.1	0.64	0.5	1.8
Rope/Straw/Coconut				
Animal Bones				
Others				
Total Organic Wastes=	14.39		25.7	
In-Organic Waste				
Bricks/Concrete/Demolition	0.2	1.3	0.2	0.72
Glass/Bottles	0.4	2.56	0.7	2.5
Metal/Tin Can	0.3	1.92	0.1	0.36
Dust/Ashes				
Ceramic/Crockery	0.2	1.5	0.2	0.72
Others	0.15	0.96	0.1	0.36
Total In-Organic Wastes=	1.25		1.3	
Hazardous Waste				
Battery			0.3	1.08
Aerosol Bottles			0.33	1.19
Others			0.1	0.36
Total Hazardous=			0.73	
Total Wastes=	**15.64**	**100**	**27.73**	**100**

Figure 4.1 shows that weight of food and vegetable waste is major in percentage (58.2) in household. Paper and plastic posse next highest percentage, 18.47 and 10.87 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient. Food and vegetable mainly organic wastes are the major component at every stage

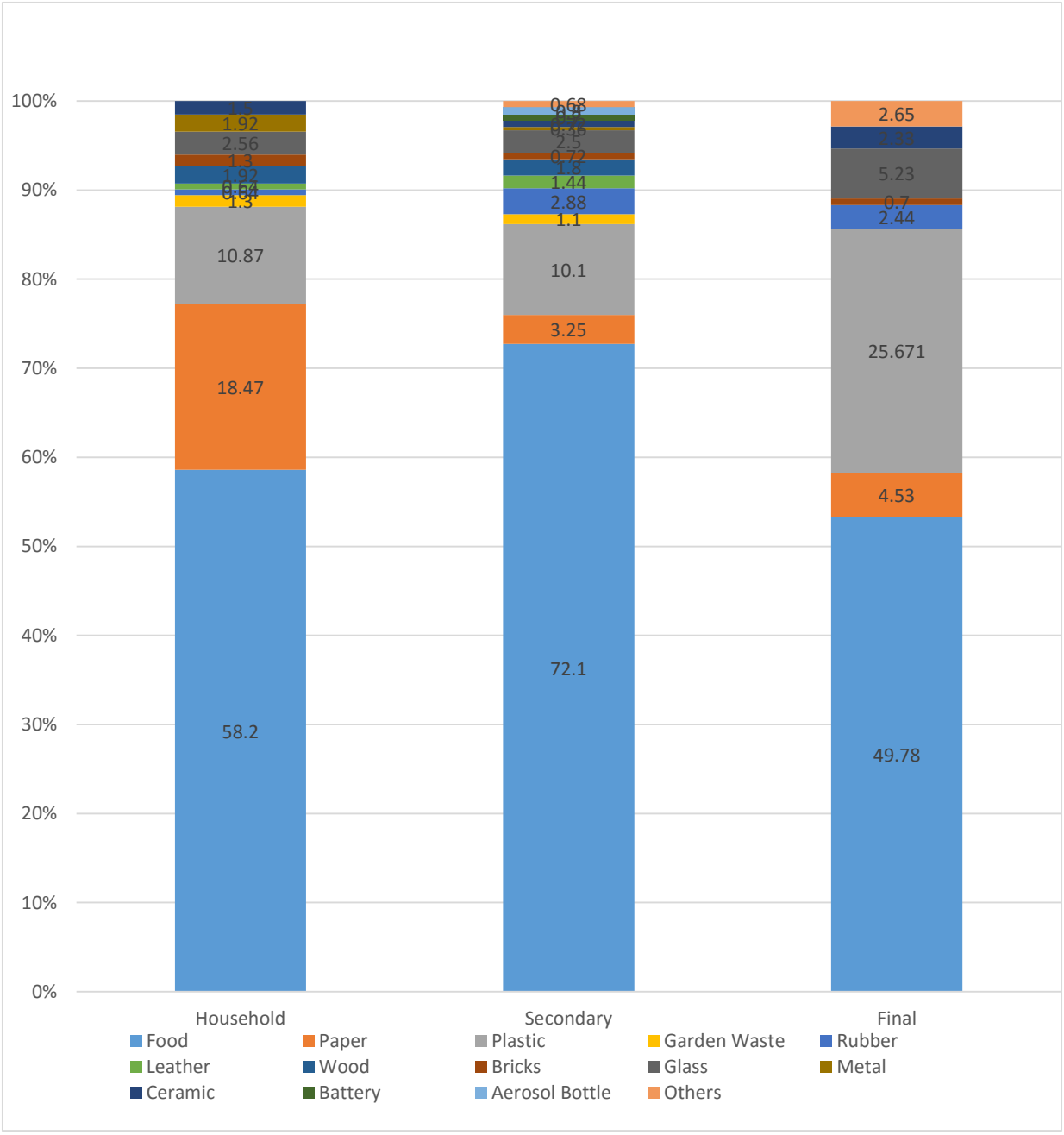

Figure: 4.1 Compositions of waste at different stages

4.2.1 Moisture content and generation rate

4.2.1.1 Household Waste:

Total no of family=15

Total no of respondent=71

Total waste collected initial=22.5kg

Weight after drying= 15.64kg (Drying time 24 hours)

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(22.5-15.64)/22.5}*100

=30.5 %

Waste Generation Rate= (wet weight or initial weight)/(person/day)

= 22.5/71 kg per capita per day

= 0.316kg per capita per da

4.2.1.2 Secondary Dumping Site:

Total waste collected initial=31kg

Weight after drying=27.73kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(31-27.73)/31}*100

=10.5%

4.2.2 Amount of non-recyclable waste

Figure 4.2 shows the Comparison between recyclable and non-recyclable wastes. It also shows that at household around 40% wastes are found recyclable that slightly reduced to 24% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 47% of total that leads to opportunity at recycling and possibilities of mass reduction in transporting if separation is done.

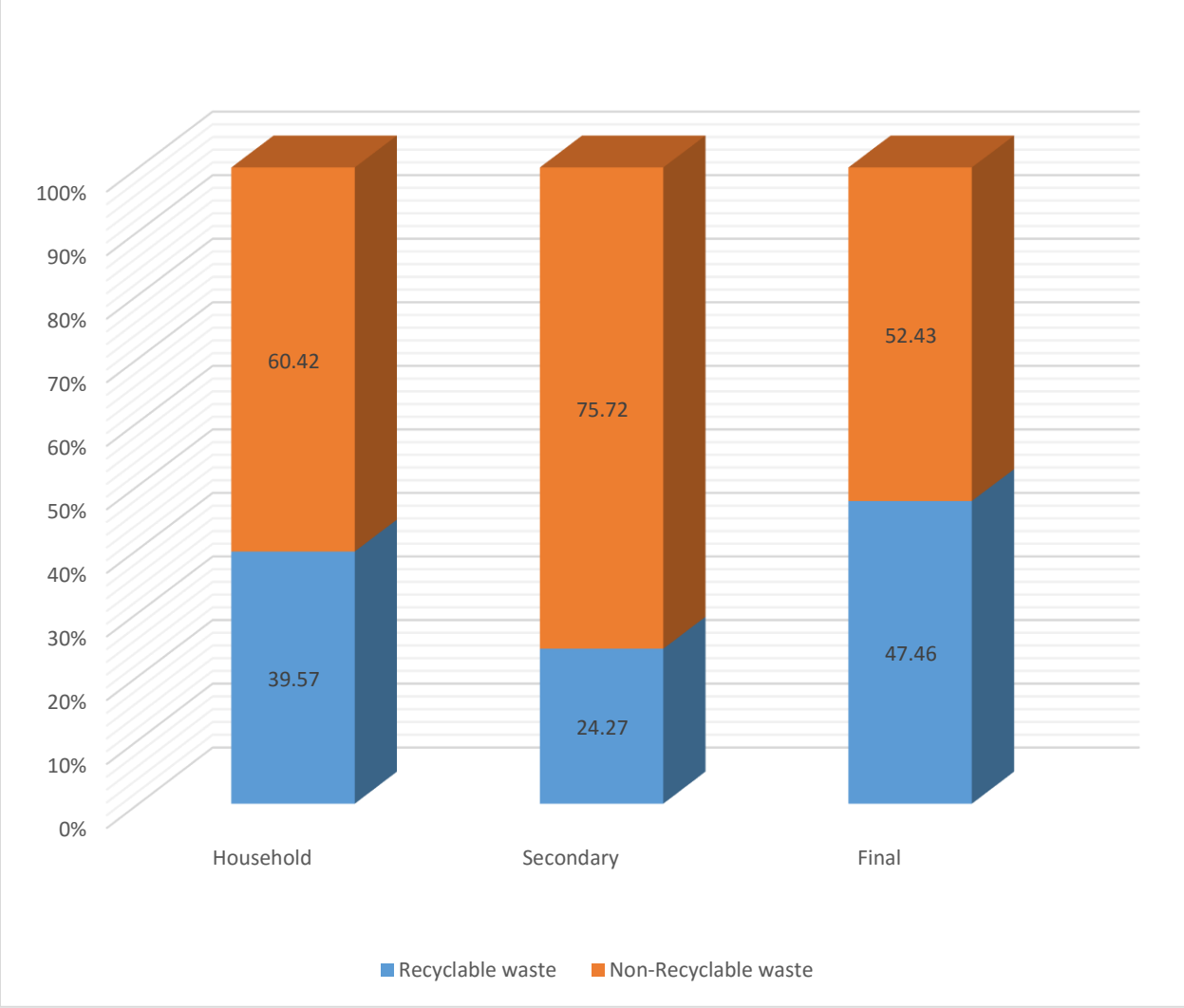

Figure: 4.2 Recyclable vs. Non-recyclable

4.3 Board Bazar zone (Wet Season)

Table 4.2 shows the waste composition data of Boardbazar zone of wet season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages .

Table 4.2 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	17.1	63.2	15.47	75.1
Paper &Paper Products	4.45	16.5	0.6	2.9
Plastic/Polythene	2.7	10.0	1.7	8.2
Garden & Trimming	0.57	2.1	0.66	3.2
Rubber	0.086	0.32	0.3	1.6
Leather	0.24	0.90	0.27	1.3
Wood	0.11	0.40	0.43	2.1
Total Organic Wastes=	**25.2**		**19.43**	
In-Organic Waste				
Bricks/Concrete/Demolition	0.243	0.9	0.12	0.6
Glass/Bottles	0.57	2.1	0.4	1.9
Metal/Tin Can	0.52	1.9	0.16	0.8
Ceramic/Crockery	0.35	1.3	0.04	0.18
Total In-Organic Wastes=	**1.68**		**0.72**	
Hazardous Waste				
Battery		0.1	0.15	0.7
Aerosol Bottles		0.2	0.17	0.8
Others		0.08	0.14	0.68
Total Hazardous=	**0.22**		**0.46**	
Total Wastes=	**27.1**	**100**	**20.6**	**100**

Figure 4.3 shows that weight of food and vegetable waste is major in percentage (63.2) in household. Paper and plastic posse next highest percentage, 16.5 and 10 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

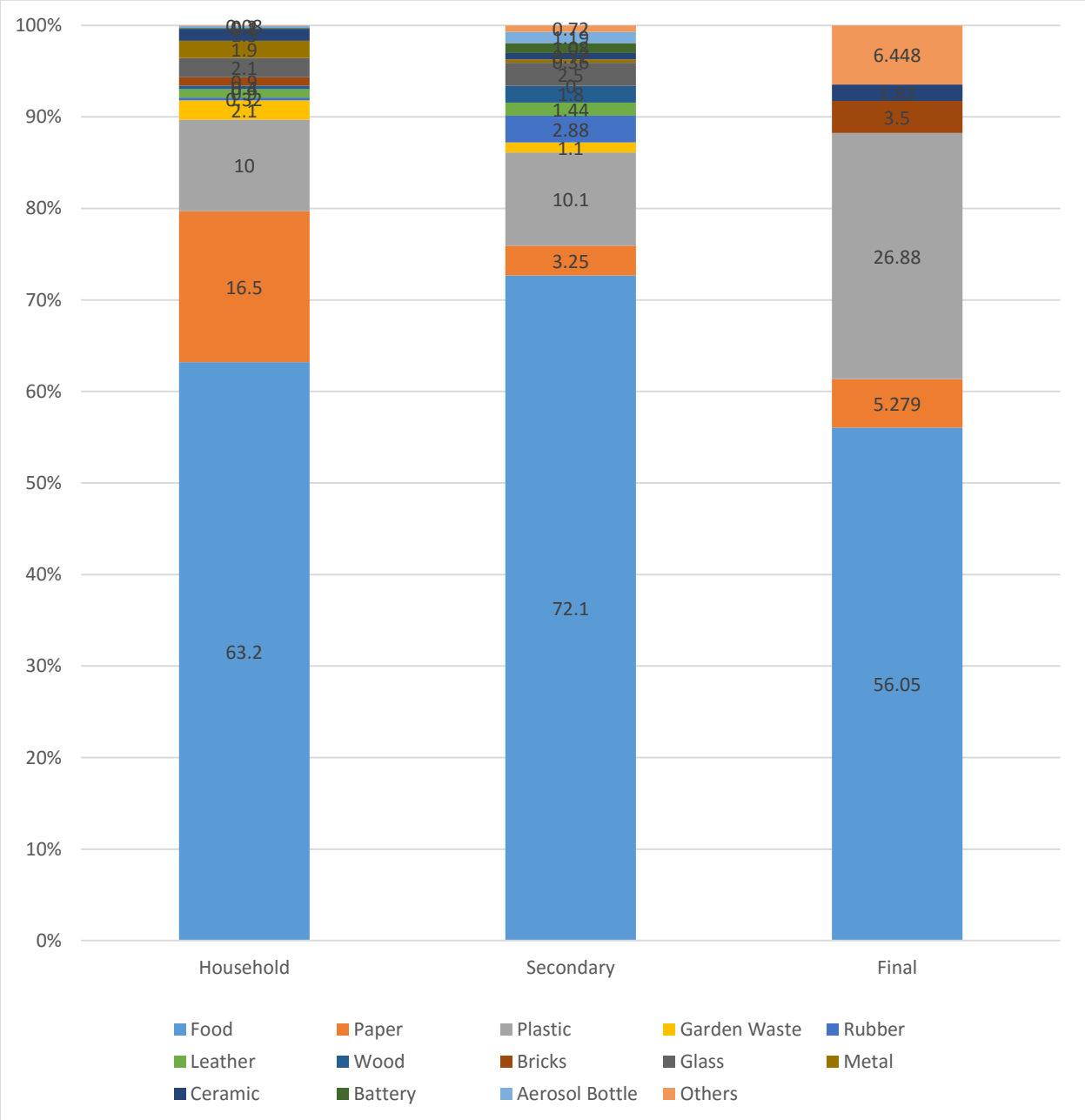

Figure: 4.3 Compositions of waste at different stages

4.3.1. Moisture content and generation rate

4.3.1.1 Household Waste:

Total waste collected initial=37.5 kg

Weight after drying=27.1 kg

- **Moisture content**={(Wet weight-dry weight)/wet weight}*100

  = {(43.5-27.1)/43.5

  = **37.7%** (at February it was **30.56%**)

- **Waste Generation Rate**=(wet weight or initial weight)/(person/day)

  = 37.5/ (88/1)

  =**0.426** kg per capita per day (at February it was **0.316** kg per capita per day)

4.3.1.2 Secondary Dumping Site:

Total waste collected initial=25kg

Weight after drying=21.87kg

- Moisture content ={(Wet weight-dry weight)/wet weight}*100

  = {(23.8-20.6)/23.8}*100

  =**13.45%** (at February it was **10.52 %**)

4.3.2 Amount of non-recyclable waste

Figure 4.4 shows the Comparison between recyclable and non-recyclable wastes. It also shows that at household around 36% wastes are found recyclable that slightly reduced to 27% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 37% of total that is lesser that Boardbazar zone.

