The International Journal of Engineering and Science (IJES)
|| Volume || 12 || Issue || 7 || July || Pages || PP 06-10 || 2023 ||
ISSN (e): 2319-1813 ISSN (p): 20-24-1805

Approaching Zero Waste Management of Municipal Solid Waste (MSW) Integreted with Agricultural, Poultry, Ruminants, Worm and Maggot Farming

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ABSTRACT

Waste is the symbol of inefficiency of any modern society and a representation of misallocated resources. Municipal solid waste (MSW) is still environmental problem in many countries, because the treatment is inappropriate yet. MSW mostly consists of biodegradable organic compounds that are degraded in open surfaces. Degradation of MSW composting is common processes, that was in order of month. More rapid process, MSW was degraded by maggot or worm, the maggot and worm are very greedy to eat the degraded MSW, the process in order of days. We can draw many scenarios of processing of MSW. The common route was MSW proceeded into compost, compost material is very useful as a soil amendment and fertilizer to increase the crop production. MSW was composted by maggot or worm to speed up the degradation process and integrated with chicken, duck and agricultural farming. Overall, this integrated scheme are reduced the cost and increased the benefits of the MSW management.

Key words: *MSW, maggot, ruminant, protein, poultry, integrated*

Date of Submission: 01-07-2023 Date of Acceptance: 11-07-2023

I. INTRODUCTION

Waste is the symbol of inefficiency of any modern society and a representation of misallocated resources.[1] MSW was generated mostly by house hold, industries, and public services. The quantity of MSW increases by increasing the population, industries and public services. The current treatment of MSW is open dumping, those treatment always spent cost, but do not get any benefits, and we called cost oriented. The open dumping system just removed a problem from one place to another places. A new approach of the MSW treatment always lead to benefit oriented and to have vision to zero waste management.

Integrated Municipal Solid Waste (MSW) management is a tendentious task requiring the simultaneous fulfilment of technical, economical and social constraints. It combines a range of collection and treatment methods to handle all materials in the waste stream in an environmentally effective, economically affordable and socially acceptable way.[2]

The issue of the municipal solid waste management was some of the most important challenges to extend the economic circular, environment sustainable protection, any benefits from the MSW management. Zero waste vision requires a change in our way of thinking and establishing of practices. The zero concept is the form of waste management, the zero waste concept including a wide range of steps.[3]

Zero waste is defined as the conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that treat the environment or human health.[4] Zero waste principles contributes to the circular economy.[5] Circular economy is an economic system that replaces the ‘’end-of-life” concept with reducing, reusing, recycling and recovering materials in production, distribution and consumption phase of their life cycle.[6] Zero waste is connected to properties agriculture, design, energy, industrial, economical and community development.[7]

Zero waste is a visionary concept for confronting waste problems in our society. The idea is being developed and implemented in various sectors including waste management and treatment. Zero Waste is a strategic vision of a community.[7] It supposes that raw materials in the system will be recycled, and will not end in an incinerator or in landfills. However, in fact this is an attainable aim, and an increasing number of states, towns, municipalities and companies all over the world are gradually joining this movement.

The economic and system tools include responsibility of producers for their products. Briefly explained, this means that if a product and its packaging may not be re-used, recycled or composted, then the producer must be responsible for its collection and its safe disposal after the end of its lifetime. In the EU countries, this concept

is applied to packaging, oils, electrical waste, accumulators, batteries and single-cell batteries, discharge and fluorescent lamps, automobiles, tyres, and medicines.[3]

The existing solid waste management system schemes have been developed and implemented including systems for recovery and reuse. In this study, zero waste lifestyle is measured by applying 3R theory (Reduce, Reuse, and Recycle). Several studies use 3R principles as the dimensions of waste management or zero waste lifestyle.[4,8,9] The Reduction principle is defined as minimizing the amount of waste through reducing consumption and waste avoidance. [4,5] The Reuse principle refers to using again a product or a component/material of the product according to the original purpose. While the recycle principle refers to the recovery operation when waste is reprocessed into products or materials. The zero waste concept includes a wide range of steps:

