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RESEARCH ARTICLE

ECONOMIC AND ENVIRONMENTAL IMPACTS OF PLASTIC WASTE: A CASE STUDY IN ADDIS ABABA CITY, ETHIOPIA.

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Abstract

The objective of this thesis work was, to look in to the multi-dimensional relationship between the source of plastic waste and the actors involved in the process from plastic waste generation up to the recycling stage; and to identify the three major types of plastic waste used and disposed at a household level (PE, PP, and PET). The thesis work had identified how each player was involved in the chain of functions, the working atmosphere among them was organized, and what the transactions between each participant look like. As the economic impact was the driving force which draws the stakeholders into the process, the benefit each stakeholder was getting at every level was indicated. The plastic waste which was delivered to the recycling factories has shown a significant consumption growth from 2012 up to 2016; where one factory registered 1394% increment in its annual consumption. The thesis also assessed the level of awareness creation and degree of implementation of regulations issued in connection with plastic waste and concluded by forwarding some suggestions and recommendations on the way forward.

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Introduction:-

After ancient Mesomerians processed the first natural rubber into ball in 1600BC and the subsequent improvisation in the production of commercial plastic, hundreds of plastic materials were made available. However, commercial production of the risen began in 1957 long after commodity plastics including PE(polyethylene) and PP (polypropylene) was discovered in 1954 by Guilio Nata, , (Andrady & Neal 2009).

The term plastics applies to a wide range of material that at some stage in manufacture are capable of flow such that they can be extruded, molded, cast, spun or applied as a coating. Synthetic polymers are typically prepared by polymerization of monomers derived from oil or gas, and plastics are usually made from these by addition of various chemical additives. There are currently some 20 different groups of plastics, each with numerous grades and varieties (APME 2006). Plastics are incredibly versatile materials; they are inexpensive, lightweight, strong, durable, and corrosion resistant, with high thermal and electrical insulation properties. The diversity of polymers and the versatility of their properties facilitate the production of a vast array of plastic products that bring technological advances, energy savings and numerous other societal benefits (Andrady & Neal 2009).

With the expansion of the city and the exponential growth of population, a huge increase has been observed on the

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waste generation from various sources in the city (Addis Ababa City administration, Dry waste Management Policy 2003).³ However, the Cleansing Management Agency (CMA), which is responsible for managing the city's waste hasn't designated space for the primary collectors and retailers for temporarily storing the plastic waste gathered from various sources. Therefore, to gather and compile essential data for this purpose, it was mandatory to follow them wherever they were roaming. In practice, the access to obtaining information on the overall waste collection system, especially on the way how primary collection is handled in developing countries is limited. (Anna Lena, et al., 2013)⁴ Taking the above mentioned factors into consideration, meeting the stakeholders was essential to get first-hand information.

The discovery and gradual conversion of plastics into commercial production has been a long process. However after it was once commercialized, its coverage has become massive globally. Plastics global production, mainly from fossil raw materials, has skyrocketed: from 1.5 million tons (Mt) in 1950 to 288 Mt in 2012. Sustainable consumption and production, and the circular economy, require minimizing use of virgin materials and greenhouse gasses emissions, while delivering clean material cycles. To this end, globalized trade in waste plastics is a major option. Production shift towards Asia Recycling operations depend profoundly on production and consumption. A shift in plastics production from the West to Asia has occurred: 40% by weight of world production is now in Asia, with 20% each in Europe and North America - China is the largest individual country at 24% (Costas Velis 2014).

Even though China, European countries and United States are taking the lion's share in the global plastic consumption, the rest of the world is also taking part in the process. Therefore, when it is seen in aggregate, global plastic production is continuously increasing and reached 322 million tons in 2015, generating revenues for plastic manufacturers of about 750 billion dollars (Nils Simon and Maro Luisa Shulte, 2017).