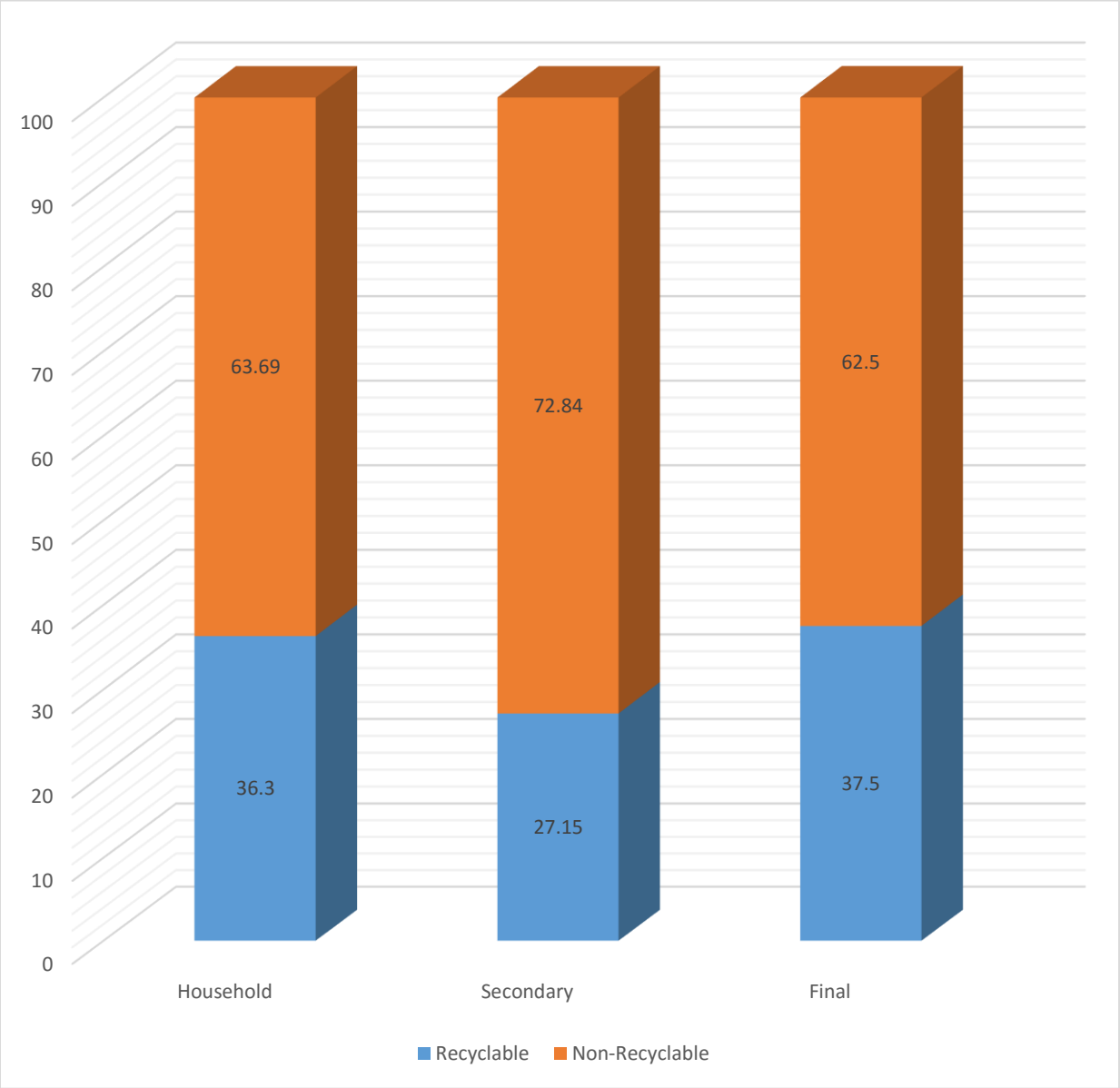

Figure 4.4 Recyclable vs. Non-recyclable

4.4 Sreepur zone (Dry season)

Table 4.3 shows the waste composition data of Sreepur zone of dry season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages .

Table 4.3 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	9.71	61.65	9.30	69.82
Paper &Paper Products	3.2	20.32	0.41	3.1
Plastic/Polythene	1.1	6.98	1.1	8.3
Garden & Trimming	0.4	2.54	0.9	
Textiles/Clothes/Rags				
Rubber	0.3	1.91	0.2	1.5
Leather	0.2	1.27	0.4	3
Wood	0.1	0.64	0.2	1.5
Rope/Straw/Coconut				
Animal Bones				
Others				
Total Organic Wastes=	15.01		11.41	
In-Organic Waste				
Bricks/Concrete/Demolition	0.1	0.63	0.4	3
Glass/Bottles	0.165	1.05	0.3	2.25
Metal/Tin Can	0.21	1.33	0.2	1.5
Dust/Ashes				
Ceramic/Crockery	0.165	1.05	0.21	1.58
Others	0.1	0.63		
Total In-Organic Wastes=	0.74		1.31	
Hazardous Waste				
Battery			0.2	1.5
Aerosol Bottles			0.3	2.25
Others			0.1	0.75
Total Hazardous=			0.6	
Total Wastes=	**15.75**	**100**	**13.32**	**100**

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Figure 4.5 shows that Weight of food and vegetable waste is major in percentage (58.2) in household. Paper and plastic posse next highest percentage, 18.47 and 10.87 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

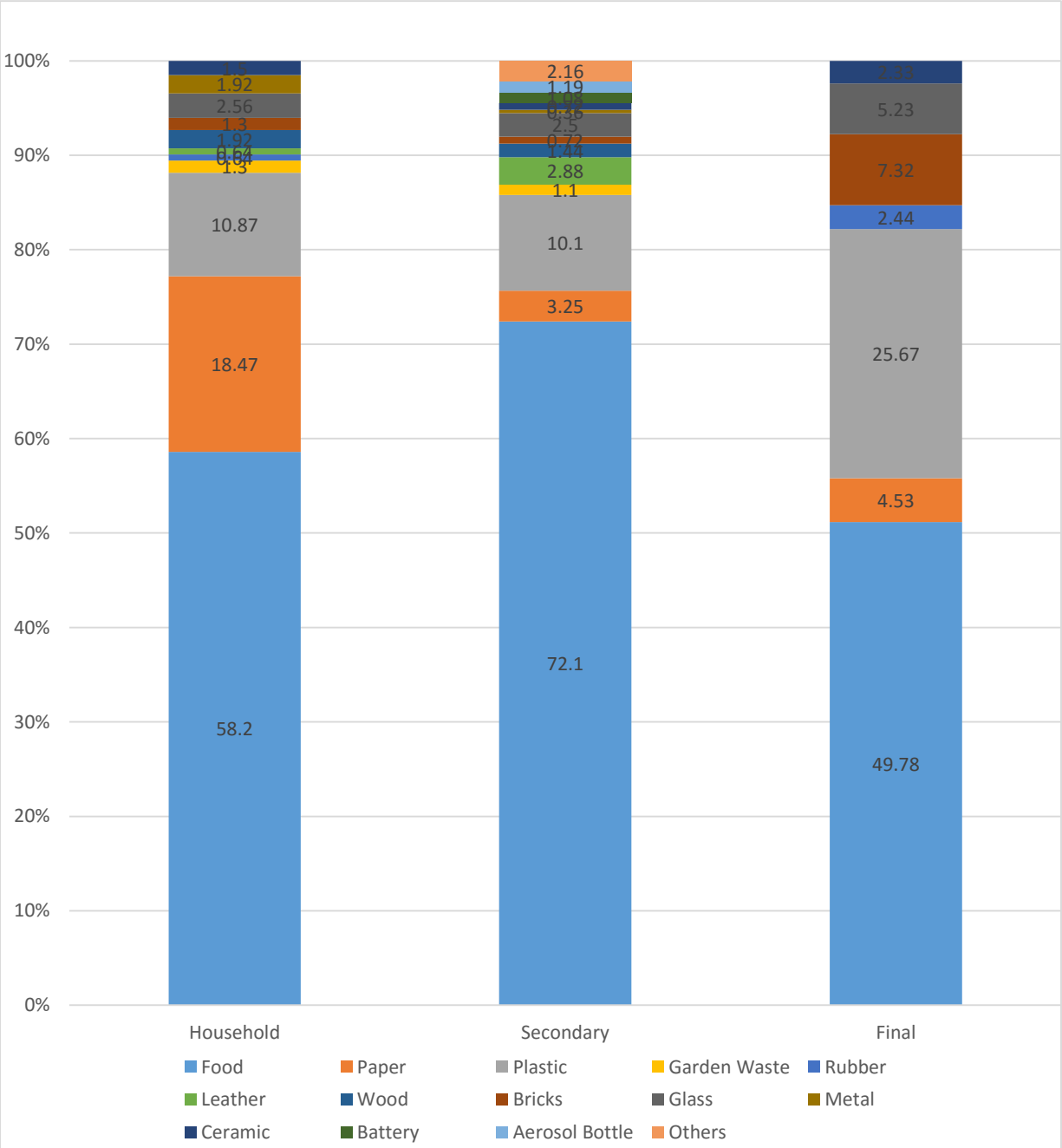

Figure: 4.5 Composition of waste at different stages

4.4.1. Moisture content and generation rate

4.4.1.1 Household Waste:

Total waste collected initial=22kg

Weight after drying= 15.75kg (Drying time 24 hours)

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(22-15.75)/22}*100

= 28.4%

Waste Generation Rate = (wet weight or initial weight)/ (person/day)

= 22 /76 kg per capita per day

= 0.289kg per capita per day

4.4.1.2 Secondary Dumping Site:

Total waste collected initial=14kg

Weight after drying =13.32kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(14-13.32)/ 14}*100

= 4.857%

4.4.2 Amount of recyclable waste

Figure 4.6 shows the Comparison between recyclable and non-recyclable wastes. It also shows that at household around 36% wastes are found recyclable that slightly reduced to 30% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 47% of total that is huge to get recyclable potential.

