

WASTE MANAGEMENT IN AGRICULTURE- CREATING WEALTH FROM WASTE

Abstract

Farming has been a part of human life ever since early settlers built up permanent communities. India's agricultural sector is one of the oldest in the world and crucial to the country's economy as a whole. Agriculture encompasses a wide range of practises, including crop farming and livestock husbandry. About 38 percent of Earth's surface is devoted to agricultural use, or about 5 billion acres. Organic or inorganic waste is produced in this procedure. What we call "agricultural wastes" are the unusable materials produced throughout the farming process. Despite the potential monetary value of these resources, they would not be worth the effort required to gather, transport, and process them for practical use. Anything not needed for farming is considered waste. Much of the waste we generate comes from the food and farming industries as a result of the numerous stages of processing. Agricultural waste is being transformed into a variety of products that provide less of a threat to people, animals, and plants.

Keywords: Agriculture, waste, generation, utilisation

Authors

Susibna Subhadarshini

C.V Raman Global University
Mahura, Janla, Odisha, India

Alisha Mohapatra

C.V Raman Global University
Mahura, Janla, Odisha, India
mamunialishamohapatra@gmail.com

Sahista Illias

C.V Raman Global University
Mahura, Janla, Odisha, India

I. INTRODUCTION

Agricultural waste consists of both consumable things and non-biodegradable byproducts of crop and plant growth, and it is produced by a wide range of industries (fisheries, poultry farms, sericulture activities, etc.). These parts may not be immediately useful to the economy, but they could be put to another use. Soil fertility can be restored and other useful substances like biogas, manures, etc. can be produced from what were once considered useless wastes that were burned or converted into organic fertilisers under less than ideal conditions. Energy is increasingly being generated from biomass, which is a byproduct of agricultural waste. As the global population increases, the disparity between energy demand and availability will only get worse. There is a large window of opportunity to convert these biomasses into an energy source because of how quickly they decay. Because of its abundance, biomass is one of the most accessible resources that can be converted into other forms of energy. The correct utilisation of these agricultural waste is a pressing issue now that they may be processed into usable energy and commodities. It's estimated that 998 million metric tonnes of garbage are generated annually in the agricultural sector worldwide. The proper disposal and management of these materials is required. The proper disposal of agricultural waste could have positive effects on human health and the environment. Instead of burning the wastes that contribute to pollution, they should be used in a way that creates something of tremendous value. AWM is essential for sustainable farming and the preservation of natural resources.

The following are just a few examples of how AWM can be put into practise:

1. To compost is to convert organic wastes like those from plants and animals into rich soil. This compost can be used to increase fertility in place of chemical fertilisers.
2. Agricultural waste can be converted into usable biomass energy through processes like anaerobic digestion, pyrolysis, and gasification. This means that fossil fuels and other nonrenewable energy sources are used less frequently.
3. Harvest residues could be returned to the soil or left where they fall instead of being burned. This can be used as mulch, which helps to conserve soil moisture and promotes soil fertility as it decomposes.
4. Composting, anaerobic digestion, and the creation of biogas all benefit animal waste management, as can other uses for manure from livestock production. Efficient waste management is crucial for lowering environmental impacts including greenhouse gas emissions and water contamination.
5. Integrated pest management (IPM) is a strategy that employs many methods to lessen the need for pesticides. Diversifying crop types, implementing biological pest management, and growing resistant varieties are all examples of this.
6. Planting cover crops out of season helps prevent soil erosion, improve soil health, and decrease weed growth. These are great because they absorb extra nutrients while also preventing nutrient runoff and water contamination.
7. Plastic bags, various packaging supplies, and agricultural plastics are only some examples of trash that can be reduced by recycling or reuse. Less environmental harm is caused as a result.
8. "Agroforestry" refers to the practise of growing trees and bushes between crop plants to improve biodiversity, reduce soil erosion, and develop new revenue streams.

These strategies improve air quality, reduce garbage production, enhance soil health, and foster sustainable farming methods. Waste management procedures are essential to the continued health and productivity of agricultural systems.

There are Several Successful cases of Managing Agricultural Waste

Case Study 1: Rice Straw Management in Punjab, India

In Punjab, where rice is the primary crop, the problem manifested itself after the harvest. The traditional practise of burning large amounts of rice straw in the field after harvest has been linked to significant increases in air pollution, greenhouse gas emissions, and soil erosion. The agricultural waste management plan was initiated by the government of Punjab and other entities to address this issue. They took up the practise of "straw mulching" as a pastime. This region of the world uses high-tech "Happy Seeders" to chop up the rice straw after harvest and spread it out evenly throughout the fields. The outcome was better than expected. The environmental damage caused by burning straw was mitigated. Fertility was increased as paddy wastes decomposed and released nutrients into the soil.

