**Agriculture: Waste to Wealth**

**Monika Chaudhary , Neha Bisht, Amar P. Garg\***

School of Biological Engineering & Life Sciences, Shobhit Institute of Engineering & Technology (Deemed-to-be-University) Modipuram, NH-58, Meerut 250110, India

[monika.lm1020@gmail.com](mailto:monika.lm1020@gmail.com) , [bishtneha1993a@gmail.com](mailto:bishtneha1993a@gmail.com) , [amarprakashgarg@yahoo.com\*](mailto:amarprakashgarg@yahoo.com*)

**Abstract**

India annually produces 350 million tonnes of agricultural waste. Between 2020 to 2025 India will undergo a drastic change wherein, we will see a rise in plastics, metals, etc by two folds. As more than half of the Indian population is dependent on agriculture, we need to find ways to utilize agricultural waste such that it doesn’t impact our environment and also becomes a source of income. Agricultural waste is produced from agricultural products, agro-industries, animal feed, horticulture, aquaculture, etc. With the vast quantity of waste being produced, in India, we still use the same old methods of waste treatment such as burning, draining the waste, etc. With new technologies around, we need to create a new era of agricultural waste management that sustains the environment and is worth more. We need to find ways to implement the mission of waste to wealth under Swachh Bharat Unnat Bharat.  A new institutional mechanism is needed to address the issue of agricultural waste and achieve India's goal of a zero-waste nation.

Keywords: agricultural waste, AWMS

**Introduction**

India ranks only 94th out of 107 countries on the 2020 Global Hunger Index, even though India is one of the largest agricultural-dependent economies. Agriculture plays a vital role in India's economy. 54.6 of the total workforce is engaged in agriculture and allied sector activities (Census 2011) and accounts for 18.8% (First Advance Estimates) of the country's Gross Value Added (GVA) for the year 2021-22 (at current prices). Studies on agricultural losses are not many but the Central Institute of Post Harvest Engineering and Technology, Ludhiana (CIPHET), an institution of the Indian Council of Agricultural Research (ICAR) has conducted two studies. The first study was conducted between October 2005 and February 2007 on the recommendation of the parliamentary standing committee of the ministry of agriculture. The report was submitted to the committee in 2010 and was published in August 2012.

The second study was sponsored by the ministry of food processing industries. It was based on production data of 43 crops and livestock produced in 2012-13 and wholesale prices of 2014. Conducted in 120 districts in 14 agro-climatic zones and the report was published in March 2015. The losses incurred in cereals, pulses, oilseeds, plantation crops, spices, vegetables, fruits, milk, fisheries, poultry, and meat at various stages of production and movement were studied. The studies of farm-level operations included harvesting, collection, sorting, grading, drying, packaging, and transportation were also conducted. The losses in the storage channel included storage at farm level and cold storage, wholesaler, retailer, and processing unit were also conducted by CIPHET.

The perception that the losses were about one-third of the production was changed and it was found that the overall losses were much lower in the study of 2012-2013. In the case of cereals, losses ranged between 4.65% (maize) and 5.99% (sorghum). In wheat and paddy, the losses were 4.93% and 5.53% respectively. It was found that the losses were higher at the level of farm operations. About 4.67% in the case of paddy and 4.07% in the case of wheat. For both wheat and paddy, the loss in storage was only 0.86%. It was reported that the perishable crops suffered much higher losses. A loss of 9.16% was reported in the case of mango. The loss at farm operations was much higher at 6.92% than the loss in storage at 2.24%. The loss in guava was 15.88% while the same in the case of apple was 10.39%.

When it came down to vegetables, the loss in the case of potatoes was 7.32% out of which 6.54% was at the level of farm operations while the loss in the storage was only 0.78%, due to the large-scale storage of potatoes in cold stores. They found that the loss in tomatoes was 12.44% which was 9.41% at the level of farm operations and 3.03% in the storage at wholesale, retail, and processing levels.