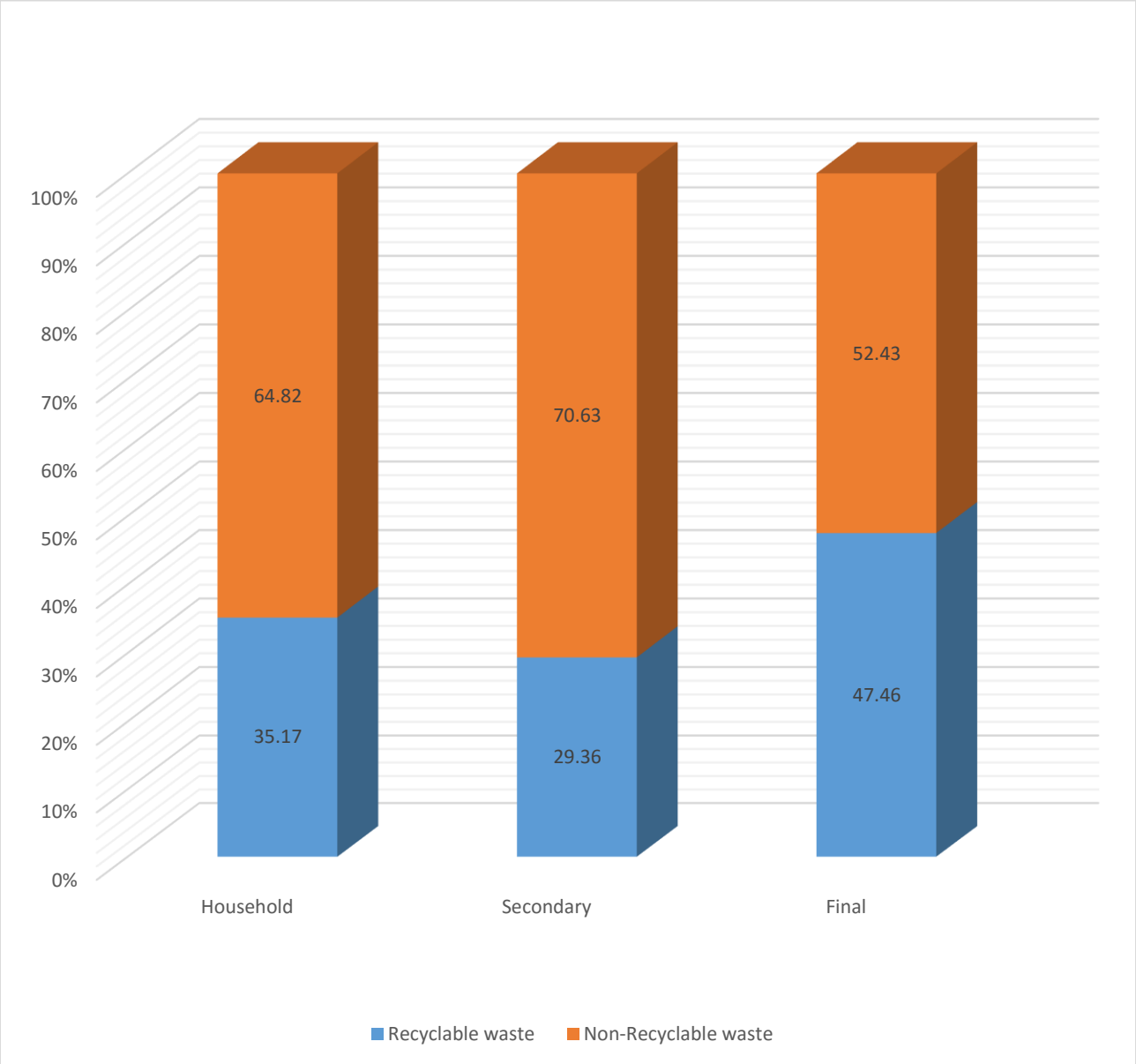

Figure: 4.6 Recyclable vs. Non-recyclable

4.5 Sreepur zone (Wet season)

Table 4.4 shows the waste composition data of Boardbazar zone of wet season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages

Table 4.4 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	11.8	63.1	10.36	71.7
Paper &Paper Products	2.56	13.7	0.36	2.5
Plastic/Polythene	1.33	7.1	1.1	7.6
Garden & Trimming	0.65	3.5	0.64	4.4
Rubber	0.04	0.2	0.35	2.4
Leather	0.12	0.62	0.23	1.6
Wood			0.16	1.1
Total Organic Wastes=	**16.5**		**13.2**	
In-Organic Waste				
Bricks/Concrete/Demolition	0.06	0.3	0.3	2.1
Glass/Bottles	0.32	1.72	0.12	0.8
Metal/Tin Can	0.23	1.21	0.08	0.6
Ceramic/Crockery	0.18	0.97	0.12	0.8
Total In-Organic Wastes=	**0.79**		**0.62**	
Hazardous Waste				
Battery	0.21	1.1	0.04	0.28
Aerosol Bottles	0.54	2.9	0.1	0.68
Others	0.65	3.5	0.08	0.6
Total Hazardous=	**1.4**		**0.22**	
Total Wastes=	**18.7**	**100**	**14.1**	**100**

Figure 4.7 shows that weight of food and vegetable waste is major in percentage (63.1) in household. Paper and plastic posse next highest percentage, 13.70 and 7.1 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

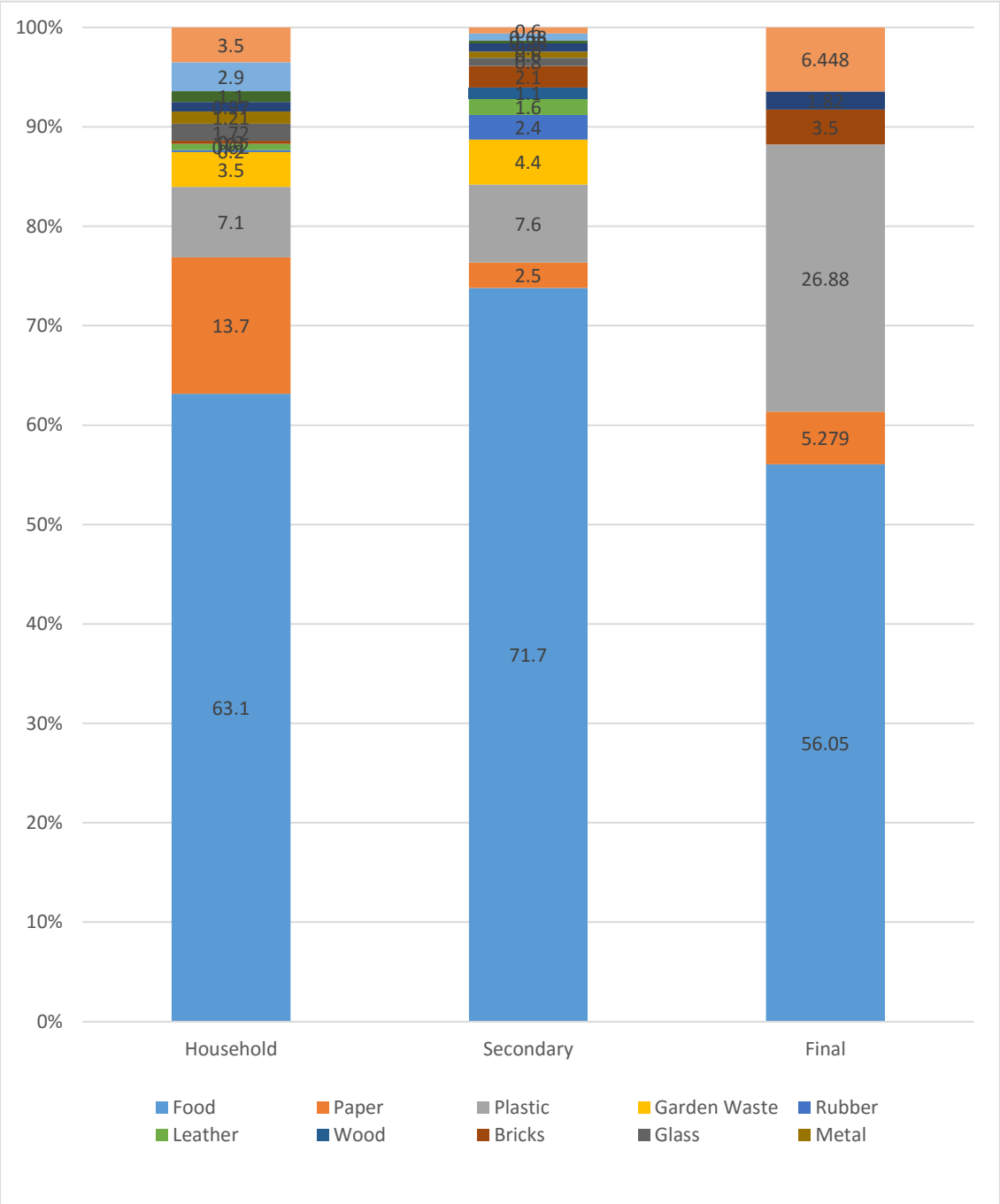

Figure 4.7 Compositions of waste at different stage

4.5.1 Moisture content and generation rate

4.5.1.1 Household Waste:

Total waste collected initial=26.4 kg

Weight after drying=18.7 kg

- **Moisture content**={(Wet weight-dry weight)/wet weight}*100

  = {(26.4 – 18.7)/26.4

  = **29.17 %** (at February it was **28.4%)**

- **Waste Generation Rate** =(wet weight or initial weight)/(person/day)

  = 26.4/ (70/1)

  =**0.377** kg per capita per day (at February it was **0.289** kg per capita per day)

4.5.1.2 Secondary Dumping Site:

Total waste collected initial=16.8kg

Weight after drying=14.1 kg

- Moisture content ={(Wet weight-dry weight)/wet weight}*100

  = {(16.8-14.1)/16.8}*100

  =**16.1%** (at February it was 4.857 **%**)

Generation rate is nearly same as previous zone but moisture content shows the effect of wet season.

4.5.2 Amount of recyclable waste

Figure 4.8 shows the Comparison between recyclable and non-recyclable wastes. It also shows that at household around 34% wastes are found recyclable that slightly reduced to 21% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 35% of total. The variation at Sreepur zone is nearly same as data of previous zones.

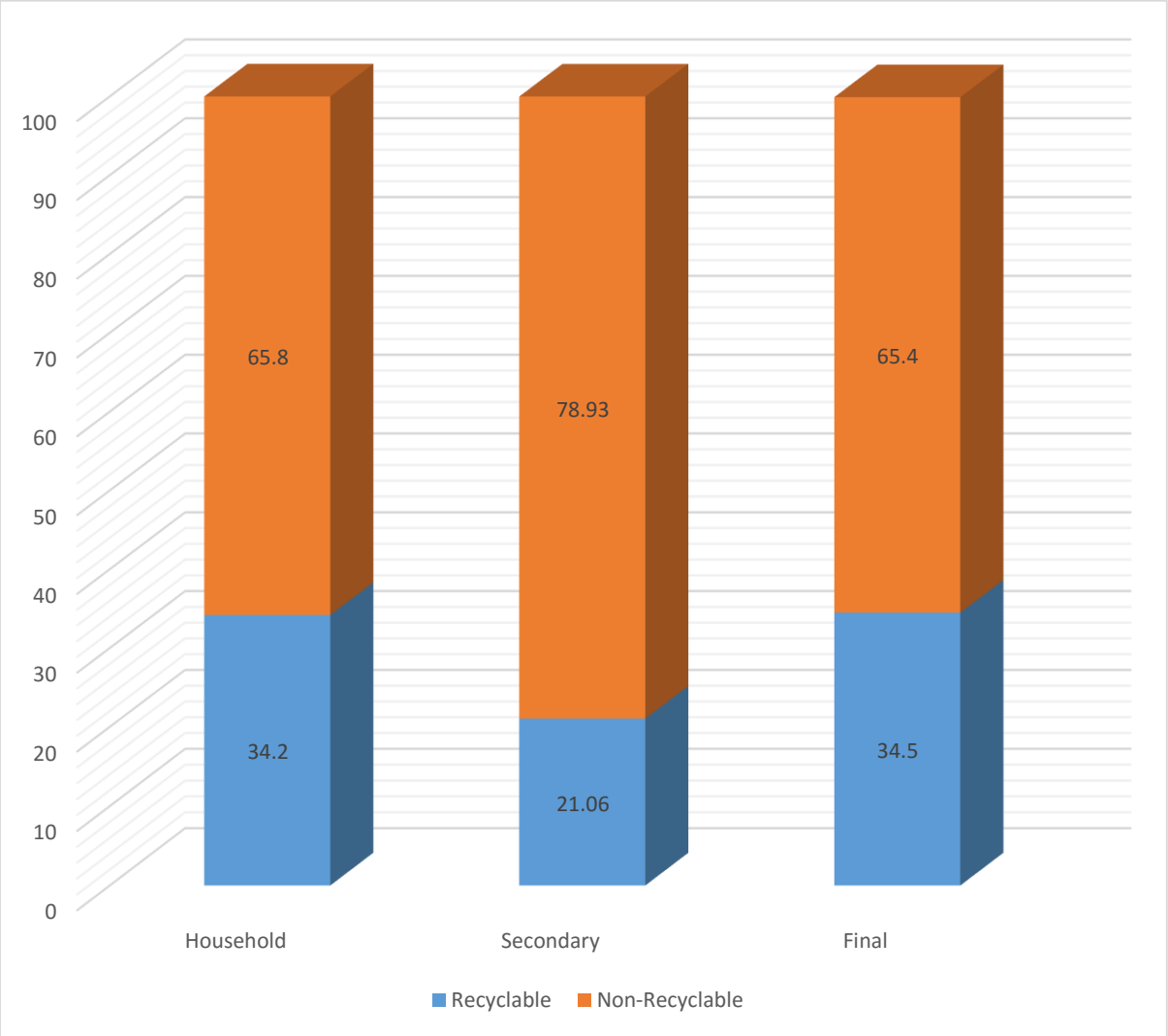

Figure: 4.8 Recyclable vs. Non-recyclable

4.6 Kaliakoir zone (Dry season)

Table 4.5 shows the waste composition data of Kalakair zone of dry season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages .

Table 4.5 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	10.3	67.70	13.31	60.86
Paper &Paper Products	3.04	20.00	0.55	2.51
Plastic/Polythene	1.43	9.4	1.13	5.17
Garden & Trimming	0.3	2.0	0.6	2.74
Textiles/Clothes/Rags			0.9	4.12
Rubber				
Leather			0.4	1.83
Wood			1.0	4.57
Rope/Straw/Coconut				
Animal Bones				
Others			0.2	0.91
Total Organic Wastes=	**15.07**		**18.09**	**82.72**
In-Organic Waste				
Bricks/Concrete/Demolition			0.3	1.37
Glass/Bottles	0.13	0.9	0.3	1.37
Metal/Tin Can			0.2	0.91
Dust/Ashes			0.40	1.83
Ceramic/Crockery			0.28	1.28
Others			0.40	1.83
Total In-Organic Wastes=	**0.13**		**1.48**	**6.77**
Hazardous Waste				
Battery			0.6	2.70
Aerosol Bottles			1.3	5.90
Others			0.4	1.83
Total Hazardous=			2.30	10.5
Total Wastes=	**15.20**	**99.97**	**21.87**	**99.99**

Figure 4.9 shows that weight of food and vegetable waste is major in percentage (67%) in household. Paper and plastic posse next highest percentage, 20 and 9.4 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are available at all.