Zero waste principle of (a) System Wide Principles Flow of resources viewed as a cycle with minimized input and output. The responsibility by products for the life cycle impacts of products and packaging, creating incentive to design more benign products. Focusing on increasing benefits to communities and optimizing productive use of resources. Also focus on locally owed, independent industries. According for environmental costs and benefits. (b) Government Policies Eliminate waste by holding producers responsible for impact. Systematically optimize environmental, economic and social impacts of the production and consumption cycle. Create level playing field or outright subsidies to promote resource conservation industries. (c) Raw Material Supply The Emphasis on recycled material use and sustainable harvesting of natural resources. Also Emphasis on use of nontoxic materials. (d) Product and Packing Design Guided by design-for-environment principles to reduce resource use and environmental emissions, and to minimize recycling or reuse costs. Focus on waste minimization, durability, reparability, and recyclability. Maximized lifespans of products. (e) Manufacturing Practices Companies redesign entire operations to minimize resource use and environmental emissions and maximize product reuse and recycling. Producing companies are responsible for end-of life management of their products and packaging. Producers influence Zero Waste throughout the system by adjusting specifications for suppliers and by taking responsibility for end of-life management. (f) Consumption Consumers select products based on environmental performance, price, and quality. Consumers participate in recycling and reuse programs. (g) End–of-life Management Programs create strong incentive to maximize diversion. Programs incorporate full cost accounting principles. Producers bear most costs of disposal. [7]

Implementation of the Zero Waste concept requires: (a) To determine the year in which we want to achieve this aim - usually, this concerns a period of 15 to 20 years, the final aim should be planned in several stages; (b) To involve the public in the intention - local representatives, entrepreneurs, inhabitants. The public campaign must be a permanent part of the plan. The campaign may include issuance of a leaflet for each household, intensive campaign in the media, opinion polls, lectures, often it is necessary to personally contact households, from door to door, competitions for schools, exhibitions, notice boards on municipal authorities. (c) To promote and support projects for prevention of production of wastes, and for their re-use - local deposit system, second-hand store selling furniture, building materials, electronics, etc.; (d) To start biological waste composting - if possible, to support composting in households and communities in the first stage, and, later, a system of collection of biological waste and its composting in the municipality; (e)To create good conditions for separated collection of dry recyclable wastes for the inhabitants - to ensure sufficient number of containers for recyclable components; in the districts of family houses, a sack system and collection from door to door may be introduced; (f) To introduce collection of high-volume, hazardous wastes, and to set a system of building waste management; (g)To motivate households - provide for introduction of just fees according to the amount of produced waste; in the case of lump-sum fees, a lower fee may be offered to people who participate in the system; (h) To increase fees for landfilling and incineration of wastes - the income from these fees should be used for setting up the Zero Waste system; (i)To support take-back programmes - to convince the local tradesmen to introduce a take-back system for their products, in accordance with the local conditions; (j) To refuse construction of an incinerator and landfills - incinerators are demanding from the economic point of view, and the investments do not stay in the region.[3]

The initial aim of any waste management technique to be adopted is to maximize profit from the generated waste and to likewise maintain environmental safety standards, hence there is need in an issue of both profitability, affordability and sustainability.

II. THE CYCLE OF MSW PROCESSING INTO VALUABLE PRODUCTS

MSW is to be handled from generating on side to end products and explored into circular economic that get of beneficial, as shown in Figure 1.

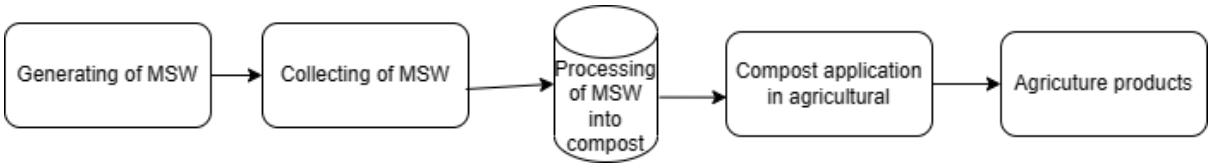

Figure 1. MSW processing and application

MSW is generated every where in many places and sides, collecting of MSW sometime have problems because of highly disparities of places and quantities. The collection of MSW may get a high portion of cost in MSW management. Municipal solid waste (MSW) generated in developing countries usually contains a high percentage of organic material. When not properly managed, organic waste is known for creating many environmental issues. Greenhouse gas (GHG) emissions, soil and water contamination, and air pollution.[10] To overcome the generated MSW, its needed the cycle of MSW processing in certain scenarios. The good cycle of MSW processing laid on the simply route, and the end products gave a valuable products.