The total loss of inland fish was 5.23%, out of which only 1.05% was in the storage channel. For poultry meat, the total loss was 6.74% but here the loss in the storage channel was found at a high rate of 4%. The milk loss was only 0.92%. Of this, only 0.21% was contributed by the storage channel.

**TYPES OF AGRICULTURAL WASTE**

Although India has high levels of food production, it ranks only 94th out of 107 countries on the 2020 Global Hunger Index. Food is a basic human need and feeding the ever-growing population is becoming a challenge. Developing countries rely mostly on agriculture but in times when our soils are less fertile, Pollution is drastically increasing, we need to find ways to increase agricultural produce without degrading the environment .Therefore , there needs to be an intervention in the form of environmental friendly technology. One of these inventions is the management of agro based waste and food processing waste , also called as agricultural waste. Agricultural wastes are defined as “the remaining from the growing and processing of raw agricultural products” like fruits, vegetables, meat, poultry, dairy products, and crops. It includes both natural and non-natural wastes produced through various farming activities such as dairy farming, horticulture, seed growing, livestock breeding, grazing land, market gardens, nursery plots and even woodlands.. Agricultural and food industry residues and wastes constitute a significant proportion of worldwide agricultural productivity (estimated at over 30%) (Sarmah, 2009).The term Agricultural Wastes relates to all left-overs and residuals of the agriculture production which do not have economical value and are meant for disposal. Special processes are needed to convert these wastes into valuable product. In most cases (and mainly in field crops and vegetables) it is difficult to remove the waste product considering the costs of removal, transport and processing of these wastes. The opportunity and feasibility for recycling these wastes comes for the care for environment and the potential to add value to these wastes by adding positive elements.

It is important to view a valuable ‘resource’ from ‘waste’ that can be converted into a variety of products. Generating wealth generally refers to the conversion of waste to product.. Hence the phrase ‘Waste to Wealth’. Waste-to-wealth has been used as the concept to address the environmental problem by changing the traditional view of waste as an end product to be disposed off and turning it into a valuable product. Given the amount of waste generated, innovative waste conversion processes can create micro-entrepreneurship fortuity on an enormous scale. In India, the potential to convert waste to wealth is very high. Increasing opportunities for this enterprise can have eclectic advantages.

It can bring back useless and discarded waste products into economic use and lead to:

a) Release of pressure caused by waste on the environment;

b) Creation of opportunities for livelihood generation in a relatively new area thereby enhance fiscal activity; and

c) Impact quality of life

Agricultural waste can be of various types depending on the type of agricultural activity shown in fig1. It can be liquid, slurry or solid form which can be soluble/insoluble, combustible/incombustible, toxic/nontoxic. The type of agricultural waste produced depends on the agro- activity and are as follows table1-

|  |  |  |
| --- | --- | --- |
| **S.NO** | **AGRICULTURAL ACTIVITY** | **WASTE** |
| 1 | Crop production and harvest | Straw, stover |
| 2 | Fruit and vegetable processing | Biological sludges, trimmings, peels, leaves, stems, soil, seeds, and pits |
| 3 | Sugar processing | Biological sludges, pulp, lime mud |
| 4 | Animal production | Blood, bones, feather, litter, manures, liquid effluents |
| 5 | Dairy product processing | Biological sludges |
| 6 | Leather tanning | Fleshings, hair, raw and tanned trimmings, lime and chrome sludge, grease |
| 7 | Rice production | Bran, straw, hull |
| 8 | Coconut production | Stover, cobs, husk, leaves, coco meal |

**Table 1: Agricultural activity and waste created**

**Agricultural Waste**

**Crop residue**

* Rice straw
* Wheat straw
* Corn stover
* Barley straw
* Oat straw

**Industrial processing waste**

**Food waste**

* Sugarcane bagasse
* Rice bran
* Rice husk
* Orange peel
* Apple
* Mango
* Cabbage
* Tomato
* lettuce