Case Study 2: South Africa's Methods for Handling Fruit and Vegetable Waste

South Africa has a significant issue with the wastage of fruit and vegetables, which has been exacerbated by produce markets, manufacturers, and grocery stores. This garbage was thrown out in the wrong places, leading to pollution and material waste. Anaerobic digestion was employed to break down the garbage, and the resulting digestate was put to good use as a nutrient-rich organic fertiliser. As a result, new jobs were made possible, garbage was redirected, organic fertiliser was produced, and renewable energy was produced.

Case Study 3: Reusing Spent Coffee Beans in Costa Rica

The coffee business in Costa Rica generated a lot of waste coffee pulp. Traditional methods of waste management, such as dumping garbage into bodies of water or landfills, pose serious risks to human and environmental health. Efforts have begun to address this problem. Waste coffee pulp was added to soil and utilised as an organic fertiliser because of its high nutrient content. Using used coffee grounds had some positive outcomes. Measures included diversifying revenue sources and reducing negative environmental impacts like water contamination.

These cases show how a change to more resourceful methods of managing agricultural trash can benefit both the environment and agricultural sustainability.

Targets of Agricultural Waste Management include: The major goal is to handle agricultural waste in an ethical manner. The primary objectives of waste management are to protect the environment, conserve resources, improve soil health and fertility, reduce costs, eliminate pests, adhere to regulations, and slow global warming. Waste management's ultimate goal is to strike a balance between farm output and ecological health. This is achieved by lessening agriculture's toll on the planet and on people's health. Waste management in agriculture is essential for preventing pollution and protecting human health and the environment during the many steps of food production.

II. GARBAGE GENERATION IN THE COUNTRIES

Wastes from inefficient intensive farming methods and the overuse of chemical fertilisers are a typical sight beside agricultural development operations, with serious consequences for environmental quality. Trash composition is highly correlated with prevalent agriculture methods.

Decomposing Trash

- 1. Cultural Waste:** although the weather is perfect for growing crops, weeds and bug populations explode, forcing farmers to spray massive amounts of chemical pesticides. When farmers use a lot of pesticides, they frequently dump the unused containers and packaging into neighbouring ecosystems. Pollution, food poisoning, unsafe food hygiene, and contaminated farm land are all possible outcomes due to the 1.8% of chemicals that are still present in that container, as revealed by PPD (Plant Protection Department). And if the toxins manage to get out, or are released into the air through osmosis, it will be disastrous for the environment. Fertilisers play a crucial role in agriculture, allowing farmers to maintain high yields and quality of their crops. Due to its low cost, inorganic fertiliser can help farmers raise their income. Even while excessive application of fertilisers increases annual agricultural output, the rate of absorption of such chemicals varies according to land characteristics, plant type, and irrigation systems. The excess is partially absorbed by the earth, partly transported by runoff into waterways, polluting surface water, partly transported by groundwater, and finally partially released into the atmosphere via evaporation, leading to air pollution.

Air pollutants such H₂S and CH₄ and smells, as well as solid wastes like manure and organic materials, liquid wastes like urine and waste water from bathing animals and maintaining hygiene in slaughterhouses, all arise from livestock activities.

- 2. Unsanitary Waste:** *Dung is the waste product of cattle and other bovine species; it is also known as cow pats and cow manure. The term "cow dung" refers to the indigestible plant matter that has passed through a cow's digestive system. The byproduct is excrement that is high in minerals.

Cow manure is a rich source of
Content in water: 77%
20 percent biomass
3.2% Nitrogen
Phosphorus content of 0.14 percent
Only 1.30% Sodium
Calcium content of 0.004%

Any food that is lost, forgotten, or never consumed is considered wasted feeding material. Straw, sawdust, wood shavings, paper bedding, and so on all qualify as "soiled bedding material."

