JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

AN OVERVIEW OF WOMEN EMPOWERMENT'SEFFORTS OF HOUSEHOLD SOLID WASTE MANAGEMENT IN BANGLADESH

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Abstract: Women's empowerment refers to their ability to make decisions in social, economic, and political affairs. It is a multifaceted concept that incorporates a wide range of factors. Women have always been more active in waste management, and they typically work forno pay. The waste management program in Bangladesh has a systematic approach, focusing on household waste creation and separation aswell as collection, transportation, and disposal or recycling/reuse, with women playing a crucial part. This initiative combines the efforts of women to establish themselves as entrepreneurs with the participation of municipalities. This review paper aims to look into women's experiences with self-motivation through household solid waste management programs, as well as the factors that influence their participation in 5R-based solid waste management (reusing, reducing, recycling, repurposing, and recovery) programs at the household level. This article proposes a new idea for implementing and a better understanding of women's involvement in 5R-based HSWM and theirparticipation as entrepreneurs to generate empowerment in Bangladesh.

IndexTerms **- Women empowerment, solid waste management, household solid waste management, reusing, reducing, recycling, repurposing, recovery, Bangladesh.**

1. INTRODUCTION

Waste management is a key development issue across the world, and solid waste management is a serious concern in many cities, particularly in developing countries (Boateng et al. 2019; Ali and Rahitashw, 2019). It has been the subject of intense discussion in recentyears at a range of international events, from local forums to summits and conferences (Habib et. al., 2021; Chowdhury et.al. 2014). It devastates the environment, damages ecosystems, poses a threat to all forms of life, and disregards future generations' rights (Ali and Rahitashw, 2019) Global annual waste generation is expected to rise to 3.4 billion tons in the next 30 years, up from 2.01 billion tons today,due to rapid urbanization and rising populations (World Bank, 2018). Cities, particularly those in developing countries, confront a variety of challenges when it comes to managing their solid waste (Mondal, 2022). The elements of an environmentally friendly solid waste management system in the residential sector can be influenced by socioeconomic status and housing features, which can have an effect onboth the amount of municipal waste produced and how it is managed (Al-Khateeb et.al., 2017). The transition to integrated solid waste management in households is hampered by poor waste disposal practices. For appropriate decision making in the shift towards a more sustainable approach, knowledge of current practices and perceptions of HSWM is required (Fadhullah et. al., 2022).

Household solid waste management (HSWM) is a major challenge across the world, particularly in developing countries like Bangladesh due to the growing diversity of household waste characteristics, a lack of successful implementation of consistent waste policies, and rapidurbanization. According to the UN data, Bangladesh is recently rated as the most populous country in South Asia, with 167 million people and a population density of 1265 people per square kilometer (Worldometer, 2022). Furthermore, increasing urbanization and population growth are primarily responsible for the rapid increase in municipal and household solid waste generation in Bangladesh's urban areas (Chowdhury et. al., 2014). The current waste management system has gotten to the point that it threatens the future of the populace. Both cities and towns are experiencing the worst of the situation. Industrialization, unplanned urbanization, garbage removal, hazardous waste disposal (electrical, medical, industrial, and household), and expansion of city parks are only a few causes of environmental issues that arerapidly becoming challenges (Nasrin, 2016). For development authorities, urban planners, city dwellers, and other concerned stakeholders, this scenario poses a socio-environmental and professional threat (Chowdhury et. al., 2014). All landfill sites in Bangladesh are unmanaged and open dumps, and a significant

quantity of solid waste is dumped in them, resulting in significant amounts of methane (CH4) gas being released into the atmosphere (Chowdhury et. al., 2014). Waste management in this country is constrained by a lack of knowledge, poor technical selection, insufficient financial support, and a lack of standard regulations for waste disposal (Abedin and Jahiruddin, 2015In Bangladesh, the six major cities (Dhaka, Chittagong, Rajshahi, Khulna, Barisal, and Sylhet) produce over 8000 tonnes of solid waste in a single day, with Dhaka accounting for about 70% of the total solid waste (Abedin and Jahiruddin, 2015; Rahman et al. 2017). In 2016, Dhaka city produced 6,100 tonnes of domestic waste per day, rising from 3,200 tonnes in 2005. The amount of waste produced has increased by 90% in the previous ten years. because the city's waste management system is unknown to 86 percent of Dhaka residents (Nasrin, 2016).

Dhaka city is the most affected by Bangladesh's fast urbanization of all the country's cities (Hasan et. al., 2015; Abedin and Jahiruddin, 2015). The city is dealing with severe challenges such as inadequate housing and insufficient housing facilities as a result of its unplanned and uncontrolled growth (Hasan et. al., 2015; Urme et.al., 2021). Through strong coordination between the government and other national and international organizations, it is possible to initiate and improve community-based solid waste management strategies in every site in Dhaka city and adjacent municipalities (Hasan et. al., 2015). A key element in current developments to enhance solid waste management approaches in emerging economies is the engagement of both the public and commercial sectors in delivering solid waste management, like HSWM (Rahman et al. 2017). As a result, HSWM has become a growing concern among environmentalists and researchers (Habib et.al., 2021; Afroz & Tudin, 2017; Sibanda et al, 2017).

With their regular interaction, women have a unique relationship to the environment that has not been observed in Bangladesh (Afroz and Tudin, 2017). To ensure the long-term sustainability of the HSWM system, society's perception of women's importance must change. Because women play such a significant role in environmental conservation and use, gender perspectives must be incorporated into solid waste disposal and HSWM practices (Afroz and Tudin, 2017). If women are given the chance to manage household solid waste initiatives, they will be able to find work and will be able to sort and separate waste as waste users. Women are frequently the innovators in solid waste management projects. They are the primary users of municipal services, and their cooperation is essential for the long achievement of any environmental initiative. In many cultures, they are in charge of maintaining the home and cleaning up after themselves (Davies and Kudzai, 2016). Women are more worried than men about health hazards and environmental issues because of their primary household roles, and this awareness can often result in effective behaviors toward HSWM (Al-Khateeb et al, 2017). They are placed in a situation where they must rely on the environment to carry out their roles and responsibilities, such as farming, fetching water, collecting fuel wood, shopping for food, and conducting management of household solid waste (Braun & Traore, 2015). Bangladesh's waste management program is implemented through a national 3R (Reduce, Reuse, and Recycle) policy that was carried out with assistance from the United Nations Centre for Regional Development (UNCRD) and the Ministry of Environment of the Japanese government (Nasrin, 2016). However, none of these strategies were fully implemented, and the 'repurposing' and 'Recovery' strategies are still in operation (Nasrin, 2016).