**Livestock waste**

* Animal fat
* Cattle manure
* Swine manure

**Fig1: Types of agricultural waste**

**AGRICULTURAL WASTE FROM DIFFERENT SOURCES**

1. **CULTIVATION ACTIVITIES**

Cultivation is the tiling or unsettling and refining of soil by digging the soil to prepare a better soil bed for plantation. Various methods and techniques have been deployed for the cultivation of crops such as terrace cultivation, crop rotation, agroforestry, shifting agriculture etc. With increasing cultivation activities and farmers using variety of pesticides and fertilizers to increase the annual growth of the crops, it leads to different waste being produced from different activities and different crops, such as –

* **Rice** : The rice crop produces variety of waste, such as rice hulls which can be used as a fuel or as an abrasive character.
* **Paddy**: Waste produced from paddy crops such as paddy husk, paddy straw, etc which can be used for several purposes such as animal feed, mulching purpose, composting, and fuel purpose.
* **Wheat**: The waste produced by the wheat crop is straw, and it can be used as animal feed, particle board, dry flowers, mats, hats, carpets, and many more handcrafts.
* **Cotton**: The waste produced by cotton crop is cotton sticks. These sticks are used in power plants, plywood industries, and particle board industries, and can also be used in composting as well.

1. **AQUACULTURE**

Aquaculture growth depends totally on feeds, but when an excess amount of feed becomes solid waste. The water flow pattern reduces the fragmentation of fish feces and also allows rapid settling. The primary source of waste in aquaculture is feed, chemicals, and pathogens. All the factors contribute to the generation of waste.

1. **LIVESTOCK PRODUCTION**

Livestock waste is the waste produced from excreta, wastewater such as urine, cage water, wastewater from bathing of animals, hair, feather, soil, etc from animals and birds. Improper management of livestock waste leads to agricultural runoff. Livestock waste contains many beneficial by-products that can be used by farmers to make dung cake and it becomes a better option for fuel generation such as biogas, composting, fodder for animals, etc.

1. **PLANT WASTE (FRUIT AND VEGETABLE PROCESSING)**

(a) **Banana stalks and leaves**: They are used as painting and waterproofing agents. Boiling banana stalks with water and then mixing them with lateritic clay has been used as a waterproofing agent. This mixture can also be used for painting, and it protects from heavy rains.

(b) **Coconut**: The byproducts of coconuts include husks, coir fiber, unrented and retted pith, coconut shell, straw, etc. They can be used for board making, fiber making, wood particles, roofs, roads, mats, etc.

(c) **Sugarcane**: The by-product of this crop is sugarcane trash, growing green fodder, and bagasse. Sugarcane waste is mainly used in ethanol production, sugar manufacture, etc.

(d) **Jute**: The main by-product of jute is Jute stalks, and it can be utilized in making soft boards, matrices, etc.

**5. AGRO-INDUSTRIAL WASTE (SUGAR PROCESSING)**: Sugar industry produces a large amount of bagasse per year that can be used in wall panels, insulation boards, and manufacturing paper. Other agro-industrial wastes include wheat bran, rice bran, and corn bob It is very helpful in the circular economy. (Sen 2002; BMTPC 2005).

**6. HORTICULTURE WASTE**: Unused and spoiled vegetables and fruits, branches, leaves, and dead plants are the types of horticulture wastes (Zhang et al. 2011). This waste can be  converted into compost, and animal feed. The fruits and vegetables that go unsold can also be used as waste.

7. **FOOD PROCESSING WASTE**: Food Wastage occurs at all stages of the food supply chain. In low-income countries, most loss occurs during production, while in developed countries, about 100 kilograms per person per year is wasted at the consumption stage. The food industry produces large amounts of waste, both solid and liquid, resulting from the production, preparation, and consumption of food. These wastes cause severe pollution and a loss of valuable biomass and nutrients. Besides their pollution and hazard aspects, in many cases, food processing wastes might have the potential for conversion into useful products of higher value as by-products.