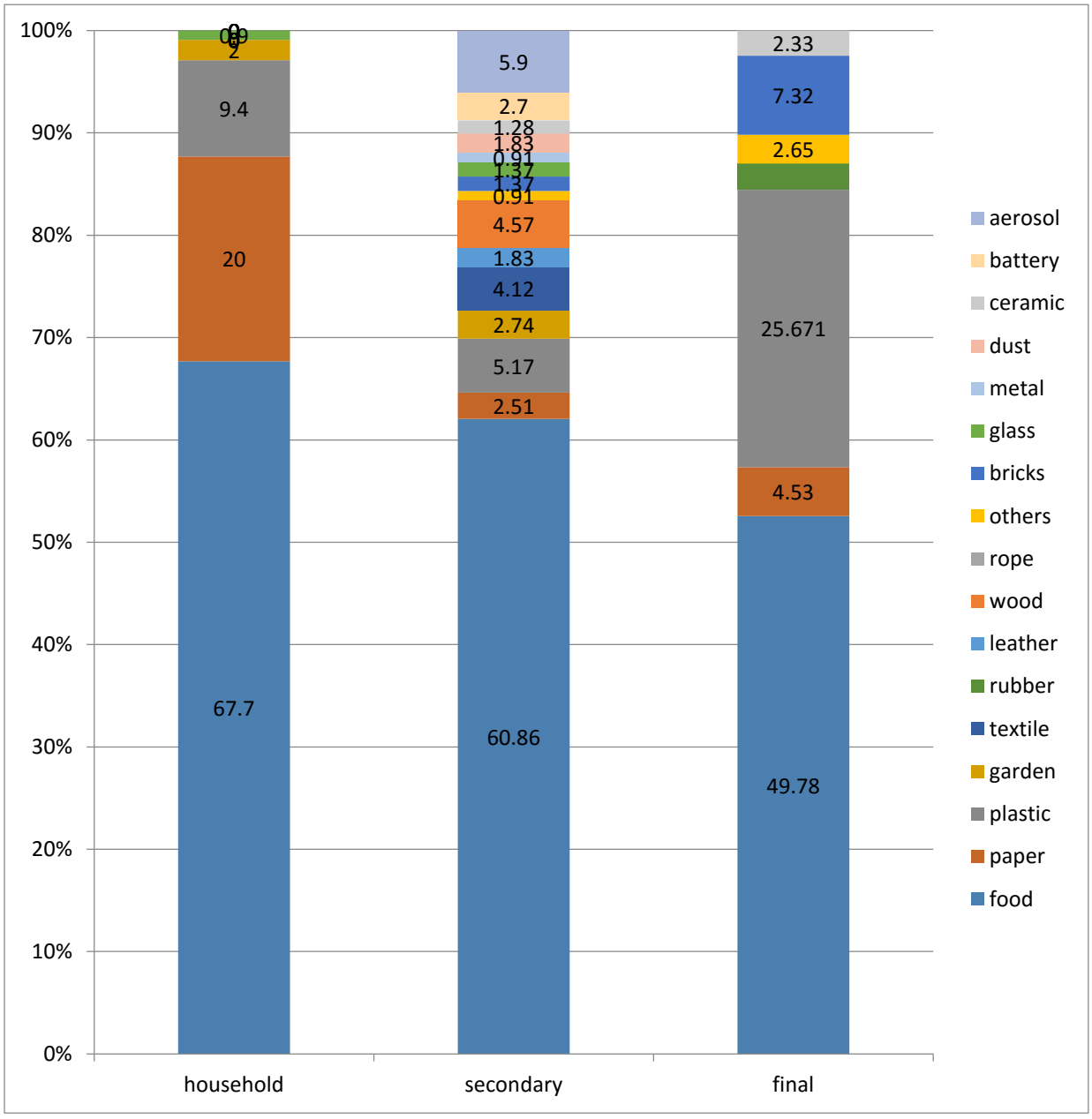

Figure: 4.9 Compositions of waste at different stages

4.6.1 Moisture content and generation rate

4.6.1.1 Household Waste:

Total waste collected initial=23.80kg

Weight after drying= 15.20kg (Drying time 24 hours)

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(23.80-15.20)/23.8}*100

=36.10%

Total no of family=17

Total no of respondent=77

Waste Generation Rate= (wet weight or initial weight)/ (person/day)

= 23.8/ (77/1)

=0.31kg per capita per day

4.6.1.2 Secondary Dumping Site:

Total waste collected initial=25kg

Weight after drying=21.87kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(25-21.87)/25}*100

=12.52%

4.6.2 Amount of recyclable waste

Figure 4.10 shows the comparison between recyclable and non-recyclable wastes. It also shows that at household around 30% wastes are found recyclable. At secondary site the amount slightly increased to 36% and this may be because of no or lesser recycling activities are done at kaliakoir zone. At final site amount of recyclable wastes are increased to 47% of total as expected.

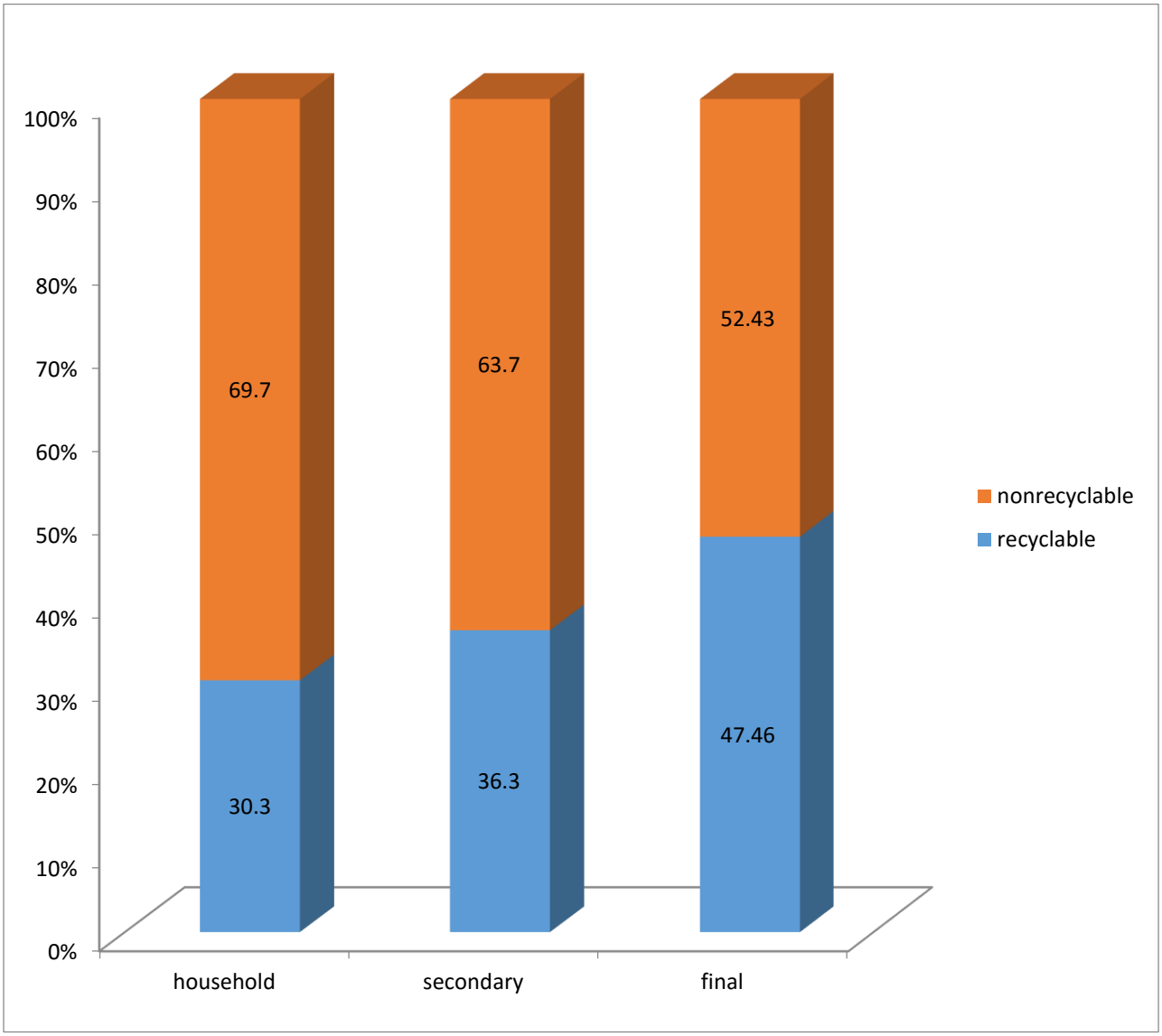

Figure: 4.10 Recyclable vs. Non-recyclable

4.7 Kaliakoir zone (Wet Season)

Table 4.6 shows the waste composition data of Kaliakair zone of wet season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages

Table 4.6 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	15.1	64.61	10.2	61.41
Paper &Paper Products	4.03	17.24	2.04	12.28
Plastic/Polythene	1.0	4.28	1.48	8.90
Garden & Trimming	1.0	4.28	1.08	6.50
Rubber	0.2	0.86	0.09	0.54
Leather	0	0	0.08	0.48
Textile	0.2	0.86	0.12	0.72
Wood	0.78	3.34	0.42	2.53
Others	0.1	0.43	0.07	0.42
Total Organic Wastes=	**22.41**		**15.58**	
In-Organic Waste				
Bricks/Concrete/Demolition	0.1	0.43	0.08	0.48
Glass/Bottles	0.45	1.93	0.28	2.1
Metal/Tin Can	0.20	0.86	0.14	0.84
Ceramic/Crockery	0.13	0.56	0.04	0.24
Others	0.08	0.34	0.30	1.81
Total In-Organic Wastes=	0.96		**0.84**	
Hazardous Waste				
Battery	0	0	0.04	0.24
Aerosol Bottles	0	0	0.10	0.60
Others	0	0	0.05	0.30
Total Hazardous=	**0**		**0.29**	
Total Wastes=	**23.37**	**100**	**16.61**	**99.98**

Figure 4.11 shows that components are found at nearly same composition. But organic wastes are found little higher because of the effect of wet season. And paper products are found to be reused but plastic products are increased at final dumping site.

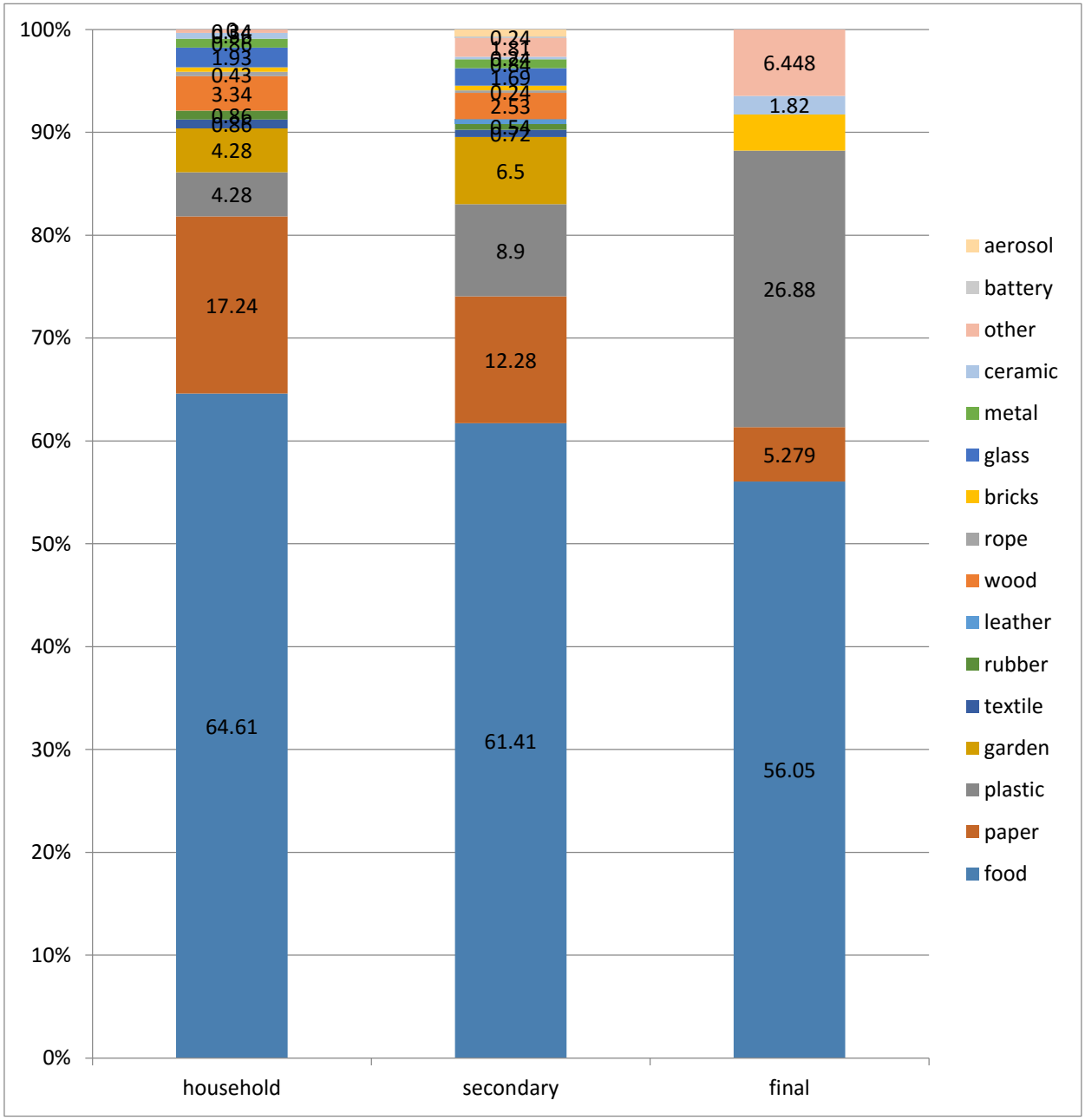

Figure 4.11 Compositions of waste at different stages

4.7.1 Moisture content and generation rate

4.7.1.1Household Waste:

Total no of family=17

Total no of respondent=93

Total waste collected initial=35.2 kg

Weight after drying=23.37 kg

- **Moisture content**={(Wet weight-dry weight)/wet weight}*100

  = {(35.20 – 23.37)/35.2

  = **33.6 %** (In dry season it was **36.10%**)

- **Waste Generation Rate**=(wet weight or initial weight)/(person/day)

  = 33.5/ (93/1)

  =**0.37** kg per capita per day (In dry season it was 0.31 kg per capita per day)

4.7.1.2 Secondary Dumping Site:

Total waste collected initial=20.5kg

Weight after drying=16.61 kg

- Moisture content ={(Wet weight-dry weight)/wet weight}*100

  = {(20.5-16.61)/20.5}*100

  =**18.97%** (at February it was **12.52% %**)

4.7.2 Amount of recyclable waste

Figure 4.12 shows the comparison between recyclable and non-recyclable wastes. It also shows that at household around 30% wastes are found recyclable. At secondary site the amount slightly increased to 36% and this may be because of no or lesser recycling activities are done at kaliakoir zone. At final site amount of recyclable wastes are increased to 37% of total that is good amount to get recyclable resource.