Used-up Fluids:

A. Pee

Sewage B Wastewater

Waste from aquaculture Aquaculture is a rapidly expanding industry that provides a healthy, environmentally friendly food source for millions of people across the world. Production from fisheries around the world increased from 69 million to 93 million tonnes over the past three decades, while production from aquaculture increased from 5 million to 63 million tonnes during the same time period. Fish is a significant source of protein for humans, making up 16.6% of the world's animal protein supply and 6.5% of all protein ingested (Food and Agriculture Organisation of the United Nations, 2012). Despite rising fish populations, 25% of the world's annual catch goes to waste (FAO, 2012). The fishing business generates a variety of liquid waste, including wastewater from fish processing. Whole fish carcasses, organs, tails, skin, bones, blood, liver, gonads, intestines, and even some muscle tissue are all examples of waste. Countless tonnes of these wastes are discarded annually from fish processing plants and grocery stores. Some raw materials and the way they are handled in relation to a given end product make it difficult for their parent corporations to repurpose surplus or unwanted co-products from food processing. In 2006-07, it was calculated that 3,02,750 metric tonnes of waste were generated by India's fish processing (and pre-processing) enterprises. More waste was produced by processing prawns than any other type of seafood, including fin fish or cephalopods. In the modern context of environmental pollution, the generation of waste from fish processing is a major reason for concern. This trash has potential as a high-quality material in the production of high-value items like protein-rich foods. The extraction of bioactive compounds from them is also highly recommended. Another key cause of environmental decline is careless trash disposal.

Many different types of solid waste are produced by the poultry industry. These include: faeces, urine, saw dust, drug remnants, pesticide residues, and disinfection of chicken coops and slaughterhouses. Poultry manure's high phosphorus content has a stimulating effect on plant growth and harvest. It's even more effective in farming when combined with mineral phosphorus fertilisers. Poultry wastes contribute significantly to odour and rodent problems in the environment, as well as to the spread of disease.

III. MAKING MONEY FROM WASTE: INNOVATIVE STRATEGIES FOR REUSING OBJECTS AND MATERIALS

Agricultural waste utilisation technology quickly puts the rubbish to good use to avoid rotting or other changes that would make it unsuitable. These remnants can be put to many different purposes. Several of them are:

- 1. Fertiliser Application:** Using animal manures as fertiliser has the added bonus of decreasing the need for synthetic fertilisers. Manures are a source of nitrogen for chemical fertilisers at the rate of 19%, phosphorus at 38%, and potassium at 61%. Poultry manure's high phosphorus content boosts plant growth and harvests. The physical condition, water retention, and structural integrity of the soil are all enhanced by the addition of manures. However, there is significant risk because of the high costs of

energy, transportation, storage facility requirements, odour difficulties, and the potential for groundwater pollution.

- 2. Anaerobic Glycolysis:** Manures can also be used to produce methane gas. This gas works great for grilling, heating water and drying grains, among other uses. Manure must undergo two phases of microbial fermentation before producing methane-rich gas. Acid-forming bacteria initially break down volatile materials, leading to the production of organic acids. They are utilised by microorganisms engaged in methane gas production. The byproduct gas contains between fifty and seventy percent methane, twenty-five to forty-five percent carbon dioxide, five point five percent nitrogen, ten percent hydrogen, and trace amounts of hydrogen sulphide. Cons include high initial cost and potential for explosion. However, the upsides much outweigh the risks.
- 3. Adsorbents can be used to get Rid of the Heavy Metals:** Because they don't break down in water or soil like organic pollutants do, heavy metal ions like copper, cadmium, mercury, zinc, chromium, and lead pose a serious environmental threat. The toxicity of effluent containing heavy metals can be reduced by using adsorption, which has been proved to be an incredibly efficient method for removing these compounds from waste streams. Activated charcoal is increasingly used for this purpose. In recent years, the use of agricultural wastes for the adsorption of heavy metals from effluents has been demonstrated to be a cost-effective strategy. Several studies have shown that sugarcane bagasse, rice husk, saw dust, coconut husk, oil palm shell, neem bark, etc. are effective at removing heavy metals from wastewater.
- 4. Pyrolysis:** Char is produced by vaporising organic waste at temperatures between 400 and 600 degrees Celsius in an oxygen-free environment. The state-of-the-art technology utilised in this rubbish disposal procedure. In addition, there are procedures such as hydrolysis and hydro gasification. In addition to their use in restoring energy, they are also involved in the production of chemicals. Alcohols for fuel, ammonia for fertilisers, and glucose for food and feed all have important roles to play in agriculture. When agricultural waste is pyrolyzed, oil, char and low heating value fuel are produced.
- 5. Animal Nourishment:** Low protein sources are widely available, which is a major problem for animal feeds in developing countries. That's why it's crucial to look into alternative treatments. Due to the high fibre content and low protein, lipid, and carbohydrate content of crop residues, traditional techniques of enhancing livestock output, such as supplementing forage and pasture with grain and protein concentrate, may not be sufficient to supply future meat protein needs. Humans and animals will be competing for the same limited supplies of grain and protein. One answer to this problem is to feed animals leftovers.
- 6. An Electric Spark:** Burning agricultural waste for energy is a very old example of biomass conversion. Carbon dioxide and water are simultaneously created as the last products of the oxidation of organic materials during a complete combustion. Agricultural waste is most beneficial in the thermal conversion process if it is processed into a solid form. Burning it generates heat, food, charcoal, steam, mechanical power, and electrical power, among many other things. Combustion is the most common technique for