Global plastic consumption is accelerating in an exponential manner and it indicates how the role of plastic in everyday life of society could be significantly important. In this connection, the graph below indicates how consumption increased significantly between 1950- 2013. As the world around us changes, our lives will be affected both directly and indirectly. Plastics will not just be a tool to respond to the major challenges facing the global community; they will also be an intrinsic part of our everyday lives. The key driver of change here will be the acceleration of technology: the combination of technology and plastics will change the way we live work and relax (Ray Hamond, 2007)

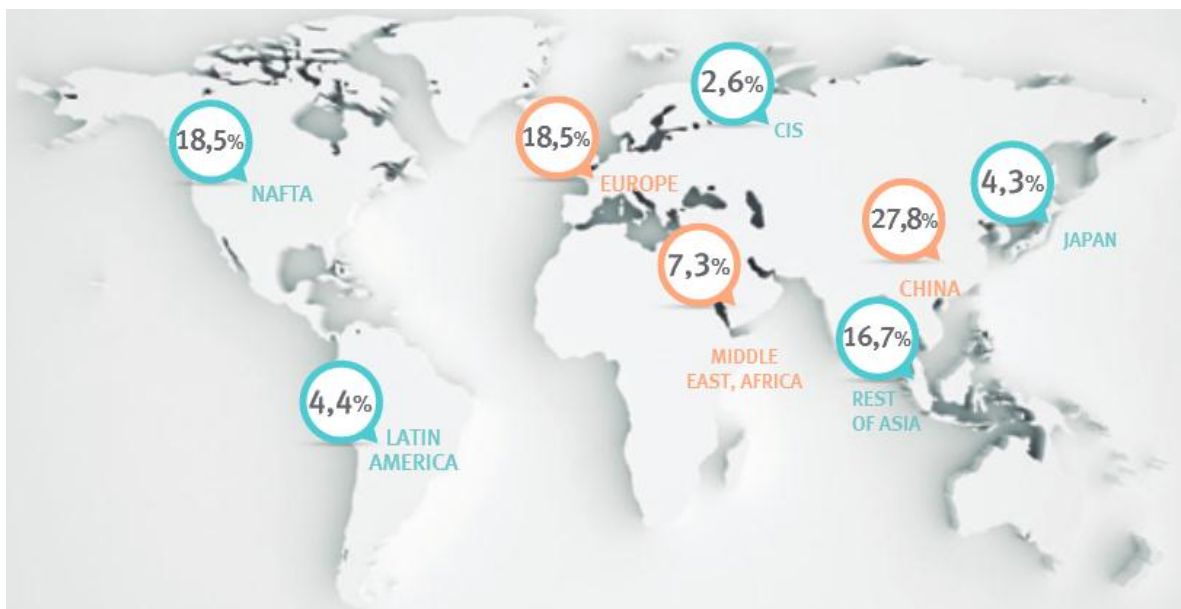


Figure 1:- Source:Plastic Europe, 2013

The increase in human population and gross national income (GNI)/capita growth in developing countries are the major drivers in increasing quantity of MSW from urban centers. To tackle this mammoth problem there is need to introduce sustainable approaches in existing conventional MSW management systems in majority of cities of

developing nations. However, the waste management is now becoming resource conservation practice (ISWA, 2012).

Informal waste recycling is carried out by poor and marginalized social groups who resort to scavenging/waste picking for income generation and some even for everyday survival. This is widespread throughout urban areas of the developing world and it is reported that up to 2% of the population in Asian and Latin American cities depend on waste picking to earn their livelihood (Medina, 2000).

In any country's public perception, posture and behaviour are significant elements that determine the success of the recycling program (Delistavrou et al., 2005). In this connection Addis Ababa City Administration Cleansing Management office has planned and Executed awareness creation programmes using the National Television, radio Stations and printed Media.