The primary goal of this article is to examine the kind of HSWM system in Bangladesh and the process of generating women's empowerment through 5R-based HSWM. People in Bangladesh are mostly unaware of waste management, particularly the 5Rs (Reducing, Reusing, Recycling, Repurposing and Recovery). Despite the fact that household waste is a major problem in our country, individuals throw their waste on the streets and do not utilize waste bins. Every family must participate in the waste management system. In Bangladesh, the majority of families throw of their rubbish on the streets, lanes, and outside of waste bins. Various studies have been conducted to determine the economic viability of household solid waste reduction using the 5R (reduce, reuse, recycle, repurpose, and Recovery) technology, as well as to propose a viable socio-environmental management strategy for empowering women in Bangladesh.

2. HOUSEHOLD SOLID WASTE

Waste is defined as anything that is both a nuisance and something that belongs somewhere else but has no value. Waste is never created by nature; it is always the direct result of human activities. Waste is a social problem that requires social technologies to solve (Ali and Rahitashw, 2019). According to Van & Stegemann, (2020) and Balwan, et. al., (2022), waste is defined as "any material or item that the holder discards, wants to discard, or is obligated to trash,". Waste is actually just the material that is left over, ignored, or thrown away from everything we do, whether it be working, playing, or eating. Simply put, it is content that its maker does not desire. Waste is sometimes referred to as trash, junk, or rubbish (Balwan, et. al., 2022; McDonough, W., 2002). Solid waste (SW) is the rubbish, junk, and sludge produced by our daily activities in the form of non-liquid, non-gaseous, hazardous or non-hazardous, fresh, organic or non-organic, non- biodegradable, worthless things. (Mourshed et. al., 2017).

It is the most obvious and harmful side effect of a consumer-driven, resource-intensive economic lifestyle. (Hoornweg and Tata, 2012; Sharma, H., 2021). Around 80 per cent municipal wastes come from residential areas, which includes paper, plastic, metal, glass, ceramic, wood, cardboard and organic wastes (Suthar and Singh, 2015; Abedin and Jahiruddin, 2015; Huda et. al., 2014). The eight categories of solid waste producers are: domestic, commercial, industrial, institutional, demolition and construction, municipal services, process, and agricultural. (Schübeler, 1996).

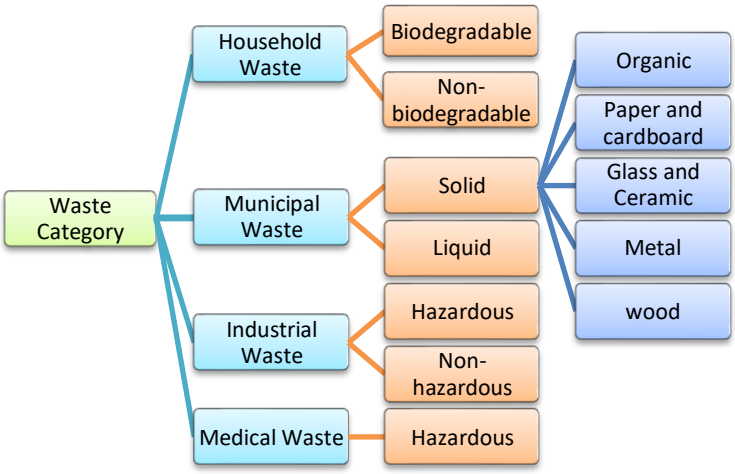

Fig 1: General Category of Wastes in the Developing Countries

In developing countries like Bangladesh, four categories of wastes are often found: household waste, municipal waste, industrial waste,and medical waste. Household wastes are classified into biodegradable and non-biodegradable wastes (Fig 1).

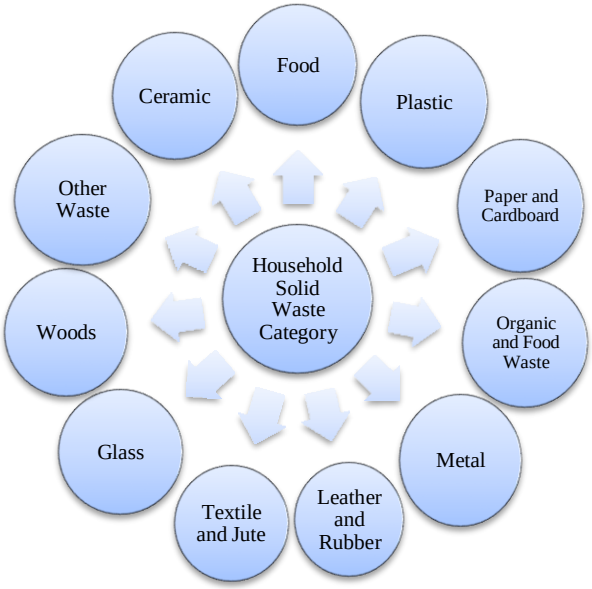

Fig 2: Household Solid Waste Category

The household solid wastes are divided into six main categories like glass and ceramics, paper, plastic and polythene, kitchen/food waste, wood and cardboards, metal and other wastes which is explained in Fig 2 (Suthar and Singh, 2015). The majority of household wasteis food waste, which is collected from kitchen waste and successfully transferred from urban areas to landfills and other sites, whose location and construction are planned with the goal of concealing the waste (Burke and Napawan, 2020).