III. THE CYCLE OF MSW PROCESSING AND APPLICATION

III.1 MSW processing adopted with composting to crop production

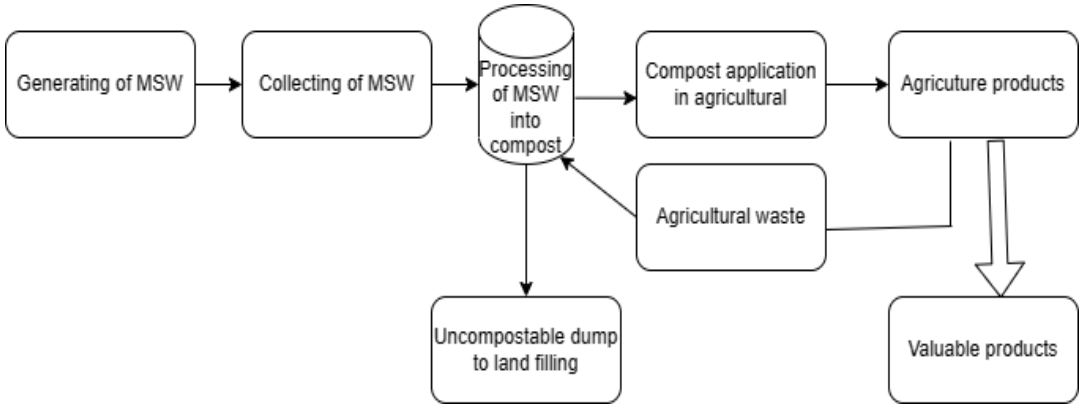

Figure 2. MSW processing adopted into agricultural farming

There are many scenarios of processing of MSW into valuable products. Composting of MSW has been adopted in several countries. Utilization of MSW to convert into compost has simple route compared to other scenarios such as integrated with animal farming. Composting pile can be built in large area or big capacity, composting can process a big capacity of MSW, but compost mature needs several months.

III.2. MSW management adopted with the maggot, chicken, ruminants farm and crop production

The selected alternative scenarios aiming at minimizing the unused material fraction to be disposed to landfills.

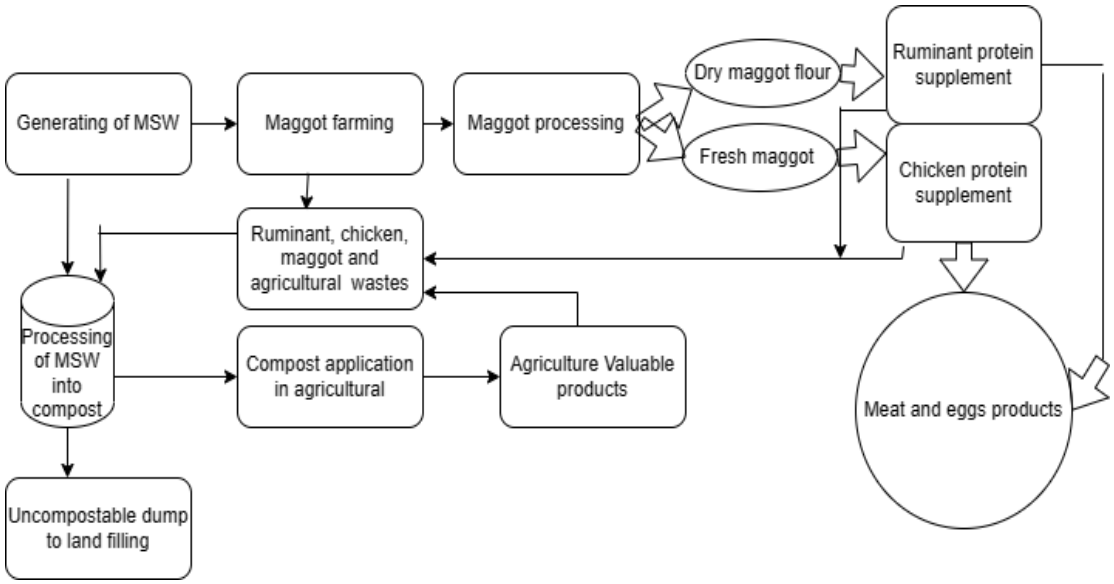

Figure 3. MSW processing adopted with maggot, chicken, ruminant farm and agricultural farming

MSW was collected from several places such market, super-market, agricultural waste, leftovers food and industries. MSW was grinded to reduce the size and ready to feed the maggots, maggots were very greedy to eat the blended MSW, its take in order of day.[11] Maggot goes through stages from being an egg to larva (whitish worm-like creatures), to pupa (transformative chrysalis) to fly in just over two weeks.

The feed put daily until the maggots got mature, and then maggots were harvesting. Fresh maggot readily to feed the chicken. Other way maggots were frying to dry and grinded to be maggot flour, its used to ruminant protein supplement.[12] Its makes a sustainable protein source for livestock (Makinde, 2015)[13].

Other waste from ruminant, chicken, maggot farm, and agricultural waste were composted in appropriate compost pile.[5] Compost used as soil amendment to increase the land capabilities. The end products of this scenario were eggs, meat and agricultural products that were the basic of human kind needs.