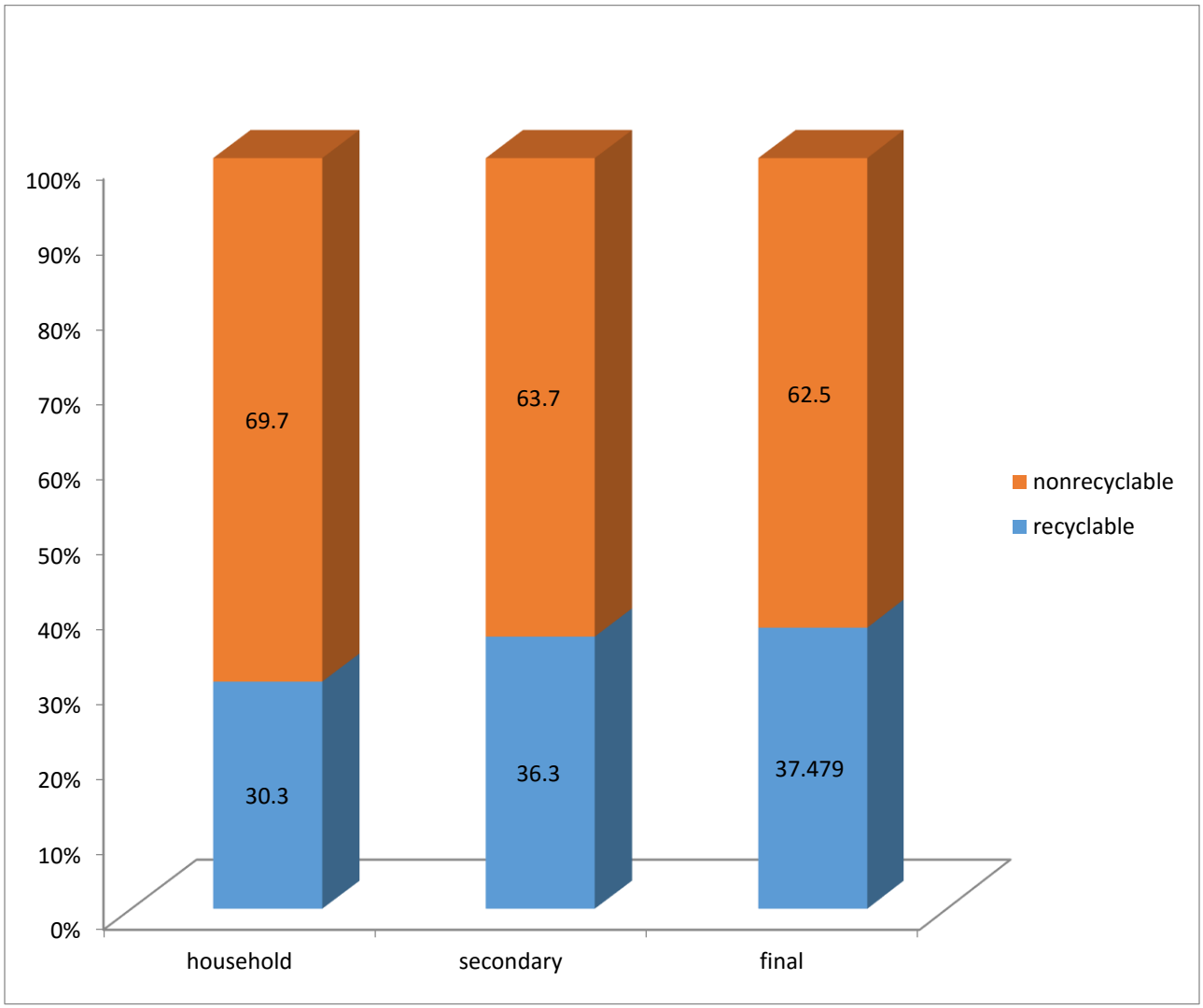

Figure: 4.12 Recyclable vs. Non-recyclable

4.8 Kaliganj zone (Dry Season)

Table 4.7 shows the waste composition data of Kaliganj zone of dry season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages

Table 4.7 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	9.4	63.92	13.7	44.89
Paper &Paper Products	2.96	20.03	0.60	1.96
Plastic/Polythene	1.2	8.12	1.58	5.18
Garden & Trimming	0.3	2.03	0.70	2.30
Textiles/Clothes/Rags	0.5	3.38	2.16	7.07
Rubber			0.58	1.90
Leather			0.21	0.69
Wood			0.46	1.50
Others			1.30	4.25
Total Organic Wastes=	**14.36**	**97.16**	**21.29**	**69.75**
In-Organic Waste				
Bricks/Concrete/Demolition			0.33	1.08
Glass/Bottles	0.13	0.87	1	3.28
Metal/Tin Can	0.19	1.28	0.24	0.79
Dust/Ashes				
Others	0.1	68	1.56	5.11
Total In-Organic Wastes=	**0.42**	**20.03**	**3.13**	**10.25**
Hazardous Waste		8.12		
Battery		2.03		
Aerosol Bottles		3.38	4.3	14.1
Others			1.8	5.90
Total Hazardous=			6.1	20.0
Total Wastes=	**14.78**	**100**	**30.52**	**99.99**

Figure 4.13 shows that weight of food and vegetable waste is major in percentage (58.2) in household. Paper and plastic posse next highest percentage, 18.47 and 10.87 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

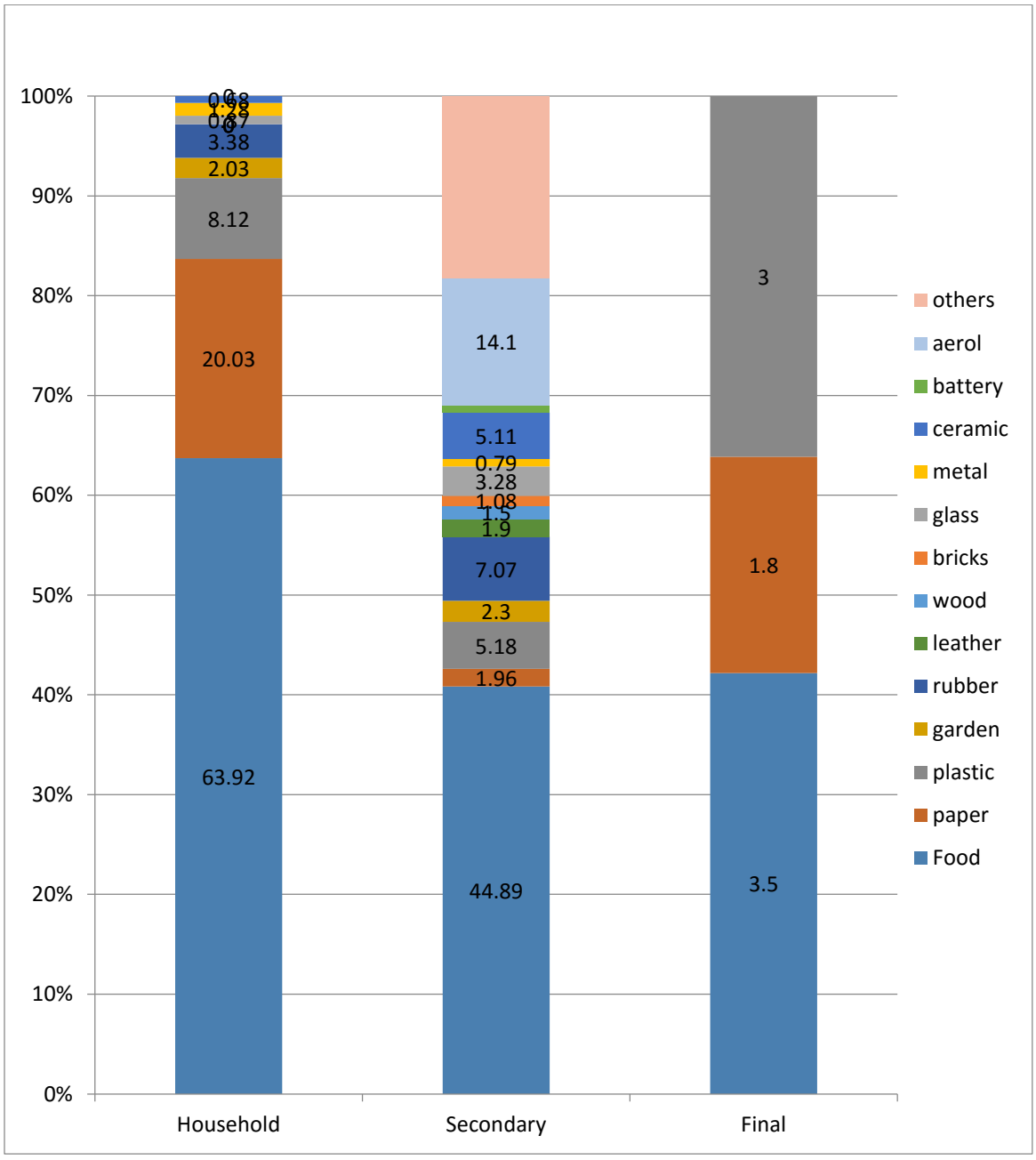

Figure 4.13 Compositions of waste at different stages

4.8.1 Moisture content and generation rate

4.8.1.1 Household Waste:

Total waste collected initial=21kg

Weight after drying = 14.78 kg (Drying time 24 hours)

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(21-14.78)/21}*100

=29.62%

Waste Generation Rate= (wet weight or initial weight)/ (person/day)

= 21/ (79/1)

= 0.27kg per capita per day

4.8.1.2 Secondary Dumping Site:

Total waste collected initial=35.18kg

Weight after drying=30.52kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(35.18-30.52)/35.18}*100

=13.25%

4.8.2 Amount of recyclable waste

Figure 4.14 shows the comparison between recyclable and non-recyclable wastes. It also shows that at household around 36% wastes are found recyclable. At secondary site the amount slightly increased to 42% and this may be because of no or lesser recycling activities are done at kaliganj zone. At final site amount of recyclable wastes are increased to 48% of total that is very large in amount.

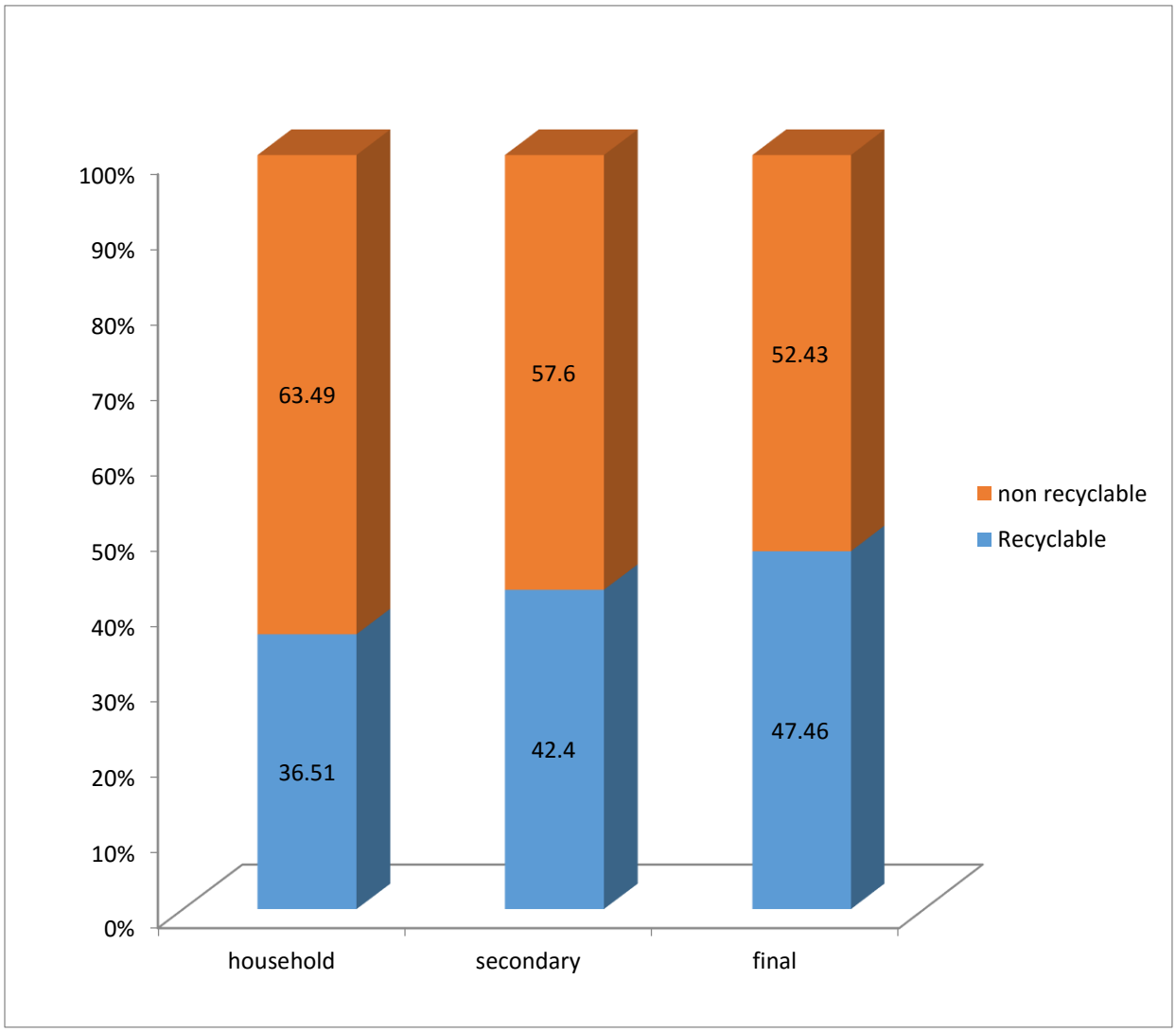

Figure: 4.14 Recyclable vs. Non-recyclable

4.9 Kaliganj zone (Wet Season)

Table 4.8 shows the waste composition data of Kaliganj zone of wet season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages

Table 4.8 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	14.87	64.94	10.1	73.1
Paper &Paper Products	2.924	12.77	0.29	2.1
Plastic/Polythene	1.625	7.095	1.14	8.3
Garden & Trimming	0.67	2.92	0.6	4.3
Rubber			0.24	1.8
Leather	0.19	0.83	0.23	1.7
Wood			0.37	2.7
Total Organic Wastes=	**20.27**		**12.97**	
In-Organic Waste				
Bricks/Concrete/Demolition	0.07	0.292	0.11	0.8
Glass/Bottles	0.153	0.6677	0.3	2.1
Metal/Tin Can	0.11	0.459	0.08	0.59
Ceramic/Crockery			0.04	0.28
Total In-Organic Wastes=	0.333		**0.53**	
Hazardous Waste				
Battery	0.48	2.1	0.08	0.6
Aerosol Bottles	1.3	5.69	0.11	0.8
Others	0.41	1.8	0.1	0.68
Total Hazardous=	**2.19**		**0.29**	
Total Wastes=	**22.8**	**100**	**13.79**	**100**

Figure 4.15 shows that weight of food and vegetable waste is major in percentage (64.94) in household. Paper and plastic posse next highest percentage, 12.77 and 7.095 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

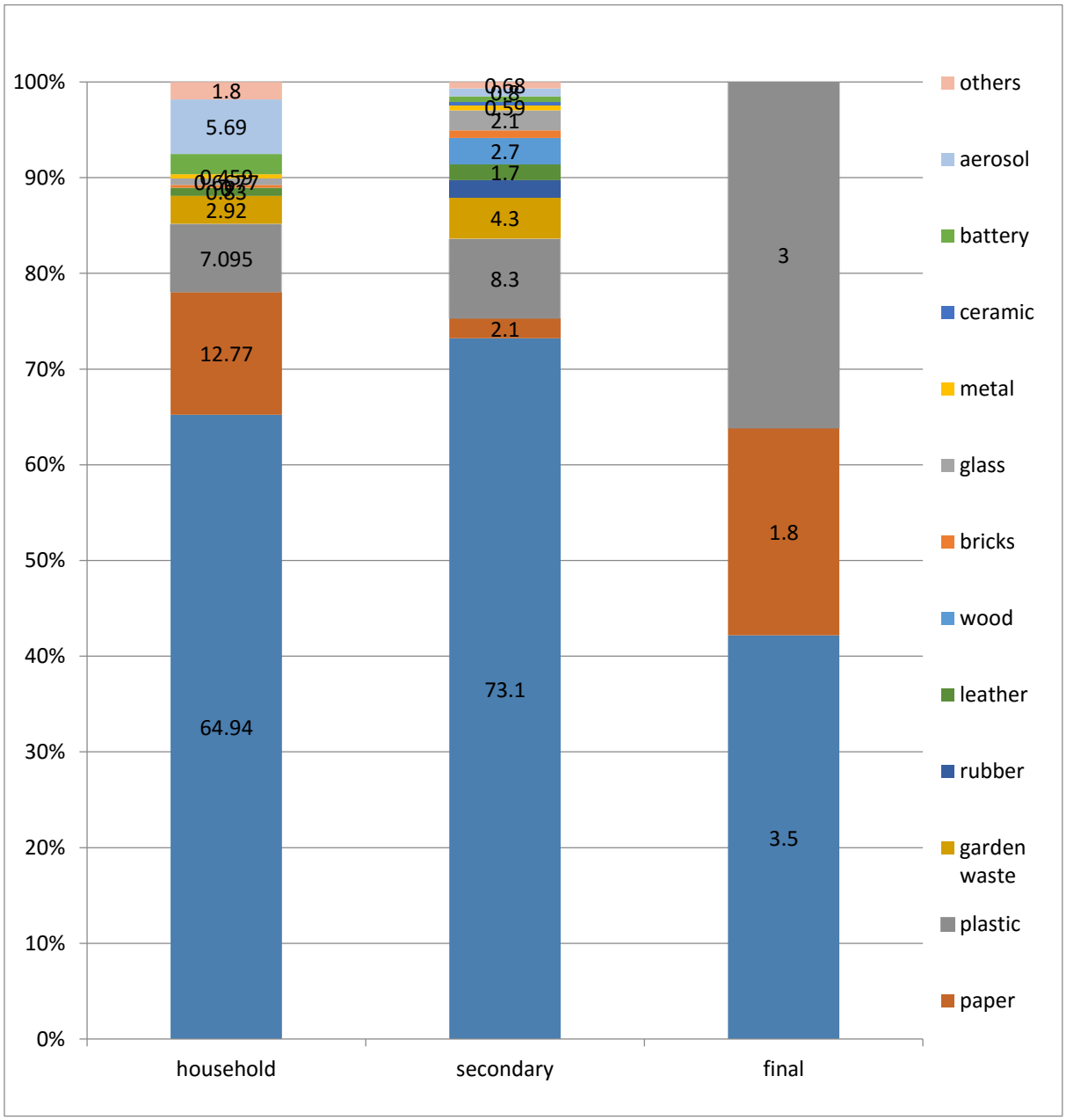

Figure: 4.15 Compositions of waste at different stages

4.9.1 Moisture content and generation rate

4.9.1.1 Household Waste:

Total waste collected initial=33.5 kg

Weight after drying=22.8 kg

Moisture content= {(Wet weight-dry weight)/wet weight}*100

= {(33.5 – 22.8)/33.5

= **31.9 %** (at February it was **29.62%**)

Waste Generation Rate= (wet weight or initial weight)/ (person/day)

= 33.5/ (93/1)

=**0.36** kg per capita per day

(In dry season it was 0.27 kg per capita per day)

4.9.1.2 Secondary Dumping Site:

Total waste collected initial=18kg

Weight after drying=13.79 kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(18-13.79)/18}*100

=**23.38%** (at February it was **13.25% %**)

4.9.2 Amount of non-recyclable waste

Figure 4.16 shows the Comparison between recyclable and non-recyclable wastes It shows that at household around 32% wastes are found recyclable that slightly reduced to 19.14% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 37.479% of total that leads to opportunity at recycling and possibilities of mass reduction in transporting if separation is done

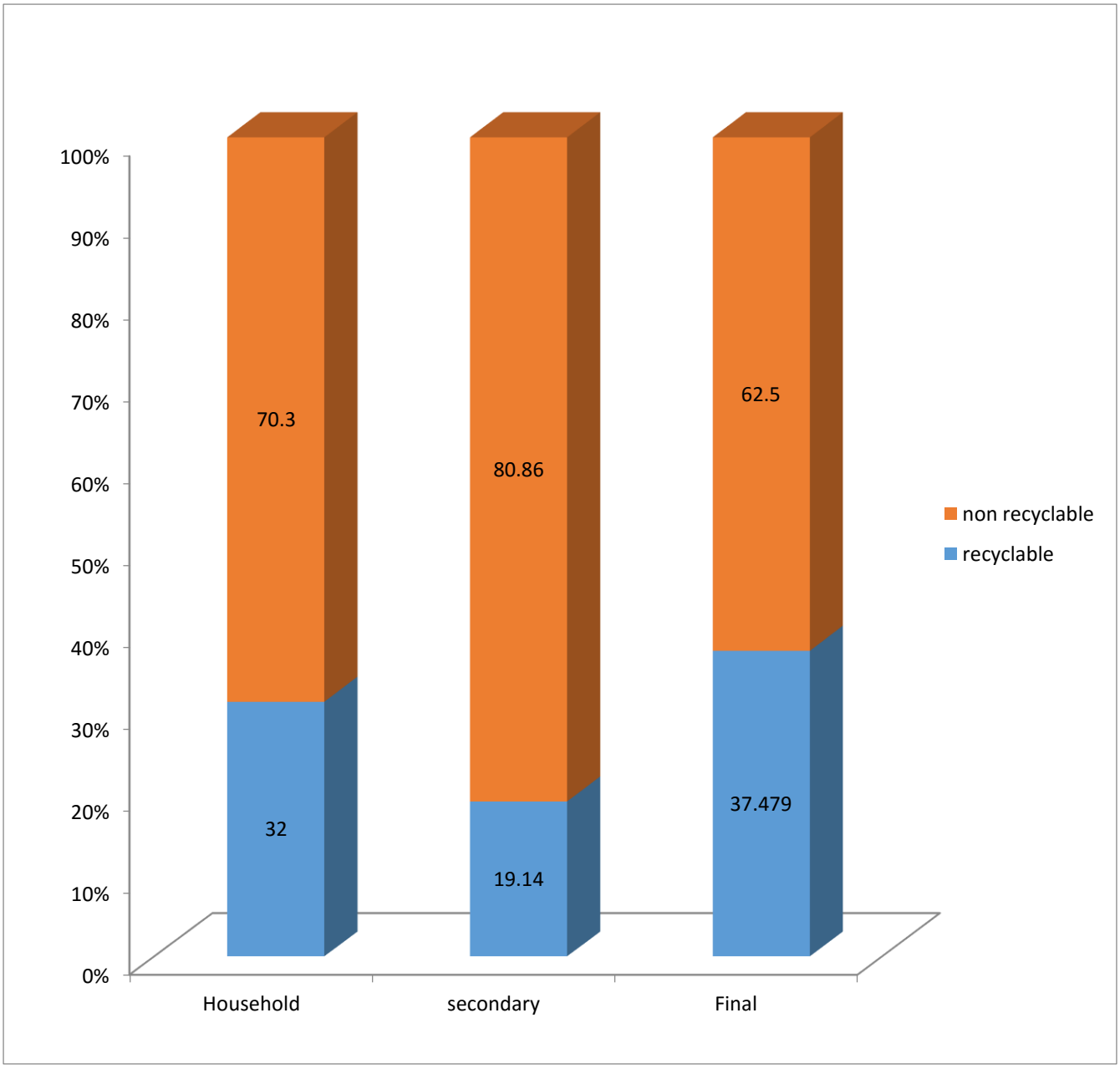

Figure: 4.16 Recyclable vs. Non-recyclable

4.10 Kapasia zone (Dry Season)

Table 4.9 shows the waste composition data of Kapasia zone of dry season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages

Table 4.9 Solid Waste Composition Data

Wastes	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	10.2	50.75	5.6	61.6
Paper &Paper Products	4.1	20.4	0.3	3.3
Plastic/Polythene	2.1	10.45	0.55	6.1
Garden & Trimming	1.1	5.47	0.8	8.8
Textiles/Clothes/Rags				
Rubber	0.4	1.99	0.13	1.43
Leather	0.2	0.99	0.16	1.76
Wood	0.3	1.49	0.14	1.54
Total Organic Wastes=	18.4		7.68	
In-Organic Waste				
Bricks/Concrete/Demolition	0.8	3.98	0.3	3.3
Glass/Bottles	0.3	1.49	0.13	1.43
Metal/Tin Can	0.3	1.49	0.1	1.1
Dust/Ashes				
Ceramic/Crockery	0.1	0.5	0.13	1.43
Others	0.2	1	0.2	2.2
Total In-Organic Wastes=	1.7		0.86	
Hazardous Waste				
Battery			0.15	1.65
Aerosol Bottles			0.3	3.3
Others			0.1	1.1
Total Hazardous=			0.55	
Total Wastes=	**20.1**	**100**	**9.09**	**100**

Figure 4.17 shows that weight of food and vegetable waste is major in percentage (50.75) in household. Paper and plastic posse next highest percentage, 20.4 and 10.45 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