3. HOUSEHOLD SOLID WASTE MANAGEMENT (HSWM)

Household solid waste management is a serious issue for the environment and public health in many urban areas of developing countries. It includes the waste generated by the domestic or commercial or other notifies areas either in any form such as solid, semi solid or in the liquid form, excluding the hazardous waste coming out from the industries and includes the treated bio-medical wastes. Due to concerns about public health, aesthetics, the preservation of natural resources, and other environmental factors, it refers to actions meant to effectivelycollect, transport, process, and dispose of garbage (Ferronato, & Torretta, 2019). The process of it consists of the generation, storage, collection, transportation and final disposal stages in such a way to bring about effective environmental management (Fig 3) (Abedin and Jahiruddin, 2015; Davies and Kudzai, 2016; Mukherji et al. 2016). The main goals of are to maintain natural resources, defend the environment, and promote public health. Unfortunately, many cities, especially those in developing nations, are struggling to manage theirhigh levels of solid waste (Gutberlet et al. 2017). These countries often have poor waste collection coverage, inefficient collection methods, an absence of infrastructure and technologies for solid waste management, insufficient technological and financial capacity, inadequate handling, pollution from dumping openly, and scant information on garbage production. Other features include a lack of involvement in waste management and public awareness. (Krystosik et al. 2020). In developing nations, collection rates range from 30% to 50%, and collected waste is disposed of in

unregulated landfills (Kapadia & Agrawal, 2019). It is estimated that India generates more than 55 milliontons of municipal waste each year (Ferronato, & Torretta, 2019). These aspects of management, therefore, require the intervention of legal, economic, governmental, political, administrative and environmental actors. The structure and management function are site-specific and depend on socio-economic, behavioral, cultural, institutional and political frameworks. With the increasing household solid wastes, the costof waste management is rising, and the associated socio-environmental and health problems also increased (Boateng et al. 2019). In manycities of Bangladesh, waste is being inadequately disposed of in open land. The uncollected garbage is deposited in public areas, on roadways, and in drains, clogging the drainage system and seriously harming the environment. Nevertheless, many studies did not emphasison waste minimization and recovery as integrated plans for improvement.

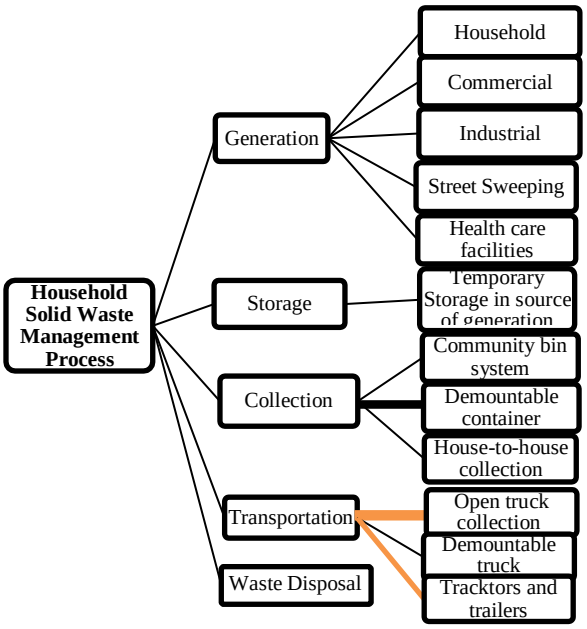

Fig 3: Household Solid Waste Management Process

Thus, a mixed waste management approach needs to be designed to attain the goal of solid waste management (Afroz and Tudin, 2017). Sustainability is a keystone in HSWM systems to insure consistent waste management (Al-Khateeb et al, 2017). Any HSWM system that is intended to be long-lasting is mostly dependent on the community's participation and the financial resources that are readily accessible.

Table 1: Application of 5r approaches of different household wastes

Household Solid Waste	Parts of Different Types Waste	Smart Waste Management Strategy	Application of 5R Approaches
Glass and Ceramics	scrape of glass, bottles/ containers, broken kitchen articles made of glass	Reuse/Recycle	Glass and Ceramics Reusing/ Recycling to produce a new item
Paper	Paper, Newspaper, Plain paper, packaging other paper	Reuse/Recycle/Repurpose	Paper reusing, recycling and Recovery/handm paper/Paper craft/up cycle/reuse Briquetting/fu pallets/Paper Crete (bricks)/partition wall/furniture making Incineration/WtE (decentralized)
Plastic and Polythene	plastic articles, polythene and other items made of primarily plastic.	Reuse/Recycle/Repurpose	Plastic Reusing/Recycling and Recovery Plastic to brick Plastic to pavement/roof tiles Plastic to furniture/barricades making Incineration/WtE (decentralized
Kitchen and Food Waste	peeling waste, discarded vegetables, food waste, discarded food, seeds,	Reduce/Reuse/Recycle/Rep urpose	Food Waste Reducing / Kitchen Waste Recycl for Organic Fertilizer/Recovery Food Waste (e;g;Using Egg Shells for making showpieces
Wood and Cardboards	non-recyclable paper, cardboards, cartons,	Reuse/Repurpose	Wood and Cardboard reusing after repair and Recovery as room furnitures (e.g. using cardboard for making desk organizer and kids toyes
Metal	metallic items, can, jars of metal,	Reuse/Reuse/Repurpose	Scrap metal and Ornament collection and resa
Other Waste	wood, saw dust, leaf litter, garden pruning, dirt and other inert material.	Reduce/Reuse/Repurpose	Different mode of waste management is application for different wastes.

4. HOUSEHOLD SOLID WASTE MANAGEMENT WITH 5RS

Large volumes of waste are continuously produced as a result of growing population, higher consumption, and an expanding economy. Even though waste used to be seen as a disposable item, it is now considered a resource. (Sibanda et al, 2017). The environment and publichealth are both significantly impacted by waste management. Hazards to human health and the environment are produced by various waste management techniques. The open disposal of garbage is a significant cause of environmental degradation, air, water, and soil contamination, as well as health risks (Karunarathne, 2015). Most of the studies focused on the economic advancements of reusing or recycling household waste, but few studies have been conducted to waste minimization and resource generation. The 5R approaches of HSWM are the parts of the sustainable environment and empowerment with different characteristics from the sources (Fig 4). Different smart waste management strategies are applicable for different types of waste, making sources for income-generating activities for womenthrough 5R approaches (Table 1) (Afroz and Turin, 2017). This type of income-generating project needs both cooperation and collaboration between public and private organizations, which need to be implemented in all governmental policies (Nasrin, 2016).