**UTILIZATION OF AGRICULTURAL WASTE**

Agricultural Waste utilization means the reuse of leftover residues, proper storage system, and conversion of the waste into the desired product (Komnitsas 2012). There are a lot of applications of agro-wastes shown in fig5. Useful approaches from the agro-wastes-

1. **MANUFACTURING CEMENT AND GLASS** : Rice waste can be utilized for the production of Portland cement, and a porous silicate  Combination of the heating value and silica content of the rice hulls is used in the manufacture of Portland cement. To manufacture water glass (sodium silicate) rice hulls are used as a source of silica and use the process of complete combustion. Another way for the production is wet-air oxidation called as Zimmerman process. The good bonding quality of rice hull ash can be used for the production of a wide range of materials like building blocks, pipe lagging, architectural insulating slabs, etc.
2. **MANURE / VERMICOMPOSTING**: With tons of waste being generated from all the sectors of developing nations, we should always look for sustainable and economic approaches to minimize the waste and get the best out of it. One such way is vermicomposting. In India for ages, the best way to manage the waste has been dumping it in the landfill, we need to step up, and rather than dumping the waste in the landfill, we should utilize it as vermicompost. Vermicomposting is a natural decomposition of waste in synergy with earthworms and microorganisms and converts it into organic manure in table 2 (Pramanik P, 2011). It helps maintain soil health by improving its physical and chemical properties. Apart from industrial and domestic waste, agricultural waste can also be used for vermicomposting. Agricultural waste including crop residue, rice straw, wheat waste along with livestock waste is a preferable choice for the process of vermicomposting.  Manures are utilized as they provide 19% nitrogen, 38% phosphorus, and 61% potassium. (Pratt 1975). It can be converted into organic manure which boosts crop production and lowers the cost and offers various health benefits, which is a serious problem caused by various inorganic manures. Vermicomposting helps increases soil fertility, nutrient maintenance capacity, soil texture stability, and water-holding capacity (CAST Report No. 41. 1975).

**ADVANTAGES OF VERMICOMPOSTING**

* It is an eco-friendly and zero-waste method for the management of waste.
* It is cheaper than the traditional method of composting.
* It produces uses compounds that help in reducing waste.
* It releases fewer greenhouse gases as it consumes less energy.
* Its use is multidimensional as it is economical and produces energy.
* It takes less time as compared to traditional ways.

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| **S.NO** | **AGRICULTURAL WASTE** | **DURATION** | **REFERENCE** |
| 1 | Coconut husk poultry manure, pig slurry | 21 Days | Swarnam *et al* 2016 |
| 2 | Wheat straw, pig dung, poultry dung, rabbit dung, cattle dung, sheep dung, and vegetal compost | 90 Days | Vodounnou *et al.* 2016 |
| 3 | Sawdust, boxwood leaves, and cardboard compost (MSW) | 100 Days | Alidadi *et al*.2016 |
| 4 | Pig manure and rice straw | 40 Days | Zhu *et al* 2018 |
| 5 | Cow manure and wheat residues | 60 Days | Sudkolai and Nourbakhsh2017 |

**Table 2: Waste and its duration of decomping**

1. **PAPER INDUSTRY :**

The Paper industry is one of the biggest industries utilizing agricultural waste such as sugarcane bagasse, paddy straw, and wheat straw shown in fig2. Using agricultural wastes, around 22% of paper is produced by the paper industry. Paper produced is recyclable, biodegradable, and is a sustainable and environment-friendly process.