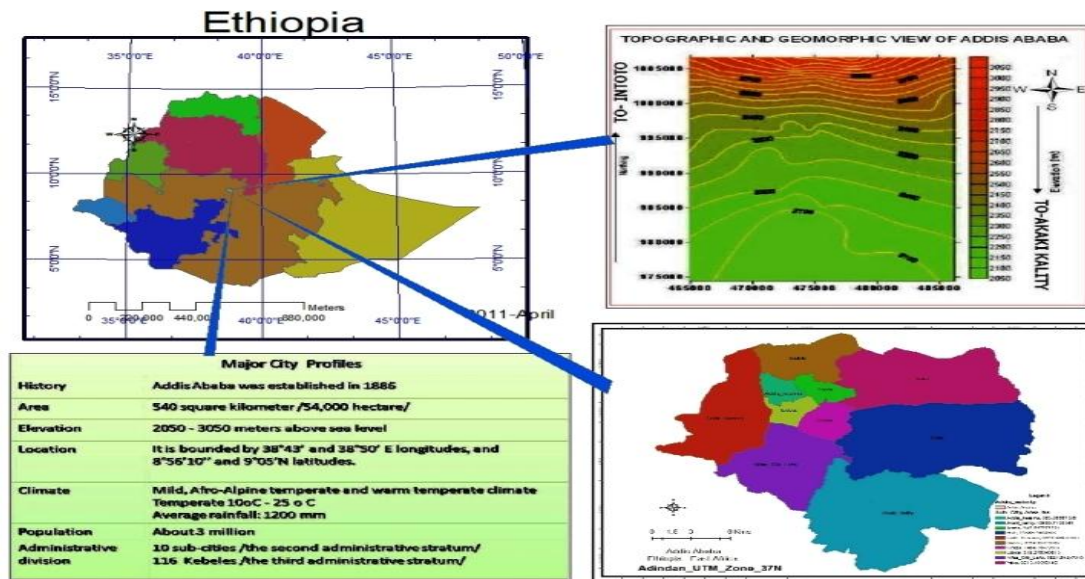
The Aim of the Research:-

To identify the three selected types of plastic waste generated form HHs and their economic impacts on the stakeholders' Livelihood

Materials and Methods:-

Study area Description:-

The capital city of Ethiopia is Addis Ababa ("New Flower"), located almost at the center of the Country. Addis Ababa is the diplomatic capital for Africa (OAU, ECA), regional headquarters and international organizations like UNDP, UNICEF, UNHCR, FAO, ILF, ICO, and ITU. According to the Central Statistical Agency (CSA 2010), the population of the city is 2,917,295 inhabitants that live in 10 sub-cities¹ and 99 Woredas; divided for administrative purpose. Addis Ababa is a center for modern economic and social activities where infrastructure services are found relatively in better situation than other cities of Ethiopia. Addis Ababa has an area of 540 square kilometers, of which 18 square kilometers is rural. It lies between 2000 and 3,000 meters above sea level. Despite its proximity to the equator, The city enjoys a mild, Afro-Alpine temperate and warm temperate climate. The lowest and the highest annual average temperature are about 10°C and 25°C. Annual rainfall is around 1200 mm.



Source: Addis Ababa Cleansing Management Agency

Figure 2:- The Location map of Addis Ababa city, Ethiopia

Research Methods and data Analysis:-

The information gathering process on the primary consumers of recycled plastics, the disposal, collection and finally the recycling of Municipal Solid Waste in general, and plastic waste in particular, involves several of stakeholders. Primary and secondary data has been collected using questionnaires, interviews and filed visit has been conducted

according to the nature of the source of the data needed. In this connection, the data collection was administered with stake holders at various levels as indicated below.

Results and Discussion:-

Economic Benefits of Plastics Waste:-

The usage and disposal process of plastic materials starts at the household level and with the help of different actors it reaches the recycling plants passing through various stages. One of the major benefits that every participant acquires is the economic benefit which varies according to the role everyone plays.

Sales of used plastic materials at household level:-

In most cases the type of plastic waste disposed from residential areas is related with food Items. Jerry cans, plastic bottles, PP bags for collecting grain and shipping bags come with food and drinking items. On the other hand these materials are seriously needed by the collectors. The following table illustrates their demand and value.

Table 1:- Type of Plastic waste collected from residential quarters.

