MANAGEMENT OF AGRICULTURE WASTE IN PROTECTING ENVIRONMENT

Seminar Report

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I[st] Doctoral Seminar Report

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Management of agriculture waste in protecting environment

Introduction:

Agriculture has a major share in the overall economy of India. With increase in food production crop residues also increasing. It is estimated that India generates around 500 Mt of crop residue annually: (**NPMCR)** National Policy for Management of Crop Residues (2019**).** Highest in the state of Uttar Pradesh (60Mt) followed by Punjab (51 Mt) and Maharashtra (46 Mt) with a grand total of 500 Mt per year out of which 92 Mt is burnt. Cereals, fibers, oilseeds, pulses and sugarcane contributed the highest crop residue with production estimations of 352 Mt, 66 Mt, 29 Mt, 13 Mt and 12 Mt, respectively. Among cereal crops- rice, wheat, maize and millets together contributed 70% of crop residue followed by fiber crops (13%).One-acre land produces 2.5-3.0 metric ton paddy straw and the burning of this one acre of paddy straw can destroy 32 kg Urea, 5.5 kg Di-Ammonium Phosphate (DAP) and 51 kg Potash manure which is already present in residues. Primary reason behind managing agricultural waste is to make good sense both environmentally and economically. Systematic utilization of agricultural waste also helps to improve environmental conditions by reducing pollution caused by disposal of huge agricultural waste.

Wastes: Wastes are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use.

Types of wastes: Solid waste and Liquid waste

According to their effects on human health-: Hazardous type and Non-Hazardous type

According to their properties: Organic waste or bio-biodegradable and Non-biodegradable

Agricultural Wastes: Agricultural wastes are defined as the residues from the growing and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products, and crops.

Agricultural wastes can be in the form of solid, liquid or slurries depending on the nature of agricultural activities.

Impact on environment: Waste from cultivation activities after using pesticides, most of the bottles and packages holding these pesticides are thrown into fields or ponds.

Depletion of dissolved oxygen caused by phosphate induced algal growth leads to death of fish and other aquatic biota. In presence of phosphates, nitrates too bring about an exaggerate growth of vegetation.

Nitrate pollution Accumulation of nitrates in water drunk by cattle or humans. Combines with the haemoglobin to form methaemoglobin, which interferes with the oxygen-carrying capacity of the blood, producing a serious disease known as BLUE BABY SYNDROME.

Crop burning: Monsoon, rice crop production has increased at a linear rate of 0.18 million tonnes from 2002 to 2016 in Punjab. Delhi had suffered its worst smog. In October-November 2016 there were nearly 18,000 crop fires in Punjab and Haryana put together the highest since 2002.

An Agricultural Waste Management System (AWMS): Planned system in which all necessary components are installed and managed to control and use by-products of agricultural production in a manner that sustains or enhances the quality of air, water, soil, plant, and animal resources