**Fig 2: Agricultural waste utilization in paper industry**

1. **ADSORBENTS IN THE REMOVAL OF HEAVY METALS**: A large number of heavy metals are produced due to industrialization and urbanization which are toxic to all life forms. Agricultural wastes are cost-effective alternatives for the treatment of heavy metals through the process of adsorption. Some examples of agricultural wastes that have been used for the elimination of heavy metals are bagasse (Mohan and Singh 2002), rice husk (Ayub *et  al*. 2002), sawdust (Ajmal *et  al.* 1996), coconut husk (Tan *et al*. 1993), oil palm shell (Khan *et al.* 2003), neem bark (Ayub *et al*. 2001), etc
2. **PYROLYSIS**: Heating agricultural waste at a temperature of 400-600 0 C in the absence of oxygen is called pyrolysis, which yields char, oil, and low-heating-value gas.
3. **ANIMAL FEED**: Waste generated from postharvest operations like threshing and the milling process can be used directly for the feeding of various animals and the development of various value-added products. Rice and wheat bran can directly be served to some animals such as goats, cattle, etc.
4. **ENERGY FROM AGRICULTURAL WASTE**: Biochemical conversion of agricultural biomass waste to bioenergy is an environmentally friendly and sustainable technique shown in table 3. Besides generating revenue, waste-to-energy schemes offer an alternative and environmentally friendly means of waste disposal. Additionally, it also provides a valuable by-product: a good quality agricultural fertilizer that is odorless. India is a developing country whose economy is largely based on agriculture and the concern over future energy shortages and increasing costs of fuels and electricity looming over us, we need to adhere to the concept of waste–to–energy. Agricultural waste can be utilized to produce energy from biomass as mentioned in table 3.
5. **BIOETHANOL PRODUCTION FROM AGRICULTURAL WASTE** :

Fuel sources are limited and we are dependent on non-renewable sources for fulfilling our needs such as fossil fuels. However, the production of fuel from non-renewable sources leads to environmental pollution by the emission of greenhouse gases causing global warming. We are living in a world where sustainable development is of utmost importance. The usage of agricultural waste is one of the ways to produce a fuel that not only is environmentally friendly but also reduces the loss of by-products. Biofuel is an alternative source to reduce dependence on fossil fuels. Production of bio-ethanol from agricultural waste is a widely explored area shown in Fig3..

Bio-ethanol production from natural resources such as sugar cane, wheat, corn, etc is called first-generation bio-ethanol. Second-generation bioethanol is produced from agricultural waste. Producing bio-ethanol using the Second generation is the best option as it not only reduces the waste produced but also generates valuable fuel. They also emit less carbon and produce more energy. Agriculture waste such as wheat straw, barley husks, corn cobs, paper pulp, sugar cane bagasse, banana peel, orange peels, and pineapple peels are used for the production of second generation bioethanol.

Meenakshi and Kumaresan 2014, carried out the production of ethanol from corn and potato peel waste. Similarly, Bhatt and Shilpa (2014) prepared ethanol from groundnut shell waste. Manufacturing ethanol from waste is a way to get a healthier and more sustainable environment.

**ADVANTAGES OF BIO-ETHANOL**

* Lower emission of carbon.
* Since, bio-ethanol is made from waste, it is a renewable source of energy .
* They are bio-degradable.
* They are safer to use and does not harm the environment.

1. **BIOGAS PRODUCTION FROM AGRICULTURAL WASTE**

Biogas is produced by the biological breakdown of organic matter in the absence of oxygen, also called the anaerobic conditions. It is a type of biofuel that produces high amounts of methane gas fig4. Animal waste such as cow dung, dead stock, waste forage, milk house waste, and silage effluent is used to produce biogas. It results in the production of bio-fertilizers, and biofuel and saves plant nutrients.

**ADVANTAGES OF BIOGAS**

* Large amount of methane gas is produced
* It can be used as a vehicle biofuel.
* It is also used in generating power.
* Produces odourless sludge which can be used as a biofertilizer.