III.3.MSW processing adopted with worm, duck, ruminants farm and crop production

The other scenario is that the blended of MSW product was used to cultivate worm that worm is used to protein supplement of duck, duck is very greedy to eat worm that to fulfil the protein needed. This scenario is to overcome the problem of selling compost. The commercial compost was sold by the yard to large growers and landscape services as well as in attractive bags at select home, garden and grocery stores.[14]

Ducks are adaptable creatures that eat an omnivorous diet consisting of a wide range of different foods, including foods from almost every group, such as fruits, vegetables, seafood, insects, and other proteins. When it comes to insects, ducks are happy eating all manner of worms and slugs, including mealworms.[15]

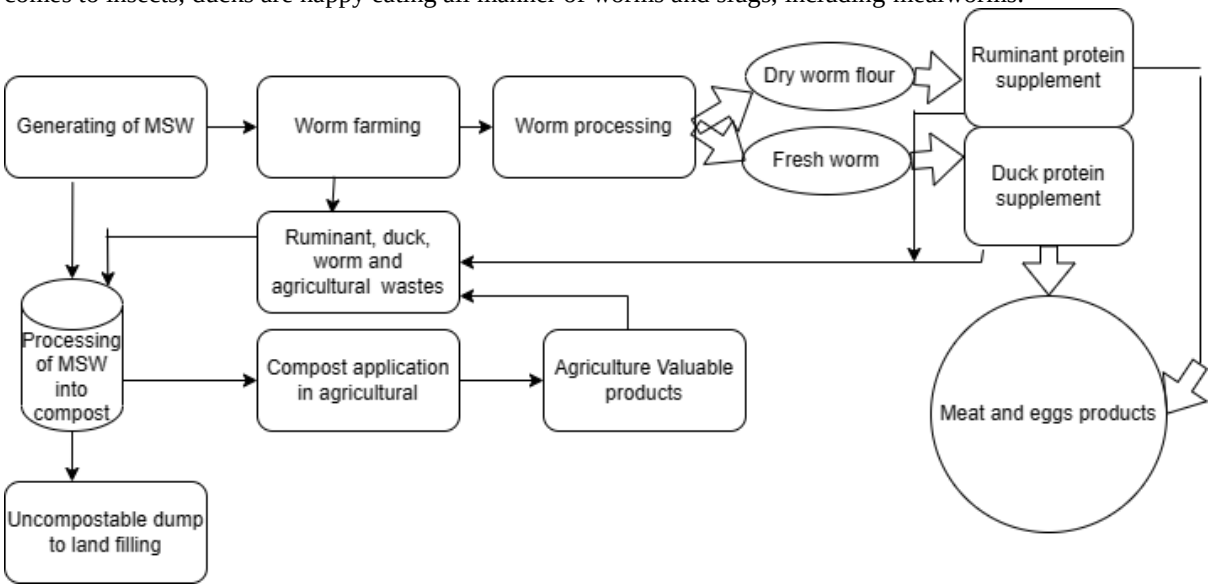

Figure 4. MSW processing adopted with worm, duck, ruminant and agricultural farming

Worms are also used to speed up the degradation process. Worm composting (aka vermiculture), which some advocates have dubbed "the organic garbage disposal," recycles food waste into a rich, dark, good-for-your-garden soil conditioner. It's a simple, natural method to take your fruit and vegetable scraps and turn them into rich nutrients for your plants.[16]

The routes here just drown of the possibility of the process can be done, not counted of the appropriate scale of each process its self. Comparing each size of appropriate devises in the real size needs real calculation. How many big of MSW generated is influence to the size of maggot bin, the size worm bin.

IV. CONCLUSION

Zero waste management can be run effectively in many steps, that is included to maximize economic benefit, used of waste to benefit conversion. It is measuring by applying of 4R (reducing, reusing, recycling and recovering). The conversion of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land or water.

The cycle scenario can be elaborated in many ways, the better scenario lead in simple one. The scenario of management of MSW to produce compost that used in agricultural field is very simple, and end production of crop products. The integration scenario of management to produce maggot, chicken, ruminants and agricultural gave end products of crop, meats and eggs that products were very useful to basic of mankind needs. The scenario of management of MSW to produce of worm, duck, ruminants and agriculture gave end products of crop, meats and eggs that products were very useful to basic of mankind needs.

All scenarios gave clear pictures that most of generated MSW can be processed to useful products. The impact of MSW got better treatment, waste was converted into useful material that used in appropriate place, the sustainable environment has guarantee perfected, create the economic circular, and hopefully, the management of MSW would got many benefits.

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Rakhman Sarwono. "Approaching Zero Waste Management of Municipal Solid Waste (MSW) Integreted with Agricultural, Poultry, Ruminants, Worm and Maggot Farming." *The International Journal of Engineering and Science (IJES)*, 12(7), (2023): pp. 06-10