Fig 4: The 5R Approaches of HSWM

Recycling of waste products such biomass, plastic bags, paper, broken furniture, medical waste, and electronic trash, which make up the majority of wastes produced in affluent nations (ADB and IGES, 2007). In light of this, some unwanted items, such as used books, baby diapers, disposable razors, mobile phones, and broken bulbs, might be categorized as domestic waste (Table 1) (A.R Fahzy, 2014). Papers, metals, glass, plastic, biological wastes, etc. are examples of waste that may be recycled for financial benefit (Table 1). Some of these items may be manually sorted, while others may need to be processed into usable forms using different methods to separate them at the dumping area, such as air separation and magnetic separation. After separation some usable materials are used in different shape in different application (Table 1).

4.1 Reusing Household Solid Waste

Reuse is defined as "to use again or more than once" by the Oxford Dictionary. To begin, replication is defined as "the process of replicatingor reproducing anything." The phrase reproduction, which is defined as "the action or process of copying something," is already included in this description (Van de Sandt et. al., 2019). Reuse of household waste means any operation by which household products or components that are not wastes and can be used again for the same purpose for which they were conceived (Fig 4) (EWWR, 2013). Recently, it has become clear that recycling and reusing are the most important variables that might contribute to the development of closed-loop supply chains, particularly for crucial resources that could experience supply interruptions if a circular economy is not properly designed and implemented. Waste reusing and recycling and are almost the same as needed to achieve some of the goals of sustainable development. There are very few formal recycling and reusing sectors of wastes are active in Bangladesh. The non-government authorities are more efficient than government city corporations for waste collection, transportation, reuse and recycling. Bangladesh needs the following sustainable development goals: household waste reduction, recycling and reusing in the metropolitan city, and the repurposing and sometimes Recovery into resources in the rural area. Women can create a source of earning for the betterment of overall country GDP.

4.2 Reducing Household Solid Waste

Reducing household waste is also known as source reduction at the household level by which less material and energy are practiced by minimizing waste generation and preserving nature (EPA, 2017). With a little planning, thought, and creativity, it is possible to reduce household waste significantly. For example, household food waste is reduced after purchasing folding reusable bags or containers and avoiding bottled water, paper towels, napkins, and tissues by practicing reusable items (EPA, 2020). Moreover, reducing waste can save money, conserve resources, save energy and water, and reduce pollution.

4.3 Recycling Household Solid Waste

Recycling household waste is a procedure of converting waste resources at the household level into new resources and it can prevent the unwanted of potential materials and household materials and convert it into fresh raw materials for reuse (Rhyner et. al., 2017). The objective of waste recycling is to reduce landfill waste, and at the same time, it reduces the number of raw materials, energy and water consumption. Recycling is a very general term to conversion through waste materials that have to be collected, processed, remanufacturedand then transformed into a resource (EPA, 2017). Composting is a type of recycling that may take place in an aerobic atmosphere. Compostmade from recycled food waste enhances soil health and structure, improves drought tolerance, and lowers the need for additional water, fertilizers, and pesticides. Composting is a completely automated process that comprises of multiple phases carried out under regulated environmental conditions (temperature, humidity, etc.) to expedite the process (Ayilara, M. S. et. al., 2020). Designing a beautiful and socially acceptable machine with a sufficient size to fit in any kitchen was taken into consideration. Decomposition of waste occurs in this procedure when it is stored in a buried pit for 3 to 6 months. Composting methods from Banglore and Indore are widely used. It's an excellent bio fertiliser. (Kosoe et. al., 2019; Memon & Agrawal, 2019). Food waste is a major global issue that has frequently been addressedthrough the use of composting systems as an alternate waste management approach (Awasthi et. al., 2020). Qatar is one of the top ten nations in the world for food waste per capita, ranging from 584 to 657 kilos per year. Food waste, in particular, has a negative impact on the environment, the economy, and public health, and it continues to be a source of serious environmental concern as the global populationand need for food continues to rise (Zulkifli et. al., 2019). Because of the high rate of food consumption and the poor rate of food waste recycling, mountains of food are thrown in landfills, where they are burnt, emitting hazardous gases.

Food consumption is regularly doubling as a result of population growth and rising living standards, resulting in a massive amount of foodwaste (FWs) production. Nonetheless, FWs make up 67.65% of all municipal solid waste (MSW) streams in Bangladesh, where total MSWproduction is 19,361.73 tons per day and total SW production is 58,963.15 tons per day (excluding agricultural wastes) (Alam & Qiao, 2020; Alam et. al., 2015; Abedin, & Jahiruddin, 2015; Islam, F. S., 2016)). Similarly, the effectiveness of SWs collection ranges from 37 to 77 percent across the country, with the rural region having minimal efficiency. Apart from that, whereas FW disposal in rural areas is not a major issue, it has become a major issue for urban authorities due to a lack of research and investment (Ananno, A. et. al., 2021; Alam & Qiao, 2020; Alam et. al., 2015). Furthermore, because to a lack of awareness among the general public and the ineffective execution of policies (3Rs approach in 2010), the majority of individuals toss their daily generators away. Moreover, most individuals dump their daily produced FWs onto neighboring roadsides/fallow lands/drainage flow because to a lack of understanding among the general public and poor implementation of policies (3Rs approach in 2010). Waste Concern is managing similar programs in Dhaka with the help of the municipal government and the Department of Environment (Ananno, A. et. al., 2021; Alam et. al., 2015).