**Agricultural waste**

**Pretreatment**

**Breaks hemicelluloses and removes lignin barrier from agricultural materials**

**Enzymatic hydrolysis**

**Hydrolysis of cellulose and hemicelluloses by enzyme**

**Fermentation**

**fermentation of sugar to ethanol to ethanol by bacteria/yeast**

**Recovery**

**using Distillation**

**Ethanol**

Physical

Physio-chemical

Chemical

Biological

**Fig 3: Production of ethanol from agricultural waste**

**Fig 4 : Bio – Gas production from agricultural waste**.

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| --- | --- | --- | --- |
| **TECHNOLOGY** | **CONVERSION PROCESS** | **BIOMASS WASTE** | **FUEL PRODUCED** |
| Biodiesel Production | Chemical | rapeseed soy beans waste vegetable oil | Biodiesel |
| Direct Combustion | Thermochemical | agricultural waste mixed waste heat | steam electricity |
| Ethanol Production | Biochemical (aerobic) | sugar or starch crops wood waste pulp sludge rice and corn straw | Ethanol |
| Gasification | Thermochemical | agricultural waste mixed waste | low or medium Btu producer gas |
| Methanol Production | Thermochemical | agricultural waste mixed waste | Methanol |
| Pyrolysis | Thermochemical | agricultural waste municipal solid waste | synthetic fuel oil (biocrude) charcoal |

**Table 3: Waste Biomass Conversion To Energy**

Compost

Paper & Pulp

Fuel

Alcohol Production

Leather Industries

Bio-fertilizer

Biogas

Industrial Material

**Fig 5: Uses of agricultural waste**

**Agricultural Waste In India under Public Private Partnership**

As India enters a new era of creating wealth from waste, all sectors of the Indian economy are coming together such as start-ups, and public-private companies are implementing new technologies and creating new useful products.Some examples are as follows –

1. A Bangalore-based company called carbon masters working on converting food and agriculture waste meant for landfill through the process of bio-methanation creating a carbon neutral fuel called Carbonlites – Bio CNG which can be used for power generation, cooking, and heating. It has proven to have better fuel quality and less cost than LPG.

With the use of digest slurry, they are also making Carbonlites Bio enriched organic manure. It helps farmers reduce the use of chemical fertilizers and pesticides improving soil health, the water holding capacity of the soil, and increasing the soil carbon.

1. A Tamil Nadu-based company called crysops biocontrol provides pest management and agricultural waste management through insects.
2. Using soil biotechnology to minimize nitrogen emissions, with only green biomass, and bio-mineral fertilizer, as byproducts, Life connections, provides cost-effective and pollution-free treatment to natural soil plant approaches.
3. Manufacturing bricks and blocks from foundry sand and bio-gas from food waste, The Mahindra group is working on reducing waste and using by-products to create environmentally friendly products.
4. Fermentech Labs Pvt Ltd, a Roorke-based company provides circular bio-economy solutions by producing enzymes that find a wide range of applications in the pulp and paper industry, biofuel production, textile industry, pharmaceuticals and animal feed etc.
5. A Chennai-based startup, developing mycelium biocomposites-based protective packaging that can replace Styrofoam using mushroom waste, with the help of farmers, such that it also helps farmers boost their income.
6. In 2020, the Andhra Pradesh government signed an MOU with the Netherlands, naming the program Waste to worth and establishing agricultural biomass-based industries to generate income for farmers and reduces the environmental pollution which is caused basically by the burning of agricultural biomass.

**AGRICULTURAL WASTE MANAGEMENT SYSTEM (AWMS)**

Six basic functions :

• Production

• Collection

• Transfer

• Storage

• Treatment

• Utilization

For a specific system, these functions may be combined, repeated, eliminated, or rearranged as necessary. One other way of waste management is Integrated Agricultural Waste Management System.

**INTEGRATED AGRICULTURAL WASTE MANAGEMENT (IAWM)**

IWMS is a combination of several processes such as waste collection, treatment, and disposal, creating a method of practical waste management. IWMS combines both the management and reduction of waste strategies that aim to provide sustainability, a pollution-free environment, and economic affordability.