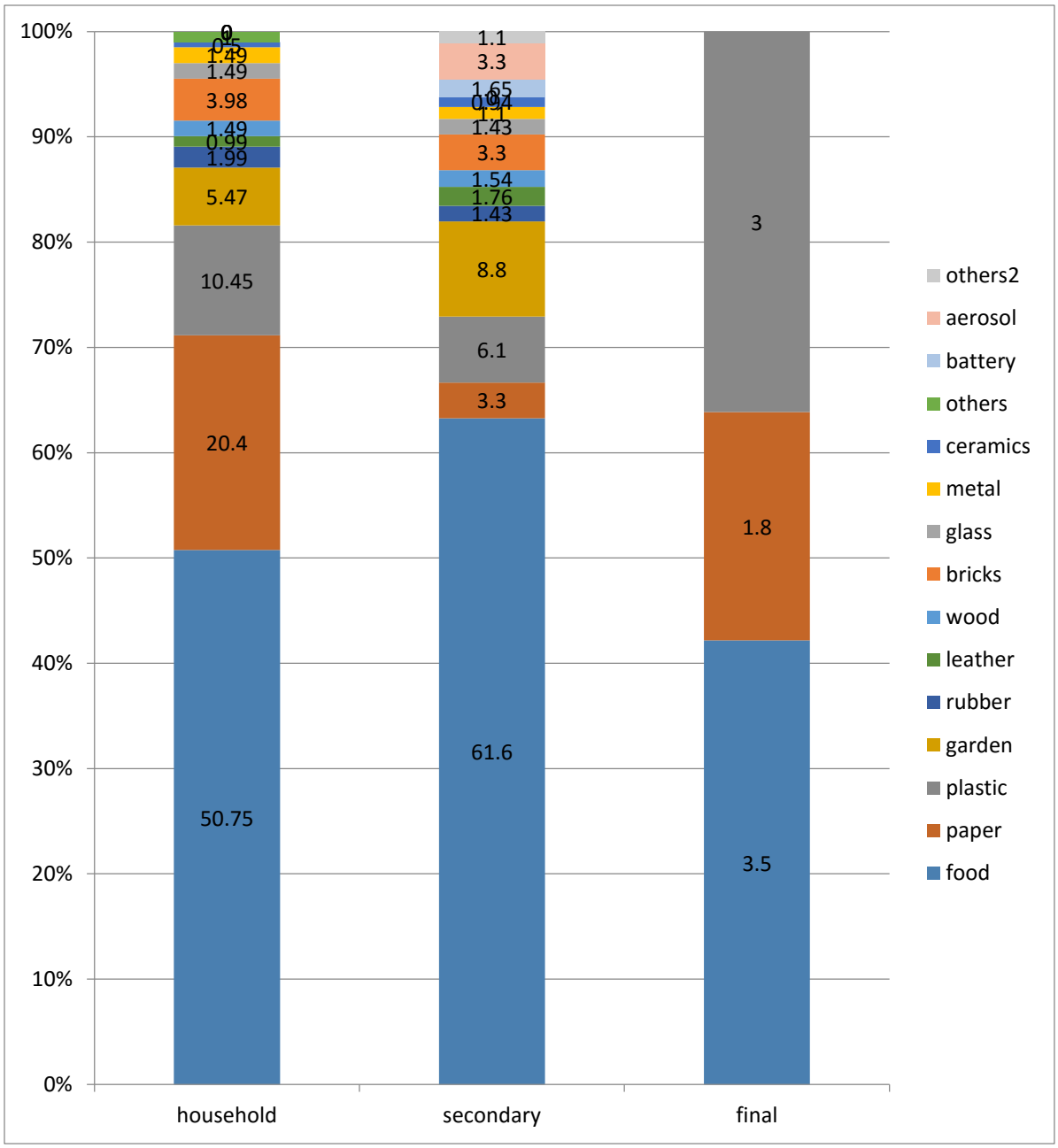

Figure: 4.17 Compositions of waste at different stages

4.10.1 Moisture content and generation rate

4.10.1.1 Household Waste:

Total waste collected initial=31kg

Weight after drying= 20.1kg (Drying time 24 hours)

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(31-20.1)/31}*100

= 35.16%

Waste Generation Rate = (wet weight or initial weight)/(person/day)

= 31/153 kg per capita per day

= 0.2026 kg per capita per day

4.10.1.2 Secondary Dumping Site:

Total waste collected initial=11 kg

Weight after drying=9.09kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(11-9.09)/11}*100

=17.36%

4.10.2 Amount of non-recyclable waste

Figure 4.18 shows the Comparison between recyclable and non-recyclable wastes. It shows that at household around 49.25% wastes are found recyclable that slightly reduced to 28% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 47.46% of total that leads to opportunity at recycling and possibilities of mass reduction in transporting if separation is done.

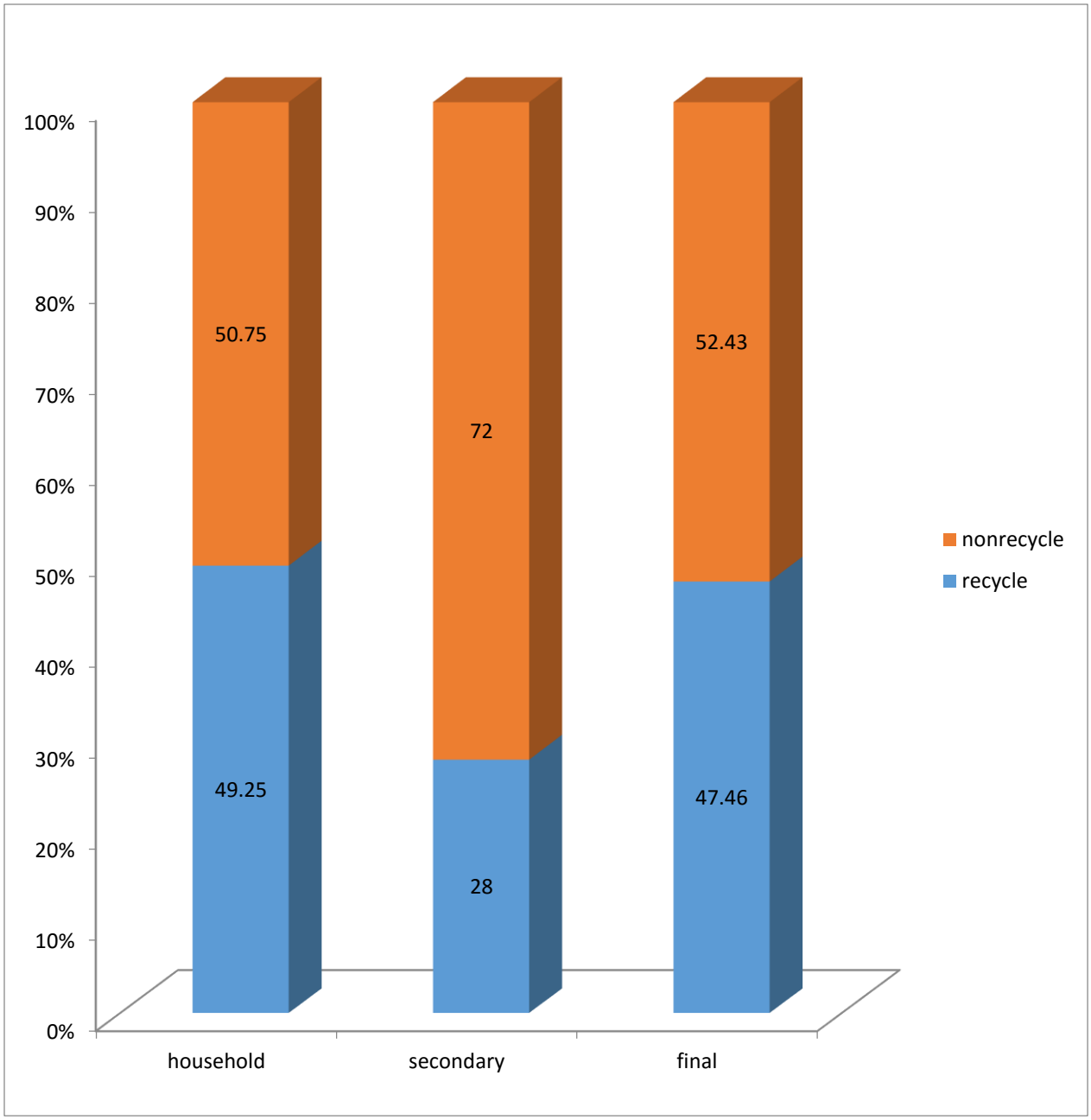

Figure: 4.18 Recyclable vs. Non-recyclable

4.11 Kapasia zone (Wet Season)

Table 4.10 shows the waste composition data of Kapasia zone of dry season at different stages. Collected wastes are sorted based on different category. Comparison of weight by percentage are prepared at every stages .

Table 4.10 Solid Waste Composition Data

Waste Type	Household Waste		Secondary Dumping Site	
Organic Waste	**Weight(Kg/day)**	**Percentages (%)**	**Weight(Kg/day)**	**Percentages (%)**
Food & Vegetable Wastes	11.3	50.71	8.5	61.81
Paper &Paper Products	4.3	19.33	0.7	5.09
Plastic/Polythene	2.0	8.98	0.8	5.81
Garden & Trimming	1.6	7.10	0.6	4.36
Rubber	0.6	2.70	0.21	1.52
Leather	0.2	0.90	0.33	2.4
Wood	0.7	3.10	0.15	1.09
Total Organic Wastes=	**20.7**	**92.82**	**11.29**	**82.10**
In-Organic Waste				
Bricks/Concrete/Demolition	0.26	1.16	0.43	3.12
Glass/Bottles	0.31	1.31	0.32	2.32
Metal/Tin Can	0.40	1.80	0.26	1.89
Ceramic/Crockery	0.21	0.94	0.39	2.83
Others	0.37	1.61	0.15	1.09
Total In-Organic Wastes=	**1.55**	**6.81**	**1.55**	**11.27**
Hazardous Waste				
Battery			0.16	1.16
Aerosol Bottles			0.42	3.04
Others			0.33	2.4
Total Hazardous=			**0.91**	6.6
Total Wastes=	**22.25**	**99.70**	**13.75**	**99.97**

Figure 4.19 shows that weight of food and vegetable waste is major in percentage (50.71) in household. Paper and plastic posse next highest percentage, 19.33 and 8.98 respectively. Paper are found to be reduced in secondary and final dumping site as they are collected for reusing purpose. But plastic tends to increase in final site as recycling arrangements are not sufficient

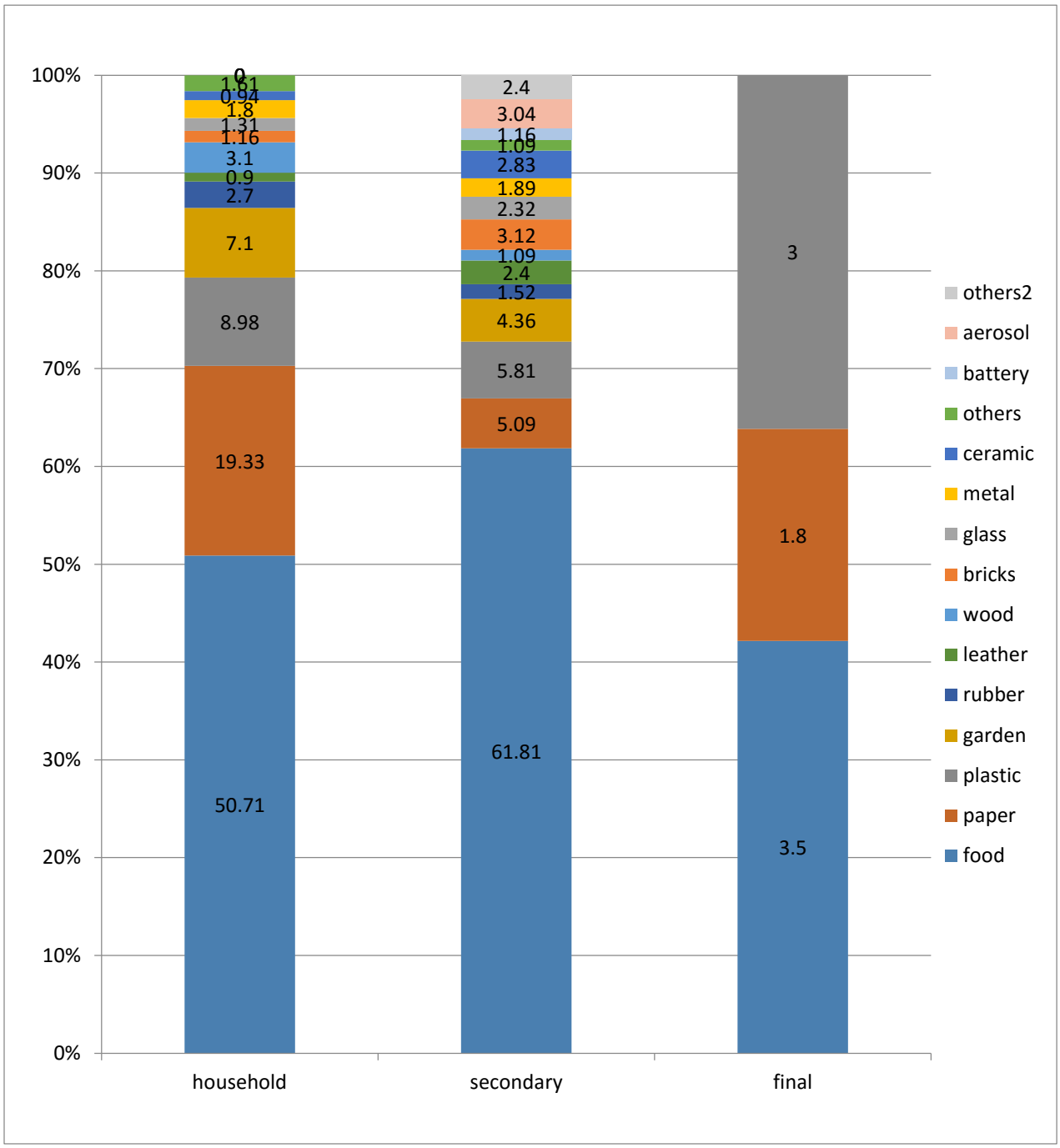

Figure: 4.19 Compositions of waste at different stages

4.11.1 Moisture content and generation rate

4.11.1 Household Waste:

Total waste collected initial=**22.25**kg

Weight after drying=**13.8** kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(22.25 – 13.8)/22.25

= **37.97 %** (in April it was **35.16%**)

Waste Generation Rate = (wet weight or initial weight)/ (person/day)

= 22.25/ (61/1)

= **0.36** kg per capita per day

(In dry season it was **0.202** kg per capita per day)

4.11.2 Secondary Dumping Site:

Total waste collected initial=13.75kg

Weight after drying=11.18 kg

Moisture content = {(Wet weight-dry weight)/wet weight}*100

= {(13.75-11.18)/13.75}*100

= **18.90**(In April it was **17.36%)**

4.11.2 Amount of non-recyclable waste

Figure 4.20 shows the Comparison between recyclable and non-recyclable wastes. It shows that at household around 42.02% wastes are found recyclable that slightly reduced to 33.82% at secondary site as few recycling activities are done. But at final site amount of recyclable wastes are increased to 37.479% of total that leads to opportunity at recycling and possibilities of mass reduction in transporting if separation is done.