transforming agricultural waste into energy or fuel, and biomass accounts for more than 95% of all energy utilised today.

IV. REMOVAL METHODS IN THE AGROINDUSTRIAL INDUSTRY:

Any waste management system should prioritise maximising financial return from waste resources without compromising environmental safety. The environment faces multiple dangers due to inappropriate garbage management.

"Management that makes use of the four Rs [reduce, reuse, recycle, and recover] is the best first option."

Reduce your trash output for environmental reasons. Either on the farm or off, the by product needs to be put to good use.

After minimising and reusing, any remaining materials should be recycled. This can be done on the farm through practises such land application of wastes, or in other settings through the use of plastic recycling, for example.

It makes sense to recycle the gas produced by decomposing manure. Only after the four R's have been used may agricultural waste be discarded. Here are some examples of significant economic sectors along with descriptions of how they handle waste.

1. Managing Farm Trash: Managing agricultural waste long after harvest has many benefits, including preventing soil erosion, lowering disease and insect populations, and boosting soil fertility. Among these techniques are:

- They could be used as mulch to keep the soil moist and avoid erosion.
- The organic matter in soil can be increased by using agricultural residues as fertiliser. It also helps to fortify the underlying soil.
- There are a number of different processes that can be used to convert agricultural waste into viable biofuels.

2. Animal Waste Management

- Animal dung compost contains a high concentration of beneficial microorganisms and other organic compounds.
- Anaerobic digestion converts waste into biogas, which can be used as a fuel source for power generation.
- Manures applied to plants can reduce the amount of nutrients that wash away.

3. Reducing Food Waste in the Industry

- Food waste includes things like peels, shells, and other by-products. What their management comprises
- Garbage can be recycled into compost or animal feed.
- Using them to generate alternate sources of power.
- Potential application in waste classification processes.

4. Chemicals in Agriculture and Their Disposal

- The usage of pesticides and fertilisers leads to environmental waste and contamination.
- All remaining chemicals and empty containers must be disposed of safely according local regulations.
- It is suggested that IPM and IDM be used to reduce the number of toxic pesticides used in farming.

5. Managing Waste in Aquaculture

- Wastes from aquaculture include things like discarded food, trash, and dead animals.
- Manage the quality of water in ponds and other buildings to cut down on waste.
- In order to recycle the wastewater, it must be cleaned.
- Biological processes and organisms should be utilised in waste treatment.

6. Disposal of Garbage Following the Harvest

In order to minimise post-harvest waste, it is necessary to:

- Utilising efficient post-harvest practises to lessen food loss and waste.
- The value increases when they are processed into final products like jams, pickles, juices, etc.
- Having the salvageable portions of the leftovers sorted and sent to other charity.

Because of the importance of preserving ecological balance and ensuring the long-term viability of agricultural output, sustainable practises should be prioritised in agricultural waste management. This will help reduce waste, promote recycling and reuse, and protect the environment. Therefore, the government, farmers, and other stakeholders must work together for an effective rollout.

V. AGRICULTURAL WASTE MANAGEMENT SYSTEM (AWMS)

Agricultural waste management systems (AWMS) are methods used to safely and effectively remove garbage from farms. We need to stop seeing wastes as something to be avoided and start seeing them as a useful resource if we want to stop the pollution of our air, water, and land and the spread of harmful substances. To do so will require different ways of thinking about and handling agricultural waste, as well as better use of technology and incentives. There is a major threat to environmental quality when animal dung and other organic wastes are not properly handled or processed. Stagnant garbage can be a breeding ground for flies and a source of sickness. Ammonia gas is released uncontrollably from decomposing organic wastes, leading to acid rain. There are six main components of the AWMS. Some examples include producing, collecting, storing, processing, transmitting, and using. Production velocity is waste generation and environmental factors. If there is enough garbage to be useful, then waste management is required. Trash at any one time depends on the nature and quantity of waste produced and when it was generated. When planning an AWMS, it's crucial to consider not only the locations from which waste must be collected, but also the manpower requirements, startup costs, and long-term effects of the system. What