The main objective of the integrated waste management system is the minimum waste production, the creation of new products from waste, a sustainable environment, and providing income to farmers with many employment opportunities.

**ADVANTAGES OF IAWM**

* Minimum use of fertilizers
* Reducing the waste
* Improved soil fertility
* Improved income
* Recycling of resources
* Environmental friendly

Even though we study the management of agricultural waste but many developing countries are not able to manage it due to various issues. Waste management differs from one country to another and one typical solution will not solve the problem of waste management. As waste management is a localized problem, it requires a multidimensional solution sustainably with a combination of different aspects assessed together to reach a solution.

We need to combine all the different aspects as per the requirement of the particular place. For example, a developing nation like India is not technologically developed and we as a country are not aware of waste management.

Technology plays an important part in waste management as well-developed nations like Japan have access to world-class technology and the developing nations still follow the conventional method of waste management which has less scope in today’s world. New age technologies can sort out waste and the country as a whole need to be made aware of the benefits of recycling and reusing,  by making them aware of the waste collection system. With adequate education and training programs, we can learn the importance of waste management.

One of the main issues with waste management is economic feasibility. All the new age technologies and techniques of waste management are not economically viable to a developing nation unless they are subsidized by the government, which is the reason that most countries are still opting for the landfill as a method of waste management. The technologies need to be made cost-effective so that companies could expand.

Policies and government support are the key drivers for any management to work. For  Sustainable development to work, besides policies, other aspects such as transparency, reduced corruption, etc are also important factors for it. For example, the Indian government has National Mission for Sustainable Development (NMSD).

As much as all the other factors are important for the system to work, waste management is a societal issue. In developed nations, children from a very young are made aware of waste segregation and management, such that when they become adults they pass on these values to the younger generation, but this is not the case in developing nations, the waste management knowledge and awareness is minimal and require am adequate roadman to overcome the barrier of lack of awareness.

**Conclusion:**

The true meaning of the phrase waste to wealth can only be realized if we are aware of every one of the 5R principles of waste management. Agricultural waste is a value whose utilization can be maximized if we are aware of its uses. It is a promising solution for the world as it will help in creating more opportunities for humans. It will help in the development of agriculture and also bring out environmentally friendly methods to meet our fuel and energy needs. With the help of new technologies, we can find new ways to maximize the utilization of agricultural waste and can create a new world based on proper waste management. Not only will it be environmentally friendly but will also generate income, especially for the farmers.

**5R PRINCIPLE OF WASTE MANAGEMENT**

**To reduce the waste generated and create a sustainable environment, there is a need to make people aware of the 5R’s and implement them**

1. **REFUSE**

The first element of the 5 R's hierarchy. Learning to refuse waste can take some practice, but incorporating this step is the most effective way to minimize waste.

1. **REDUCE**

Reduce the use of harmful, wasteful, and non-recyclable products, so that less waste is produced.

1. **REUSE**

It involves usage of already produced material over and over again such that no new cost of labor, raw material or machinery is required.

1. **REPURPOSE**

For every item that can't be refused, reduced, or reused, repurpose, also called upcycling. It is the use of a product that cannot serve its purpose can be utilized as common/other use for something else.

1. **RECYCLE**

It is the most friendly waste disposal method. It is the transformation of used product as an input to form a new product.

To develop smart and proper management of agricultural wastes, farmers and the public at large scale should be made aware of various practices of waste management. With the help of NGOs, private companies creating new campaigns for the awareness and wakefulness of agro-waste uses and recycling as a useful product will be a great start by us into a new era of development. A proper framework where policy, technology, and society go hand in hand makes way for new ideas and education of old and new ways of waste management. A healthy and sustainable environment can only be developed if reduce agricultural waste and find new ways for a cleaner and brighter India with a holistic approach to the whole situation.

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