ICAR-initiations waste management

Bio char from Agricultural Waste Material

Soil less Planting Media using Sugar Industry Residue

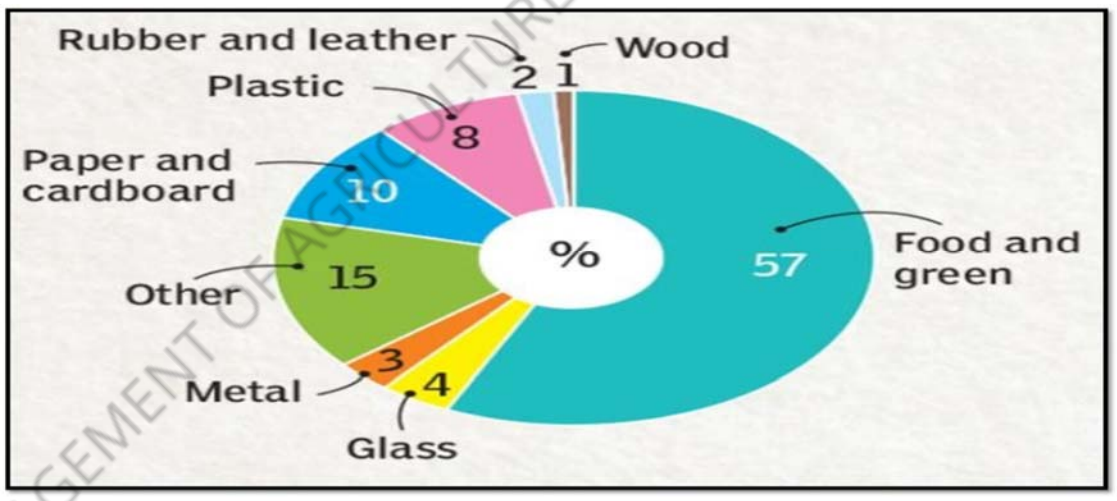
Foliar Spray from Fish Waste

PUSA Decomposer capsules

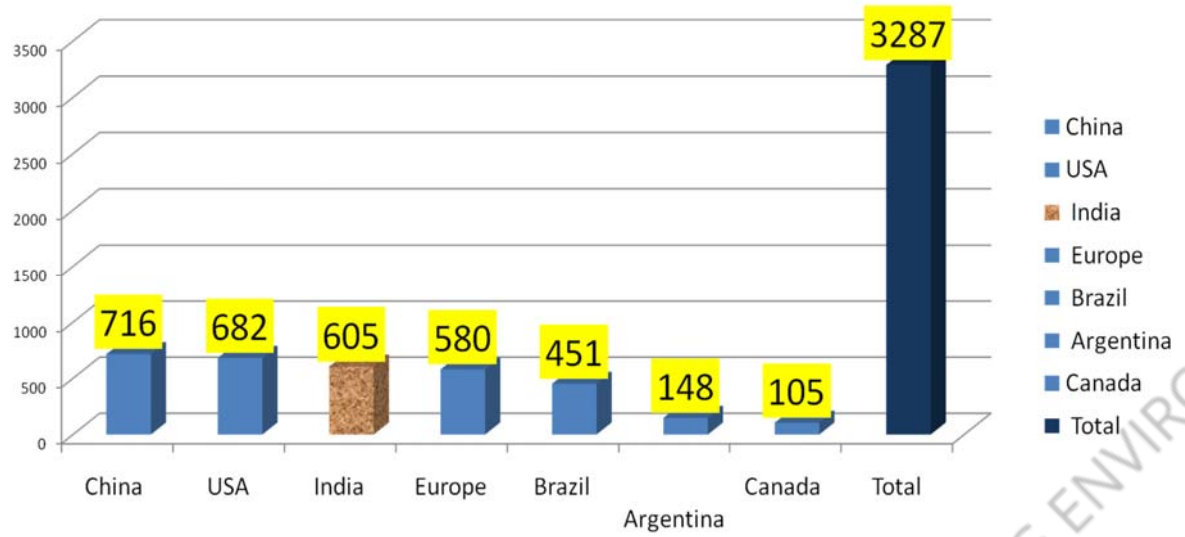
CFTRI: Banana waste management sports beverage from banana stem juice.

UAS Dharwad: Compost culture, Biogas, Vermicompost.

Strategies for waste management: Paddy, wheat, cotton, mustard and sugarcane Ethanol, Molasses.