we mean when we talk about "storage" is a place to temporarily put all of this trash. This helps with waste storage when there aren't adequate waste processing facilities available. Mechanical, biological, and chemical processes are used in the treatment process to neutralise hazardous waste. The word "waste transfer" refers to the action of moving trash from its original place to a new one where it will be discarded or recycled. The demands and total solid concentration of the trash determine whether the trash is transferred in a solid, liquid, or slurry form. Utilisation refers to the action of putting recovered materials to good use. Reusing means putting something that was once useful back into regular usage.

VI. CONCLUSION

When raw materials and by-products from agriculture are produced and used, they inevitably end up as waste. Waste products are a byproduct of any agricultural, livestock, fish, or poultry production. The wastes in question can be turned into usable resources for residential and agricultural use when the 3Rs of waste management (reduce, reuse, recycle) are put into practise. Efficient garbage collection, storage, treatment, transmission, and usage can lead to a healthy environment, a robust agriculture sector, and reliable biofuel resources.

VII. FUTURE HOPES AND CHALLENGES

1. Agricultural waste management is working towards sustainability and a circular economy. Instead of seeing trash as something to be thrown away, we should view it as something that could be put to good use.
2. Advanced technology has increased the possibility of efficient and timely waste management and recycling.
3. Farm waste such as crop residue and other organic materials could be converted into useful biofuels and biochemicals. As energy consumption continues to rise, it is hoped that this would be sufficient.
4. Refusing to throw anything out allows for the creation of useful products like biochar, compost, and supplements for animal feed.
5. Removing tax breaks and disposal restrictions is necessary for trash to be transformed into valuable products. To achieve this goal, the government and international organisations can impose stricter procedures and programmes.
6. Creating value from garbage is an excellent way to educate the public. There will be a rise in the use of eco-friendly methods.
7. Taking care of our trash is another way that we may decrease our ecological footprint and help halt global warming.

During its growth, it was supported by a variety of industries, including fishing, poultry, sericulture, and others. These parts may not be immediately useful to the economy, but they could be put to another use. Soil fertility can be restored and other useful substances like biogas, manures, etc. can be produced from what were once considered useless wastes that were burned or converted into organic fertilisers under less than ideal conditions. Energy is increasingly being generated from biomass, which is a byproduct of agricultural waste. As the global population increases, the disparity between energy demand and availability will only get worse. There is a large window of opportunity to convert these biomasses into an energy source because of how quickly they decay. Because of its abundance, biomass is one of the most accessible resources that

can be converted into other forms of energy. The correct utilisation of these agricultural waste is a pressing issue now that they may be processed into usable energy and commodities. It's estimated that 998 million metric tonnes of garbage are generated annually in the agricultural sector worldwide. The proper disposal and management of these materials is required. The proper disposal of agricultural waste could have positive effects on human health and the environment. Instead of burning the wastes that contribute to pollution, they should be used in a way that creates something of tremendous value. AWM is essential for sustainable farming and the preservation of natural resources.

VIII. DECLARATIONS

We hereby declare that the work entitled “Agricultural Waste Management” is a record of original work by our members and with reference to following eminent persons and the listed websites.