In Bangladesh, FW is frequently combined with other household waste, limiting its recycling possibilities. Community-based organizations(CBOs) then collect the waste and place it in municipal waste bins. A small portion of these dustbins is collected by certain NGOs for composting, but the majority is handled by local governments, who then throw waste into landfills without classifying or pre-treatment, causing leachate and gaseous pollutants (GHGs) (Ananno, A. et. al., 2021; Alam et. al., 2015). However, with methods like as composting, incineration, and anaerobic digestion, the whole FWs may be transformed into composting products (soil nutrients and fertilizers) and energy. Furthermore, very small-scale composting (urban) and anaerobic digestion (rural) operations of FWs are now underway in Bangladesh However, there is a scarcity of study on the formation, effects, and management of FWs in Bangladesh (Ananno, A. et. al., 2021; Alam et. al., 2015).

4.4 Repurposing Household Solid Waste

Repurposing is the use of something for a purpose other than its original intended use (Van de Sandt et. al., 2019; Kim and Youn, 2019). Itcan be done by modifying it to fit a new use, or by using the item as is in a new way. Most environmentally conscious women are very conscious of reusing and repurposing of household things. Many different projects can be done with broken items to create stunning décor.Those are from things that may initially be considered waste. The most effective examples of repurposing include using cardboard boxes for storing supplies, used printer paper for scrap paper, binder clips for holding chargers and power cords in place, and even coffee mugs, mason jars, and tin cans for holding pens and pencils. (Balwan, et. al., 2022; SZTANGRET, I., 2021; Jestratijevic, 2021). Furthermore, an aluminium dish can be reshaped as a reflector to drive birds away in a vegetable garden and a toothbrush holder can be made from a plasticwater bottle. Plastic water bottles are used in Bangladesh to store water for drinking, irrigation, laundry, and many taps. According to a recent worldwide estimate, Bangladesh generated 1,000 tonnes of textile waste annually till November 2021, equating to possibly a billiondollars' worth of repurposed material. Approximately 1% of the materials used to make clothing is recycled into new apparel, resulting in an annual waste of almost $100 billion. If current recycling technology and infrastructures are improved, the fashion sector may have an 80 percent circular by 2030 (The Financial Express, 8 February, 2021).

4.5 Household Solid Waste Recovery

The process of recovery materials or energy from solid waste for reuse is known as resource recovery. The objective is to maximize the environmental, financial, and social costs of these materials before they are permanently buried in a landfill. Reduce first, reuse second, recycle third, incinerate with energy recovery fourth, and landfill last, according to the environmentalists and the Environmental Protection Agency (EPA). Resource recovery of household waste means to use waste as an input of resource material to create valuable products as new outputs. It reduces the amount of waste generated, thus brings down the need for landfilling. Recovery optimises the values created from waste. Household wastes made of plastic, paper, cloth, aluminium, glass and metal are great examples for resource recovery where new value can be created (Iacovidou et. al., 2017). For example, organic materials can be turned into energy, compost, orfertilizer. Resource recovery is a part of a circular economy, in which natural resource extraction and waste generation become minimizedtowards sustainable waste management (Velenturf, et. al., 2019). To prevent littering and enhance the cleanliness of these places, the municipality in Bangladesh has installed public waste cans constructed from used oil barrels beside some of the main roadways.

5. CURRENT HSWM SYSTEM IN BANGLADESH

Waste management program in Bangladesh was executed in 2010 through national 3R (Reducing, Reusing and Recycling) policy which has been developed with the support of the Ministry of Environment of Japan Government and Centre for Regional Development of the UN, where Waste Concern provided the technical assistance (Afroz et. al., 2009; Nasrin, 2016; Afroz and Tudin, 2017; Ashikuzzama and Howlader, 2020). The national 3R aim for waste management is to completely eliminate waste dumping in open landfills, rivers, and floodplains by 2015 and to encourage recycling through the need of waste segregation. The program has been made available on a domesticlevel. The issue of implementation in the industry, business, and consumer of real estate is not taken into account. Prior to it, the nation's waste management procedures were essentially confined to the collection, transportation, and disposal of garbage in cities and other urbanregions with municipalities. The job of waste pickers, colloquially referred to as "tokais," has been the most noticeable action regarding waste aside from extensive littering, disposal of waste at primary collection stations, and open dumping (Urme et., al., 2021; Amin, 2017). However, any of these approaches were not appropriately applied, and the following program of 5R that includes 'repurpose' and 'recovery'strategies are still left out (Nasrin, 2016). The national 3R goal for waste management has been achieved for eliminating waste disposal inopen dumps, lack of side and roadside by 2015, and recycling of waste has started as a mandatory issue. Recently, 5R (Reusing, Reducing, Recycling, Repurposing and Recovery) is so effective from 3R. So, we have to shift to 5R implementation soon (JICA,2018).

In Bangladesh, a significant chunk of wastes, 40% to 60%, are not adequately kept, collected, or dumped in the authorized sites for final disposal due to a lack of motivation, knowledge, commitment, competence, and money (Chowdhury et. al., 2014). The effectiveness of solid waste disposing depends on choosing a suitable location, and the current global trend of waste management problems is created by unsustainable disposal practices, which are ultimately the result of very poor planning. (Urme et. al., 2021; Afroz, R., and Tudin, R. 2017).The most frequent issues with inappropriate dumping are the spread of infections, dangers from fire, odors, contamination of the air and water, aesthetic annoyances, and financial losses (Urme et. al., 2021; Afroz, R., 2011).