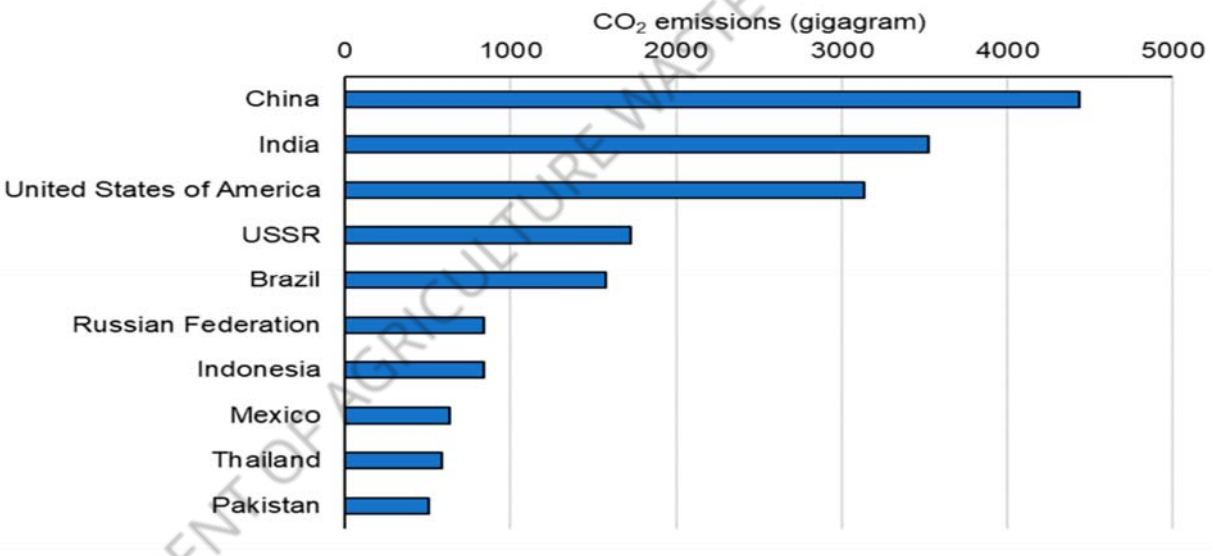


Composition of waste in South Asia Source (Times news, Mar 4, 2020)



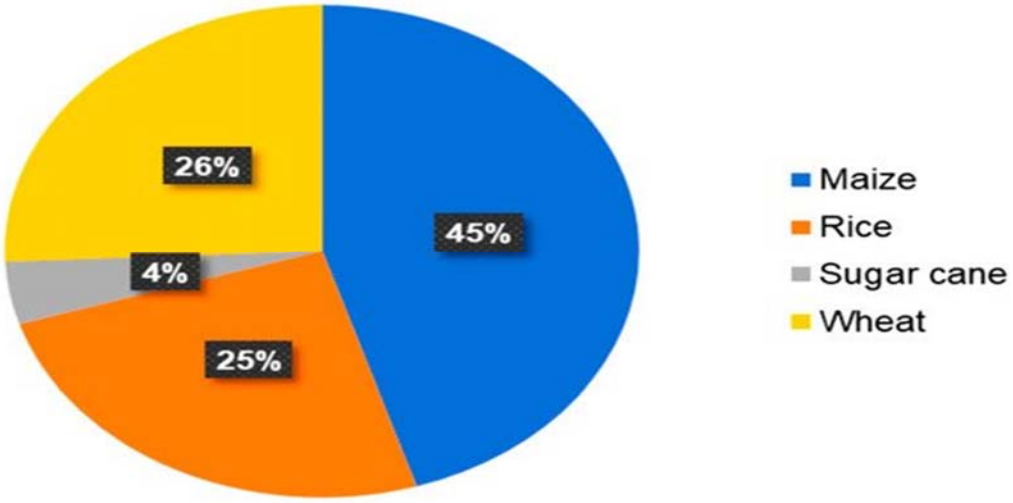
Cumulative generation potential of agricultural residues in selected countries

Composition of waste in south Asia China stands first rank 716 Mt /year generating agriculture wastes followed by USA, INDIA, EUROPE, BRAZIL, ARGENTINA, AND CANADA .682 Mt,605 ,580 Mt ,451 Mt ,148 Mt ,105 Mt respectively.



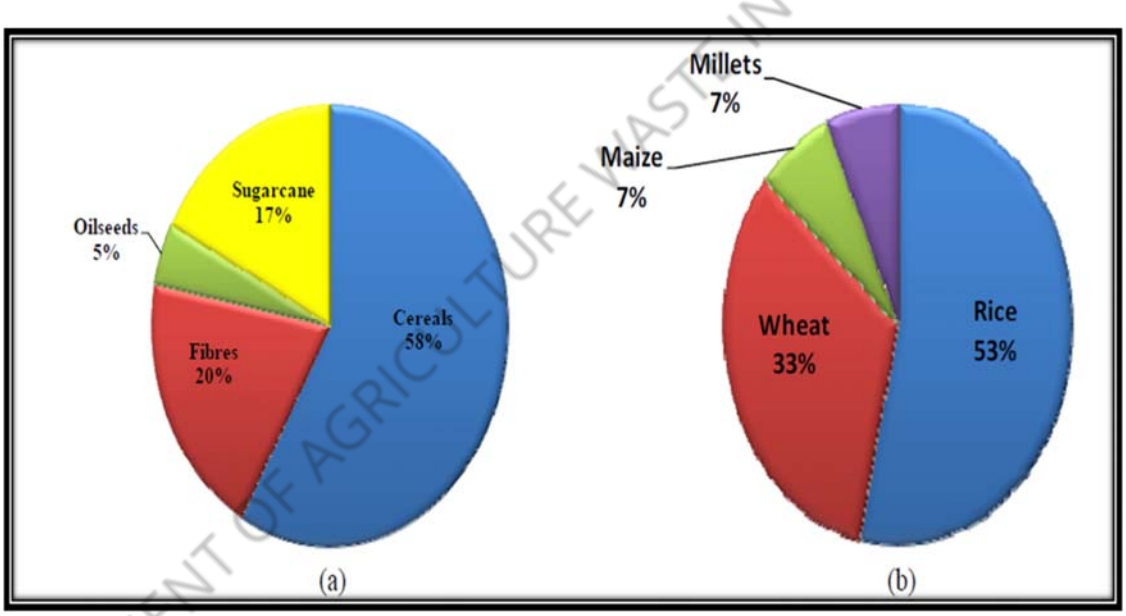
Top 10 emitting (CO_2 equivalent—gigagram) countries according to burning of crop residues