REFERENCES

- [1] Agamuthu, P. Challenges and opportunities in Agro-waste management: An Asian perspective. Inaugural meeting of First Regional 3R Forum in Asia 11 -12 Nov., Tokyo, Japan. 2009
- [2] Brown and Root Environmental Consultancy Group. Environmental review of national solid waste management plan. Interim report submitted to the Government of Mauritius. 1997
- [3] Overcash, M. R.. Livestock waste management, F. J. Humenik & J. R. Miner, eds. CRC Press, Boca Raton. 1973
- [4] Dien, B.V. and Vong, V. D.. Analysis of pesticide compound residues in some water sources in the province of Gia Lai and DakLak. Vietnam Food Administrator. 2006
- [5] Hai, H. T. and Tuyet, N. T. A... Benefits of the 3R approach for agricultural waste management (AWM) in Vietnam. Under the Framework of joint Project on Asia Resource Circulation Policy Research Working Paper Series. Institute for Global Environmental Strategies supported by the Ministry of Environment, Japan, 2010
- [6] Thao, L. T. H. Nitrogen and phosphorus in the environment. Journal of Survey Research. 2003, vol 15 No. 3, pp.56-62, 2003
- [7] Miller, D. and Semmens, K. Waste Management in Aquaculture. Aquaculture information series, Extension Service, West Virginia University, 2002.
- [8] Mathieu, F. and Timmons, M. B. Techniques for Modern Aquaculture. J. K. Wang (ed.), American Society of Agricultural Engineers, St. Joseph, MI 1995.
- [9] Timbers, G. E. and Downing, C. G. E. Agricultural Biomass Wastes: Utilization routes. Canadian Agricultural Engineering Vol. 19 No. 2, pp. 84-87. 1977.
- [10] Council for Agricultural Science and Technology Utilization of animal manures and sewage sludge in food and fiber production. Report No. 41. 1975.
- [11] Mokwunye, U. Meeting the phosphorus Needs of the soils and crops of West Africa: The Role of Indigenous Phosphate rocks. Paper presented on Balanced Nutrition Management systems for the Moist Savanna and Humid Forest Zones of Africa at a symposium organized by IITA at Ku Leuva at Cotonun, Benin Republic, October 9-12. 2000
- [12] Gupta, V. K., Gupta, M. and Sharma, S. Process development for the removal of lead and chromium from aqueous solution using red mud – an aluminium industry waste. Water Research. 35(5): pp. 1125 – 1134. 2001.
- [13] Chand, S., Aggarwal V.K. and Kumar P., Removal of Hexavalent Chromium from the Wastewater by Adsorption. Indian J Environ. Health, 36(3): 151-158. 1994.
- [14] Mohan, D. and Singh, K. P. Single and Multi-Component Adsorption of Cadmium and Zinc using Activated Carbon Derived from Bagasse – An Agricultural Waste. Water Research, 36: 2304-2318. 2002
- [15] Ayub, S., Ali, S. I. and Khan, N. A. Adsorption studies on the low-cost adsorbent for the removal of Cr (VI) from electroplating wastewater. Environmental Pollution Control Journal 5(6): 10 – 20. 2002.
- [16] Ajmal, M., Rao, R. A. K., and Siddiqui, B. A. Studies on Removal and Recovery of Cr (VI) from Electroplating Wastes. Water Research. 30(6): 1478-1482. 1996

- [17] Tan, W. T., Ooi, S. T., and Lee, C. K. Removal of Chromium (VI) from Solution by Coconut Husk and palm Pressed Fibre. *Environmental Technology*, 14: 277-282. 1993.
- [18] Khan, N. A., Shaaban, M. G. Hassan, M. H. A., Removal of heavy metal using an inexpensive adsorbent. Proc. UM Research Seminar 2003 organized by Institute of Research Management and Consultancy (IPPP), University of Malaya, Kuala Lumpur. 2003.
- [19] Ayub, S., Ali, S.I., and Khan, N.A. Efficiency evaluation of neem (*Azadirachta indica*) bark in treatment of industrial wastewater. *Environmental Pollution Control Journal* 4(4): 34 – 38. 2001
- [20] Leng, R. A., Choo, B. S. and Arreaza, C. Practical technologies to optimize feed utilization by ruminants. In: A Speedy and P L Pugliese (Editors). *Legume Trees and Other Fodder trees as Protein Sources for Livestock*. FAO, Rome, Italy, pp:145-120. 1992
- [21] Hussein, S. D. A. and Sawan, O. M. The Utilization of Agricultural Waste as One of the Environmental Issues in Egypt (A Case Study). *Journal of Applied Sciences Research*, 6(8): 1116-1124. 2010.
- [22] Klass, D.L., 2004. Biomass for renewable energy and fuels. In: Cleveland, C.J. (Ed.), *Encyclopaedia of Energy*, vol. 1. Elsevier, San Diego, pp. 193–212
- [23] Wright, R. J. Executive summary (available at www.ars.usda.gov/is/np/agbyproducts/agbyexecsummary.pdf). Accessed on 25/04/2016. 1998.
- [24] Fabian, E. E., Richard, T. K. D., Allee, D. and Regenstein, J. Agricultural composting: A feasibility study for New York farms. (Available at www.cfe.cornell.edu/).1993
- [25] USDA. Agricultural waste management field handbook. United States Department of Agriculture, Soil conservation Service. Accessed from <http://www.info.usda.gov/viewerFS.aspx?hid=21430> on 10/06/2016. 2012.
- [26] Department of Environment. National 3R strategy for waste management. Ministry of Environment and Forests, Government of the People’s Republic of Bangladesh. 2010.