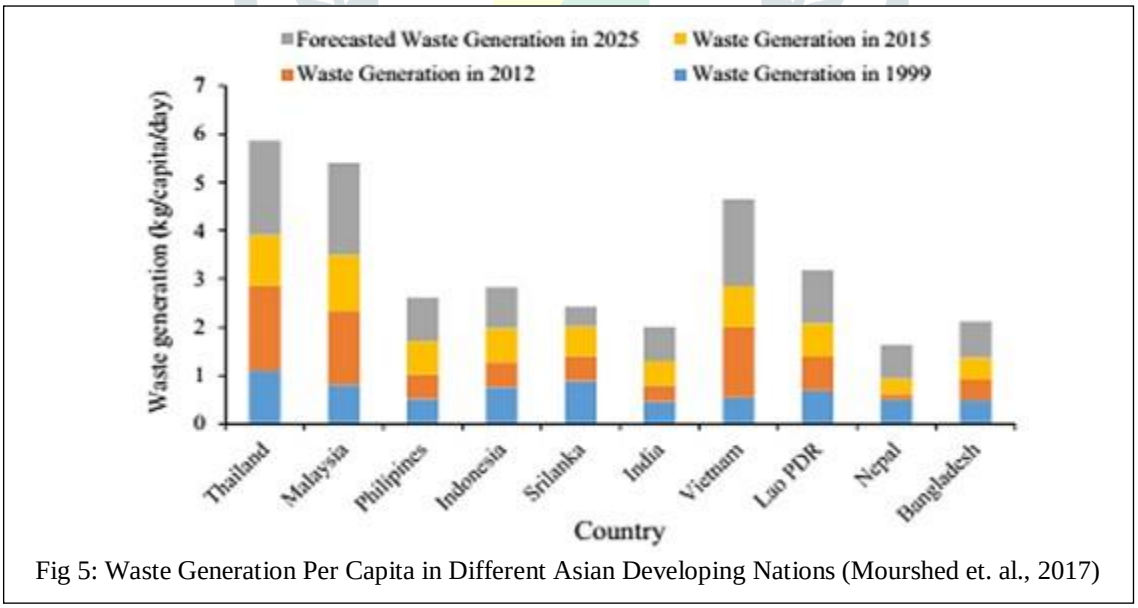

Fig 5: Waste Generation Per Capita in Different Asian Developing Nations (Mourshed et. al., 2017)

Figure 5 gives a more detailed look at the waste generation scenarios for several Asian nations for the years 1999, 2012, 2015, and forecasts for 2025. The World Bank estimates that the per capita waste production for poor nations ranged from 0.12 to 5.1 kg/capita/day, but it is around 0.45 kg/capita/day for the South-East Asian area. In contrast, Bangladesh produced 0.43 kg per capita per day in 2012 and 0.47 kgper capita per day in 2015. Furthermore, it is predicted to increase to 0.75 kg per people per day by 2025. Thailand (1.76 kilogram/day), Vietnam (1.46 kilogram/day), and Malaysia (1.52 kilogram/day) had the highest per capita garbage creation for the year 2012. Low incoming and developing nations including India, Sri Lanka, Nepal and the Philippines had per capita waste production rates that were, respectively, 0.34 kilogram/day, 0.51 kilogram/day, 0.12 kilogram/day, and 0.5 kilogram/day. It is also clear from Fig. 6 that emerging nations would face a severe danger from their waste since it is predicted that in the coming years, their waste creation will increase by a factor of two to three. As 5R (Reusing, Reducing, Recycling, Repurposing and Recovery) approach is more effective than 3R, so, the country's policy suggests shifting 3R to 5R implementation (JICA, 2018). Dhaka generates 7,200 tons of waste every day, according to JICA. In cities from outside Dhaka, 50 percent of waste

pollutes the environment. In Dhaka city, 6,110 tons of waste are produced each day from a variety of sources, including individuals, companies, and industrial units (JICA, 2018). Here, per capita waste generation estimates range between 0.29 and 0.60 kilograms per person per day, depending on the individual's level of income (CCAC, 2020). By 2025, the quantity of waste produced per person will be 0.75 kilogram/person/day, with a total annual production of 21.07 million tons of waste (Ashikuzzaman, 2019). In 2014, Chittagong City Corporation began a pilot project for the waste treatment plant in Halishahar, which had already started operating and producing fuel from waste. The project to create composite fertilizer was carried out at the lowest cost using its technology and people resources. To manufacture composite fertilizer, the project was carried out at the lowest possible cost using its technology and manpower resources (UNCRD, 2019). There are some private organizations such as Prism, Dustha Shasthya Kendra, CARE Prodipan, and Clean Kalabagan that work with every city corporation for solid waste management all over the country. For instance, Prism began working on neighborhood-based urban garbage treatment programs in Khulna city in 1989. Dustha Shasthya Kendra (DSK) provides health concern training on solid waste management in Dhaka and Chittagong city. CARE has started working in Dhaka, Dinajpur, Mymensingh city corporation, and Jessore through the "Shahor project," which USAID has funded since 2000. Prodipan concentrates on the domestic level for wastes management in Khulna city supported by the Swiss Development Cooperation. Solid waste management programs are started by Clean Kalabagan and other local private enterprises in areas of Dhaka city including Kalabagan, Mohammadpur, Shamoly-Adabor, Dhanmondi, Gulshan, Banani, Mirpur and Uttara. Many private organisations took initiatives to co-operate to Dhaka City Corporation (Dhaka city corporation, 2020) to collect solid wastes from door to door. Though Dhaka turns into a Mega city infested with slums and residents, its environmental problems are becoming complex. In HSWM, Dhaka City Corporation's cleaning employees had issues with honesty, accountability, and responsibility. There were also issues with bureaucratic obstacles, a lack of inspection, monitoring, and coordination. Overall, the Dhaka City Corporation has failed to handle the whole household solid waste of this increasing population and lower participation of the households for overall sustainable HSWM policies. Nevertheless, the current solid waste management system for women households has been neglected thoroughly to address a broad range of waste disposal problem through inefficient, corrupt, centralised, politicised and male-dominated management (Urme et., al., 2021; Afroz and Tudin, 2017).