Amongst the different countries, the highest GHG emissions (CO2 equivalent—gigagram) through the burning of crop residues were emitted by China, followed by India, the USA, and the USSR



(source: Food and Agriculture Organization (FAO)

Burning of crop residues usually results in of CH_4 and N_2O gases produced by the ignition of crop residues and the emission of GHGs.. Amongst the different crops, globally, maize contributes the highest emissions through burning of crop residues, followed by rice, wheat, and sugarcane

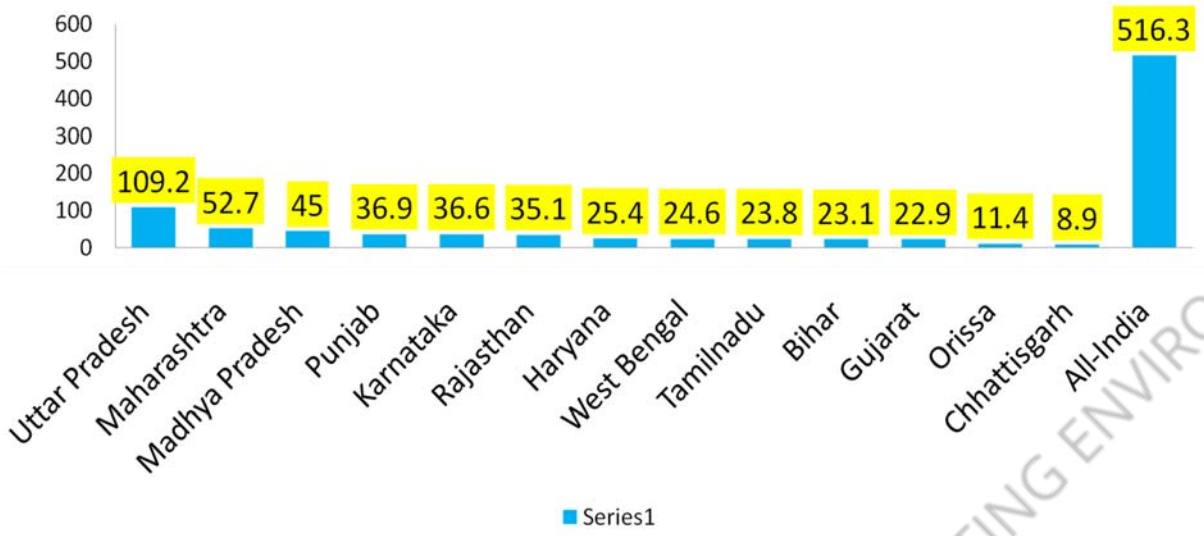


a) Contribution of different crops categories in residue generation in India.

b) Contribution of different cereal crops in residue generation in India.