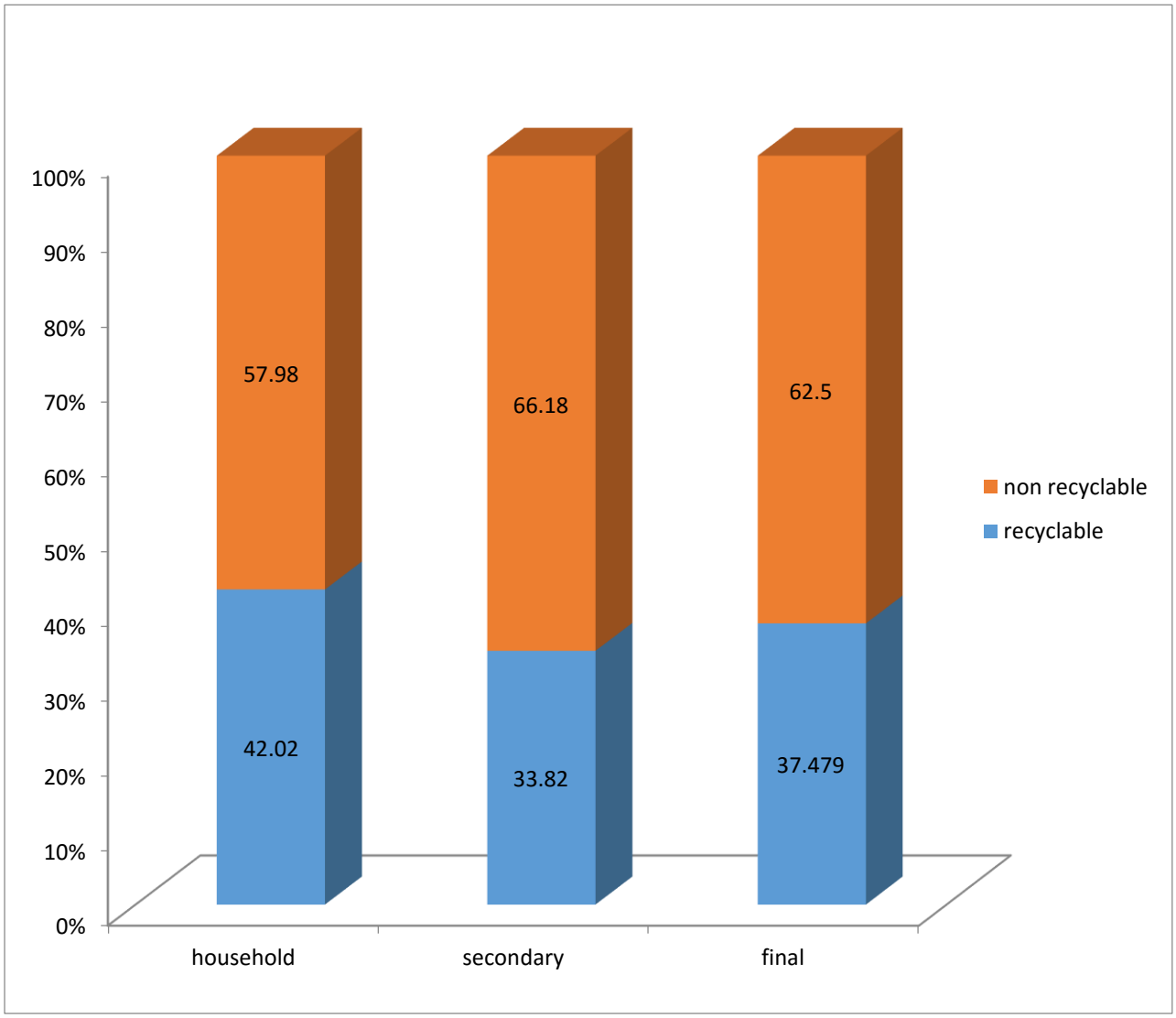

Figure: 4.20 Recyclable vs. Non-recyclable

4.12 Recyclable waste analysis

Table 4.11 Recyclable waste analysis

Cycle	Average waste generation rate (kg/capita/day)	Average total waste generation (kg/day)	Average recyclable waste (%)		
			Household	Secondary dumping site	Final dumping site
Dry season	0.2774	693500	38.16	32.066	47.46
Wet season	0.3786	946500	41.0	27.5	37.479

CHAPTER FIVE

SUGGESTIVE MEASURES

5.1 WASTE MISMANAGEMENT IN GAZIPUR CITY CORPORATION

5.1.1 PROBLEMS OF STORAGE OF SOLID WASTE AT THE SOURCE OF GENERATION

- **In Gazipur city corporation the scientific and systematic storage of waste at source is not in practice.**
- **The waste is normally thrown in nearby vacant areas, government vacant land, drains, streets etc**
- **Because of waste thrown on the street the environment becomes ugly and unhygienic, so even in case of regular cleaning be Municipal Workers also, the city cannot be kept clean for more than 2-3 hours.**
- **People generally don't take the waste to the designated points they carry it to nearby roads, railway tracks, open plots etc and generally people avoid walking to the designated disposal points.**
- **So when wind blows the heap of solid waste get carried away by wind and spread in large areas and when there are rain the problem get aggravated.**

5.1.2 PROBLEMS OBSERVED IN THE PROCESSING AND RECOVERY OF SOLD WASTE

- **Generally in Gazipur city corporation the formal processing and recovery units are not established**
- **Recovery and recyclable activities are not done properly.**
- **No protective clothing /consideration for rag pickers /scavengers.**

To ensure maximum waste collection and effective recycling system a proposed management system can be proposed**.** Figure 5.1 shows the suggested management system

Household : Separation of food and vegetables wastes

Food and vegetable wastes are main component of non-recyclable wastes. This process will lead to achieve recyclable wastes.

Two different baskets will be used by house hold families. They will dump food and vegetable waste in one basket and others in another basket.

Two baskets will be carried by same van thrice a week and both baskets will be carried to secondary site.

Secondary : Storage of recyclable component

In secondary site there will be two sections. First section is for dumping all baskets with food and vegetable wastes and another section is to store recyclable waste if any.then recyclable waste will be carried to recycling plant

Final:Landfill and Composting

In final dumping site in organic waste will be used in landfill and organic waste will be carried to compost manufacturing factory .

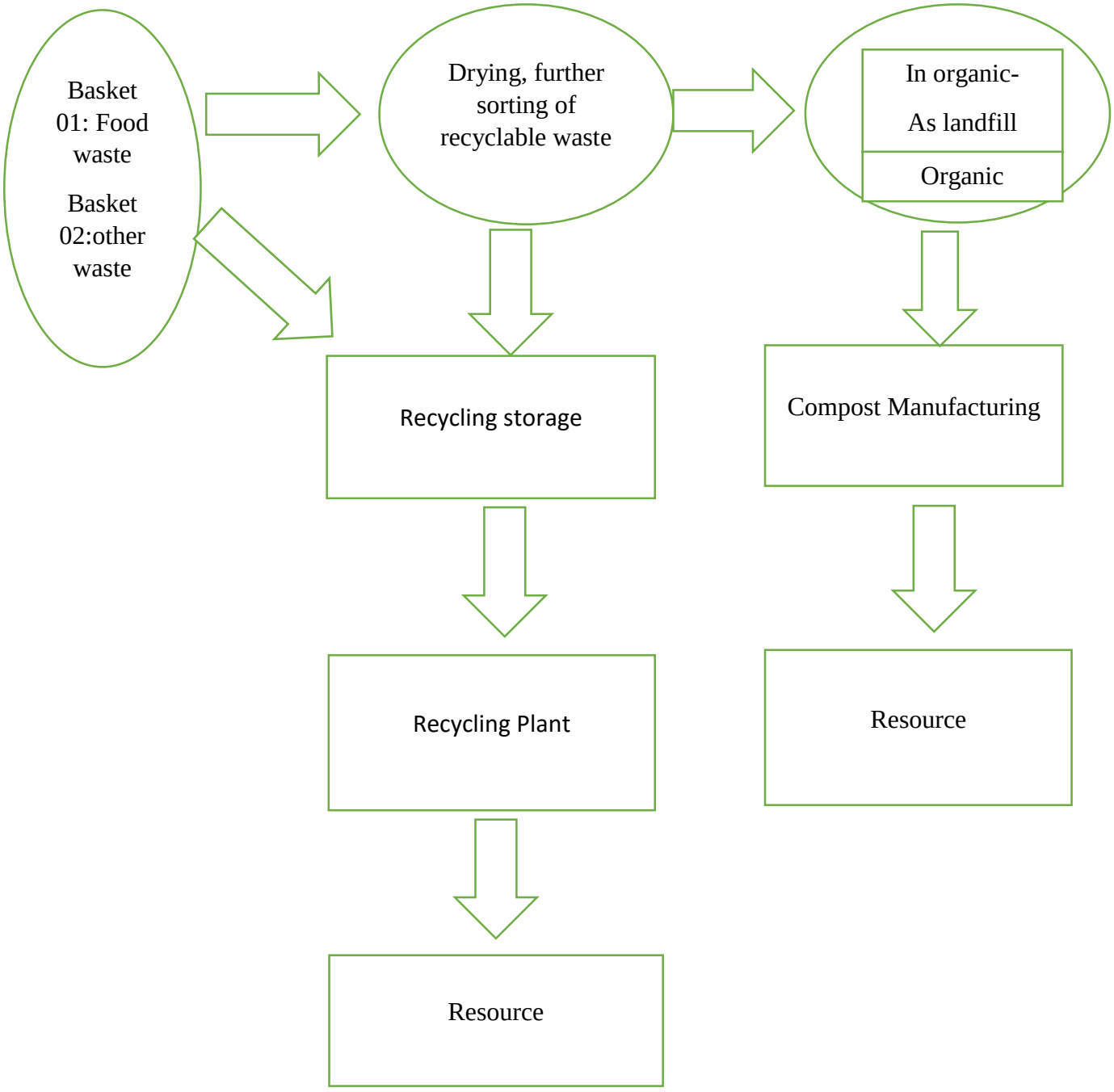

Figure 5.1 Proposed management system

CHAPTER SIX

DISCUSSIONS AND CONCLUSIONS

6.1 Discussions

Gazipur was established as a district in 1984.Recently it has been converted to city corporation. By area it is the largest city corporation in Bangladesh. Total population and population density are very high. Major reasons are

- Scope of industrialization
- Employment opportunity
- Available agricultural land
- Easy access with all over the country

By census of 2011 population density of this area is 1884 per square kilometer. So generation of waste by this huge people is a big concern that should be taken seriously without any delay. Because conservancy of wastes is a big subject on it leads to pollution.

Generation of wastes depends on income level. Lower socioeconomic people generate comparatively less than higher socioeconomic people. Main component of generated solid waste needs special care. During our study we found people living in urban areas are much interested to dispose their wastes here and there mainly behind their houses.

Waste collection and dispose them to proper areas are very tough process. Common practices that are presently done here are,

- Waste collected by city corporation vans twice or thrice a week
- People dispose waste at dustbin placed at specific places
- A common dumping site from where wastes are collected to secondary site twice/thrice a month.

Waste disposal facilities run by the city corporation under solid waste management programs cover the central and core areas only.There are well established solid waste dumping sites in the city corporation area.The main dumping site of Gazipur city corporation is located beside the highway burulia,which is in the north of the city.The present dumping site is not sufficient as per information received from the conservancy department.So the department is trying to find additional place to use it.

As our survey preferable practice is to collect waste from door side twice or thrice a week and then further went to secondary site from where all wastes will be carried to a final dumping site.

From our study generation rate that is calculated is within a range of 0.28-0.34 kg/capita/day. This generation rate is moderate. Gazipur city corporation has no structural framework to manage total wastes yet.

Another major finding of our study is the amount of recyclable wastes. Mass and volume of recyclable waste among total solid waste rectify this information that separation of recyclable solid waste from total waste before dumping to final site will help us in many ways like reduction of wastes, reduction of landfill area, reduction of pollution.

6.2 Conclusions

A healthy life,cleaner city and a better environment are the logical demand for the city dwellers.In area Gazipur city corporation is the largest city corporation of Bangladesh.It is considered as one of the most important industrial zone of our country.Because of rapid population growth and increase of industrialization the amount of waste generation in this area is increasing at an alarming rate.

As the city corporation is formed newly,corporation authority is struggling to cope with the existing situation.Inadequate management practices and uncrolled waste dumping are creating numerous environment problems.This study revealed that the existing waste management practices in Gazipur city is behind the satisfactory level due to poor infrastructural facilities in waste management ,lack of trained workers,lack of technologies and lack of proper plannings and monitoring activities.

However as an individual body it becomes difficult for GCC to ensure proper waste management system.They should upgrade the concept of solid waste management and imrove the system of entire management.They also need proper implementation of laws and regulations in proper ways

The following recommendations need to be fulfilled for the improvement of the collaborative program-

Public awareness of health education should be raised through public campaigns.

Monitoring facilities have to improve

Proper implementation of rules and regulations

Have to improve collection and transportation equipment

Modification of municipal ordinance is needed to accommodate the inclusion of NGO'S, CBO'S and micro enterprise into the main stream of solid waste management

Public awareness of waste segregation,recycling and re use should be raised through public campaigning and media demonstration through NGO's rather than capital-intensive projects

This study recommends that to implement a well-organized and proper waste management system in Gazipur city there needs a conjunctive initiatives of government and private sectors whereas community based waste management practices could play a vital role

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