Specifically in the bigger metropolitan areas like Dhaka city, controlling urban solid waste is an unavoidable difficulty in growing nations (Urme et. al., 2021). Because of the growing urban population, environmentalists have begun to emphasise scientific waste management inurban design in developing nations. Wastes from the domestic sector are often gathered in an unsegregated way and put into the small containers at the residences. City Corporation (CC) contracts with companies who carry garbage to secondary collection locations using van-men and pay for the service (containers or specified locations). After that, a wide range of vehicle sizes transfer the waste to the disposal locations at Amin Bazaar and Matuail (of the City Corporation or a private company that the City Corporation has approved). Recyclable materials are collected by the Tokai or scavengers from open garbage bins and landfills, and they then sell them to recycle waste dealers (Bhangari). The recycling traders then wash, dry, and sort the products before selling them on the market. Along with the scavengers, the Hawkers deal with the Bhangari and purchase recyclables door to door (receivables buyers). In several ways, waste collection is different in slum dwellings. In these locations, the City Corporation often doesn't offer any waste management services. The waste management procedure is very different in city streets. Daily cleaning of public spaces, such as roads, sewers, and parks, is done by the municipal agencthrough its cleaning staffs (both long-term and short-term). The management of commercial waste is far more difficult than that of waste in residential and public areas. Land filling facilities are where the city's collected waste is finally disposed of. For solid waste management in Dhaka, two significant efforts have been launched. JICA, the Japanese organization that promotes international cooperation, initiated one project in 2005 with the objectives of developing a Dhaka City master plan and enhancing the Dhaka City Corporation's management capabilities. The 3R Strategy was introduced as a new initiative in 2010 by the government's Department of Environment (DoE), Ministry of Environment and Forestry. The 3Rs are a common name for the idea of reducing, reusing, and recycling items and materials. By transforming waste into priceless resources and protecting the environment from greenhouse gas emissions, the 3Rs may play an importantrole in sustainable waste management.

According to the Dhaka City Cooperation, out of the 3500 tons of solid waste that are produced daily overall, the city corporation collectsand disposes of 1800 tons, 900 tons are dumped in backyards and landfills, 400 tons are dumped on the sides of the road and in open areas, 300 tons are recycled by the Tokais (mostly the children of slum dwellers), and 100 tons are recycled at the point of generation (Urme et. al., 2021; Afroz, R., and Tudin, R. 2017). In the city, around half of the waste produced each day is not collected and is instead discarded at permitted disposal locations. Only 14–17% of the city's total budget, or around 0.5 USD per person annually, is allocated to managing solid waste (Urme et. al., 2021; Afroz, R., and Tudin, R. 2017). As a result, the uncollected waste is primarily dumped illegally in the neighborhood's streets, wastewater drains, ponds, lakes etc. or managed informally. The condition of waste collection as a whole is not good. Uncollected waste in large quantities quickly pollutes the surrounding ecosystem. Due to its harmful impacts on the environment, municipal solid waste management and disposal are a global concern, particularly in developing nations. Solid waste management is a significant problem since it may lead to pollution of the land when abandoned in open areas, the water when placed in marshes, and the air when burned. E-waste was initially recognized as hazardous waste in Bangladesh under the medical waste management regulations in 2008. (M. T. Islam et al. 2016). According to Bangladesh's perspective, the extended producer responsibility (EPR) presented various laws and regulations that are considered to be the primary method for managing e-waste (Afroz et al. 2013).

To summarize, early waste management practices in Bangladesh permitted indiscriminate open dumping, landfilling, disposal of waste intowater bodies, burning and direct placement of waste onto agricultural land. (Afroz, R., and Tudin, R. 2017; Ashikuzzama and Howlader, 2020). The country's waste management system has evolved from traditional to contemporary as time has passed (Ashikuzzama and Howlader, 2020).

6. WOMEN EMPOWERMENT

Empowerment is a concept that connects individual talents and competences, natural support systems, and proactive behaviours to social policy and social change goals, particularly in the area of reducing gender inequality (Perkins & Zimmerman, 1995). Empowerment is defined as a process that makes no distinction between the public and private domains, moves from the personal to the social, and connectsthe individual and the communal (Yuval-Davis, N.,1994). A person's intellectual aptitude, decision-making capability, authoritative authority, and decrease of gender inequity are all necessary for empowerment.

"There is no tool for development more effective than the empowerment of women.'' -Kofi Annan. On this subject, there are two main points of view. First, it is individualistic, in which women's empowerment is based on their own capabilities and decisions (Kabeer, 1999). Second, collectivistic empowerment (Budgeon, 2015; Kurti et al., 2016), where empowerment is based on collective behavior and emphasizes collective growth. To put it another way, the first assumption is that women's empowerment is the act of employing resourcesin an agentic way to achieve certain goals (Khan and Khan, 2016). Empowering women is a critical goal for long-term development. Bangladeshi women account for approximately half of the population, and thereby have a significant ability to contribute to the country's socioeconomic development (Wei et. al., 2021; Hossain, N., 2021; Akhter & Cheng, 2020). Through capacity building and policy supportat the national and local levels, the International Environmental Technology Centre of the UN Environment Program has been working ona waste and climate change project in Bhutan, Nepal and Mongolia since 2016. The project's objective is to minimize the climatic consequences of the waste industry (Ručevska et. al., 2019). The organization employs hundreds of women who use recyclable plastic waste to produce and promote products. Recently, others have received training on how to produce compost from organic waste. In the capital of Mongolia, a woman is in charge of one of the main recycling collecting sites. The 59-year-old proprietor of the business, TserenjavSodnompil, has grown her company so much that she now employs her daughter to run it (Ručevska et. al., 2019).