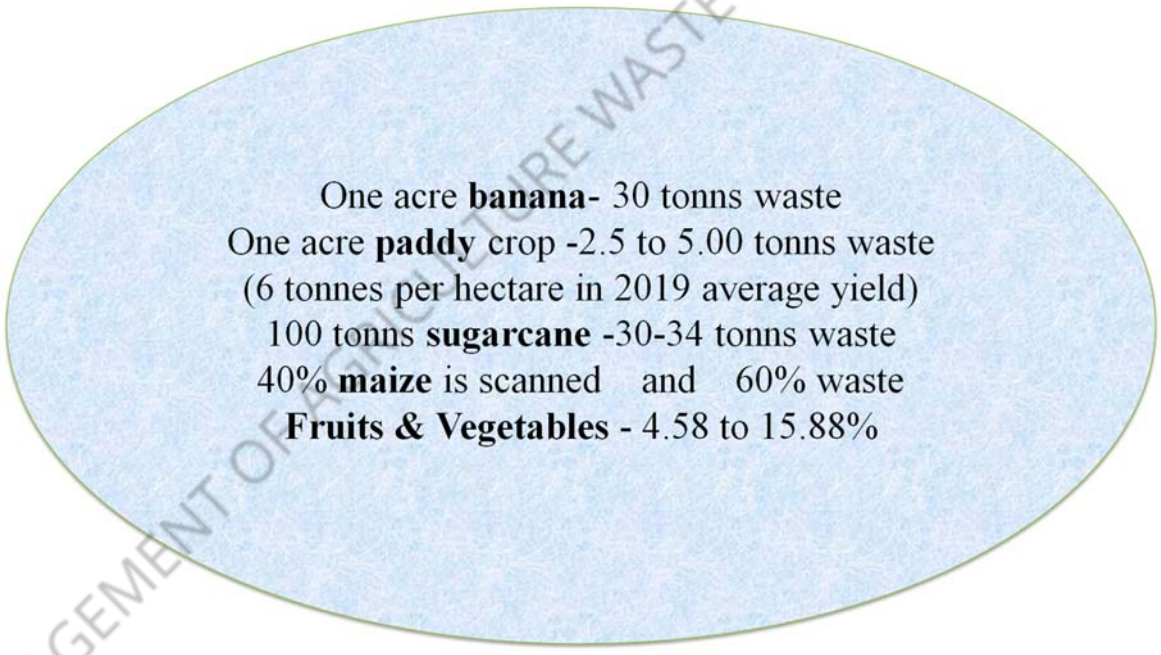
In residue generation Cereals are contributing 58% followed by fibres 20%,sugarcane 17% and oilseeds 7%.

Among the cereals crops rice contributing 53% followed by wheat 33% millets and maize 7% each residue generating .



Top residue generation states in India (SOURCE: Ministry of New and Renewable Energy (MNRE) 2018)

In India UP stands first in residue generation followed by Maharashtra, generating 109.9 Mt/yearfollowedMP,Punjab,Karntaka,Rajashtan,Hryana,WestBengal,Tamilnadu,Bihar,Gujarat h,Orissa and chattisgarh 52.7 Mt,45 Mt,36.9 Mt,36.6 Mt,35.1 Mt,25.4 Mt,24.6 Mt,23.8 Mt,23.1 Mt,22.9 Mt,11.4 Mt and 8.9 respectively.



Above figure shows that some of the important crops generating highest residue banana, sugarcane, paddy, maize, Fruits and vegetables.

What can be called waste: Waste are unwanted or unusable materials. Waste is any substance which is discarded after primary use, or is worthless, defective and of no use.

Types of waste: 1.Solid waste 2. Liquid waste

Classification of wastes

1. Hazardous type 2.Non-Hazardous type 3. Organicwaste or bio-biodegradable 4.Non-biodegradable

AGRICULTURAL WASTES

Agricultural wastes are defined as the residues from the growing and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products, and crops.

Agricultural wastes can be in the form of **solid, liquid or slurries** depending on the nature of agricultural activities.

Types of agricultural wastes

Animal waste (dung,urine,slurry, droping of birds,dead animals)

Food processing waste (vegetables and fruits peels waste)

Crop wastes (coconut shells,baggages,rice straw,maiz etc…)

Hazardous or toxic waste (pesticides, insectisides, heribicides)

Impact of agriculture waste on Environment:

Pesticides residue- Impact on animals

After using pesticides, most of the bottles and packages holding these pesticides are thrown into fields or ponds. According to (PPD), about 1.8% of the chemicals remain in their packaging. In a tragic incident, pesticides dumped at a field in Andhra Pradesh led to the death of at least 56 cows on Monday, after the animals consumed them on Sunday night.

Fertilizers and pesticides residues - Impact to aquatic ecosystem

Modern agricultural practices require the use of large amount of fertilizers, pesticides and other soil additives. Some of these along with waste are washed off lands through irrigation, rainfall, drainage and leaching into the rivers and streams where they can seriously disturb the aquatic ecosystem.

Nitrate pollution -impact to the cattle and humans

Accumulation of nitrates in water drunk by cattle or humans Combines with the haemoglobin to form methaemoglobin, which interferes with the oxygen-carrying capacity of the blood, producing a serious

disease known as BLUE BABY SYNDROME(Blue baby syndrome can refer to a number of conditions that affect oxygen transportation in the blood, resulting in blueness of the skin in babies).