Types of plastic waste	No. of respondents Gotera	No. of respondents Bole Bulbula	Unit price	In %
5 lit. Size Plastic Jerry cans /HDPE/	96	123	5 lit. 2 ETB	73
Plastic home appliances /HDPE/	134	112	negotiable	82
1 kg of Plastic bottles for mineral water /PET/	73	111	6-7 ETB	61
Plastics shopping bags /LDPE/	135	142	negotiable	92
One piece Plastic bags for cement and cereals /PP/	13	8	1.10 ETB	7

According to the information obtained from the residents the price of items depends up on the type or the quality of the material. In this connection, emptied jerry cans imported from abroad with edible oil are sold according to their size. The small ones fetch 2 ETB while those with a capacity of 20 liter could be sold for 40 ETB if they are kept in a good condition. A small damage may cause a reduction of some amount. Plastic bottles and plastic bags are not usually available at a household level because there is no interest to store the materials due to the small amount paid to these types of plastic waste. Plastic cement bag relatively has better advantage because even though the amount paid for one piece is small (1 ETB) since residents can use big amount of cement during expansion work or renovation they can keep and sell the material. In all the above cases residents are encouraged to keep the plastic waste that may be disposed after giving service; hence this contributes in protecting the environment.

The Middlemen:-

The activities performed at this stage are serving as a transfer station until the materials reach their final destination: the recyclers. According to the field observation, these groups of collectors are better organized than the primary collectors both in their performance and financial capacity. In all cases they are operating on open fields which are not totally convenient for security and the safety of the materials they collect. The middlemen stationed near the ring road at LEBU said they have the capacity of purchasing up to 10,000 pieces of cement bags every day while those at the Bole Bulbula site could collect up to 8,000 Pieces. During their transaction they pay 1.10ETB for one piece. According to the information the middle men provided in anonymity due to tax issues, they earn 7,000-10,000 ETB monthly after covering all costs.

Those who collect plastic bottle and shopping bags compact these wastes in larger plastic bags which originally served to contain cereals or sugar and deliver to the buyers. The measurement of transaction in this case is usually in Kg. Therefore, the middlemen offer 6 ETB for one kg.

In the process of transferring the collected materials from the source to the middle men, several residents ranging from young school boys to older women are participating. They support their livelihood with the money they receive by scavenging walking from one locality for long hours.

Above all, the commencement of the recycling of plastic bags, bottles and shopping bags has changed the previous trend of disposing these materials together with construction and household wastes. This on the other hand, has

contributed a lot in protecting the environment from a serious damage since the bigger size of the bags could cover larger areas of land where it would be disposed.



Figure 3:- private collectors delivering plastic bottles and cement bags to middle men.

The transaction at the Recyclers level:-

This group is well organized and mostly owned by foreign investors who came up with technology which can convert various types of plastic waste into raw materials like granules which could be consumed by other factories to produce appliances for household consumptions or other services. The table below clearly shows the steady growth of supply of different types of plastic waste to meet the demands of the recycling factories. Weidong Jia Plastic Recycling Company, which starts with 40 tons in 2012, has reached to a capacity of consuming 1213 tons annually. Great Wall Packing Materials Plc., which also commences work in the same year has started with 105 tons and reached to the capacity of consuming 2030 tons.

Table 2:- Annual plastic waste consumption of recycling factories

Year	Name of Companies			
	Weidong Jia Plastic Recycling Co.	Aisai Chemical fiber PLC.	Great Wall Packing Materials Plc.	AISAI recycled plastic manufacturing Plc.
2012	40 tons	-----	105 tons	-----
2013	84 tons	-----	170 tons	-----
2014	1078 tons	175 tons	2010 tons	-----
2015	1112 tons	178 tons	2030 tons	240 tons
2016	1213 tons	930 tons	2080 tons	360 tons

Source: of information: owners and managers of the companies

The transaction at this level has somehow a formal way where the middle men personally deliver the plastic bags or jerry cans loaded with medium size trucks which has a capacity of carrying up to 10,000 pieces. The recycling factories pay up to 30% increment on top of the middlemen's purchasing price assuming the high profitability of the business.