7. WOMEN'S EMPOWERMENT SCENARIO IN BANGLADESH

In Bangladesh's constitution, women's rights and empowerment are also emphasized. According to Article 292 of the Constitution, "equalityof opportunity in public work" means that "all citizens of the state have equal opportunity for employment or office in the service of the Republic." Bangladesh is quickly approaching its goal of being a middle-income country by 2021. A per capita income of $3500 is required by the government. Bangladesh has made significant progress in the areas of female and child development, notably in terms of job creation,empowerment, and decision-making for women, between 2008 and 2018. Bangladesh has emerged as a role model for other developing countries in recent years. These accomplishments in the socioeconomic sectors have increased the possibility of reaching sustainable development goals, particularly in terms of eliminating gender inequality (Debnath et. al., 2020). Women's decision-making power, on the other hand, is influenced by a number of factors, including their economic and child-rearing decisions, their freedom of movement, their power relationships with their husbands, and their control over resources (Wei et. al., 2021; Akhter & Cheng, 2020). However, the majorityof Bangladeshi women are housewives with limited education. They depend on their husband or father to do something for them. As a result, they are obligated to obey their husband's or father's decisions. The majority of educated women also rely on male family membersto obtain permission to carry out their desires (Wei et. al., 2021; Akhter & Cheng, 2020; Zafarullah, & Nawaz, 2019)). In comparison to men, the majority of women work in agriculture. This contributes to their less favourable working conditions compared to males. Poverty, illiteracy, unemployment, disempowerment, and food scarcity are the biggest barriers to women in Bangladesh being empowered (Wei et. al., 2021; Hossain, N., 2021; Akhter & Cheng, 2020). Bangladeshi women who work in the solid waste management sector, such as collecting waste from streets and residences, recycling it, or reusing it, at household decisions, and decision-making, are able to address gender challenges. Women's empowerment in Bangladesh is determined by their education, employment, control over their own incomes, involvement in these activities, and more (Wei et. al., 2021; Hossain, N., 2021; Akhter & Cheng, 2020). The United Nations Commission on the Status of Women (CSW63) released some preliminary findings earlier this month (Ručevska et. al., 2019). Despite the fact that so many people are hungry, Bangladeshi women are becoming more involved in generating household income and ensuring the food security of their families (Wei et. al., 2021; Hossain, N., 2021). They could want to produce poultry to provide protein for their family while also adding to household earnings.

8. PARTICIPATION OF BANGLADESHI WOMEN IN THE WASTE MANAGEMENT PROGRAM

"Waste disposal, collection, and management" is stated in the City Corporation Act of 2009. (Amin, 2017). However, in 2013, the National Environmental Policy acknowledged the 3R plan, which was adopted by the government in 2010, as an effective waste management technique (Amin, 2017). The initiative was carried out at the household level (Afroz et. al., 2020). Several Bangladeshi organizations, including the Department of Environment (DoE), the Department of Public Health Engineering (DPHE), the Sustainable Renewable Energy Development Authority (SREDA), and the Local Government Engineering Department (LGED), were thinking about integrating 3R approaches into national waste management and municipal development programs (Ashikuzzama and Howlader, 2020). In Bangladesh, thewaste management program takes a systematic approach, looking at waste generation, separation at the household level, collection, transportation, and disposal or recycling/reuse, with women playing a major role (Afroz, R., and Tudin, R. 2017; Ashikuzzama and Howlader, 2020). This initiative combines the efforts of women to establish themselves as entrepreneurs with the participation of municipalities (Ashikuzzama and Howlader, 2020). They are also receiving assistance from the government and non-governmental organizations (NGOs) in order to develop their partnerships with larger recycling companies (Ashikuzzama and Howlader, 2020). It's done through service-level agreements between waste cooperatives and municipalities that are based on performance (Ashikuzzama and Howlader, 2020). In Bangladesh, women's participation in waste management can boost efficiency levels, employee participation, product quality, profitability, a positive neighbor image, and environmental performance (Afroz & Tudin, 2017). They are also receiving assistance from the government and the NGOs in order to develop their partnerships with larger recycling companies (Ashikuzzama and Howlader, 2020). It's done through service-level agreements between waste cooperatives and municipalities that are based on performance (Ashikuzzama and Howlader, 2020).

9. CONCLUSION

In Bangladesh, a large section of the population has no idea how to get waste collection services or how to successfully manage it, and a significant amount of the garbage is improperly disposed of and dumped in unplanned sites, posing serious environmental risks. Non-governmental and community-based organizations have implemented a door-to-door collection process that gathers just a portion of the waste generated (Chowdhury et. al., 2014). Multiple researches on waste generation and characterization have been undertaken in Bangladesh by six City Corporations and several municipalities, but HSWM studies have been sparse (Chowdhury et. al., 2014). The existing HSWM system in Bangladesh is, on the whole, unsatisfactory. Despite the fact that the local government spends a significant portion of its budget on it, it is unable to effectively administer and manage it. The informal sector and NGOs help local governments as municipal solid waste management partners. It may be gradually replicated in each urban and rural centre, and Bangladesh's development spots might be crucial in mitigating climate change. The current 5Rs plan (Reusing, Reducing, Recycling, Repurposing and Recovery) will become more important in terms of women's empowerment and socio-environmental sustainability. Women are capable of providing traditional knowledge and managing natural resources, as well as household solid waste, which requires traditional knowledge and abilities to be harnessed (Nasrin, 2016) Women are more concerned than males about health dangers and environmental concerns because of their central role at home, and this concern might lead to conservative attitudes about these issues (Al-Khateeb et al, 2017). In order to learn more about women's empowerment initiatives in Bangladesh, it is essential to look at waste management strategies at the household level.The paper will provide the groundwork for future efforts, providing information that policymakers, researchers, and others will need to develop future standards. The requirement for disaggregating solid waste management difficulties is recognized using gender perspectives, which also extends to HSWM. Because a better knowledge of gender discrepancies and inequities can assist to enhance the efficacy of household solid waste disposal (Nasrin, 2016).

The majority of benchmarks and criteria for HSWM are based on international research that has no relevance on Bangladesh's actual situation. Furthermore, there has been no particular research on the influence of HSWM on women's empowerment. As a result, addressinggender disparities and inequities in solid waste disposal projects, as well as women's empowerment, will enhance their efficacy (Davies and Kudzai, 2016). This paper might be utilized as a full-fledged motivator for HSWM that is based on socio-environmental sustainability. Furthermore, waste may be turned into a resource and a source of income for women by employing appropriate technique. Furthermore, low- and middle-income families have limited space at home for recycling and storing. Dhaka also lacks a well-organized household recycling system at the moment. As a result, household waste recovery is a preferred long-term management strategy in the process of women's empowerment. By empowering women to manage their household solid waste, this article is hoped to contribute to long-term socio-environmental initiatives. It will also aid the Council's continuing household solid waste initiatives by shifting the conversation aboutsolid waste from a legal issue to a household responsibility; and it may strengthen the role of women and their untapped potential in HSWM. On the other side, through recycling and reusing household solid waste, this paper will aid Bangladeshi women in achieving socio- environmental sustainability.

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