According to the information gathered during interviews with the owners or the General Managers of the factories, they don't face any problem in receiving continuous supply throughout the year. Unlike in the case of the primary collectors or the middle men they are operating in well-constructed shades where they rented from individuals. However, due to lack of space they are obliged to store the raw materials in open space without any protection from the direct sun. In this case, whenever the waste plastics stay for a long time its strength could be diminished.



Figure 4:- Plastic waste stored outside recycling factories

Legal instruments regarding the production and use of plastic products:-

Solid Waste Management proclamation No.513/2007 Article 8 which was ratified and issued by the parliament of the Federal Democratic Republic of Ethiopia has promulgated one article and strong sub articles regarding the standard of production and import of plastic bag as indicated below:

Article (8) Sub article (1): As of the date fixed under directive to be issued by the Authority, it shall be unlawful to put on the market any plastic bag that is not labeled to how it is biodegradable or not.

Article (8) sub article (3): It is prohibited to grant permit for the manufacture or import of any non-bio degradable plastic bags with a wall thickness of 0.03 millimeters and less than 0.03 millimeters.

Without prejudice to sub article 2 of this article the authority shall, through the issuance of a directive, determine the conditions under which plastic bags with wall thickness of 0.03 millimeters and less than 0.03 millimeters may be imported or manufactured locally for specific purpose. However, what is observed in the Addis Ababa or in other cities of the country doesn't reflect this reality. Above all, plastic waste which poses danger to the environment is not only the type which is mentioned on the proclamation. Therefore, if the problem of managing the plastic waste is to be addressed, the proclamation should be revisited and look into all types of plastic wastes. The main shortcoming in this regard is the absence of strong law enforcement mechanism which would work towards the implementation of the regulations. A study conducted on the compliance level showed that 14 out of 21 companies inspected were found producing below the required 0.03 millimeter thickness.

Public Awareness Creation and Level of Response:-

In most cases, Informal waste recycling is carried out by poor and marginalized social groups who resort to scavenging/waste picking for income generation and some even for everyday survival. The attitude of the formal waste management sector to informal recycling is often very negative, regarding it as backward, unhygienic and generally incompatible with a modern waste management system.

In recent years, numerous research papers have recognized the significance of public perception, knowledge, awareness, attitude, and behavior toward environmental problems. They also reported that there was a breach between public perception, awareness, cognition, and behavior

In order to have a healthier and responsible way of managing the solid waste generated from every household, there should be a common understanding between the community, the collectors and the administration. This can be effective when the pertinent organs; in this case the Municipal Solid Waste Management office, in collaboration with the pertinent offices at different label conducts an effective awareness creation programs. The following table

illustrates how residents responded as to how they got information regarding the effects and damages solid waste can cause on Environment and human health.

Table 3:- Awareness creation level

How do you get information regarding solid waste and its effects?

Source of information	Number of respondents Bole	Number of respondents Gotera	In 100/percentage
From media	123	135	86
From flyers distributed by Woreda	67	86	51
From posters and billboards	21	9	10
From reading	17	3	6.6

The annual report for the Ethiopian fiscal year 2014-2015 prepared by Solid Waste Management Agency revealed that awareness creating among the society was one of the functions performed in collaboration with different Media outlets such as Ethiopian Television, local FM radio stations and newspapers. Accordingly, 186% of respondents claimed to get the information from Media which usually transmit interviews, complaints from residents. 51% respond as they learned about the situation from fliers distributed by the Woreda Administration. Billboards and posters erected along road sides also contributed in alerting 10% of the respondents.

Conclusion:-

The change in the lifestyle of the residents of Addis Ababa has significantly increased the consumption of different plastic products. This, in-turn, has created conducive atmosphere for the generation of massive plastic waste in the city. Until recently, plastic waste was disposed mixed with household, construction and other wastes, till recycling factories were established and use it as an input. The commencement of plastic waste recycling has created a value chain by bringing the generators, collectors, and the recyclers into one circle. Thousands are deployed in the sector to support their lives while they salvage the environment from hazardous plastic wastes. However; the process still has too many constraints ranging from lack of strong legal enforcement to absence of sufficient knowledge about the issue in the community. Therefore, even though the current trend is promising, much is expected from all the stakeholders in the time ahead.

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