Livestock waste impact on soil water and air

Air pollution includes doors emerging from cages resulting from the digestion process of livestock wastes Untreated and non-reusable waste source can generate greenhouse gases while also having negative effects on the fertility of the soil and causing water pollution. Germs and substances can spread diseases to humans and cause many negative effects on the environment.

Crop residue -Impact to air, soil and water pollution

Give shelter to various pathogens, fungi, bacteria which causes infectious diseases If not properly managed they can catch fire, damage residential area and cause air pollution Decrease the soil productivity by inhibiting the microbial activity.

Crop burning impact on environment

Delhi had suffered its worst smog. In October-November 2016 there were nearly 18,000 crop fires in Punjab and Haryana put together the highest since 2002. The number of fires reduced in 2017 — to a little more than 12,000 — but still had a huge impact on air quality in NCR, according to experts.

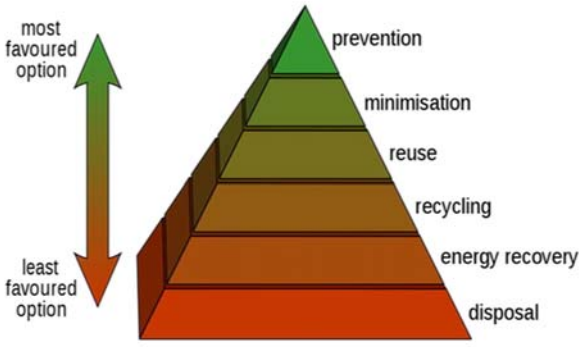
(SOURCE: Directorate of Economics and Statistics, Department of Agriculture)

An Agricultural Waste Management System (AWMS)

Planned system in which all necessary components are installed and managed to control and use byproducts of agricultural production in a manner that sustains or enhances the quality of air, water, soil, plant, and animal resources.

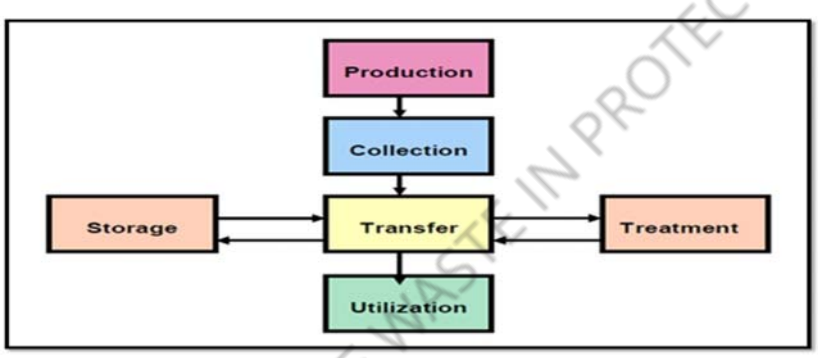
Waste minimization efficiency in 3Rs in a hierarchical order-

Reduce, Reuse and Recycle



The concept of minimizing waste reduces the quantity and ill-effects of waste generation by reducing quantity of wastes, reusing the waste products with simple treatments and recycling the wastes by using it as resources to produce same or modified products. This is usually referred to as '3R'. Some waste products can be consumed as resources for production of different goods or the same product, meaning recycling the same resource. When wastes are reused time and again, it offsets harvesting of new similar or same products. This saves fresh resources exploitation and reduces waste generation. All in all, the 3Rs individually or collectively saves fresh resources exploitation, add value to the already exploited resources and very importantly minimizes the waste quantity and its ill effects. The principle of reducing waste, reusing and recycling resources and products (3Rs) aims at achieving efficient minimization of waste generation by: Choosing to use items with care to reduce the amount of waste generated. Repeated use of items or parts of items which still have usable aspects.

Six basic functions in waste management



Poultry Waste Management Options

A poultry farm is used here to describe a typical waste management system showing the application of each component function of an AWMS. The poultry waste management system is as described in. A holistic view of the various waste management options for poultry production.

Production: Wastes associated with poultry operations include manure and dead poultry. Depending upon the system, waste can also include litter, wash-flush water, and waste feed.

Collection: The manure from poultry operations is allowed to accumulate on the floor where it is mixed with the litter. The manure litter pack forms a "cake" that generally is removed between flocks. The litter pack can be removed frequently to prevent disease transfer between flocks. In layer houses, the manure that drops below the cage is collected in deep stacks or is removed frequently using either a shallow pit located beneath the cages for flushing or scraping or belt scrapers positioned directly beneath the cages.

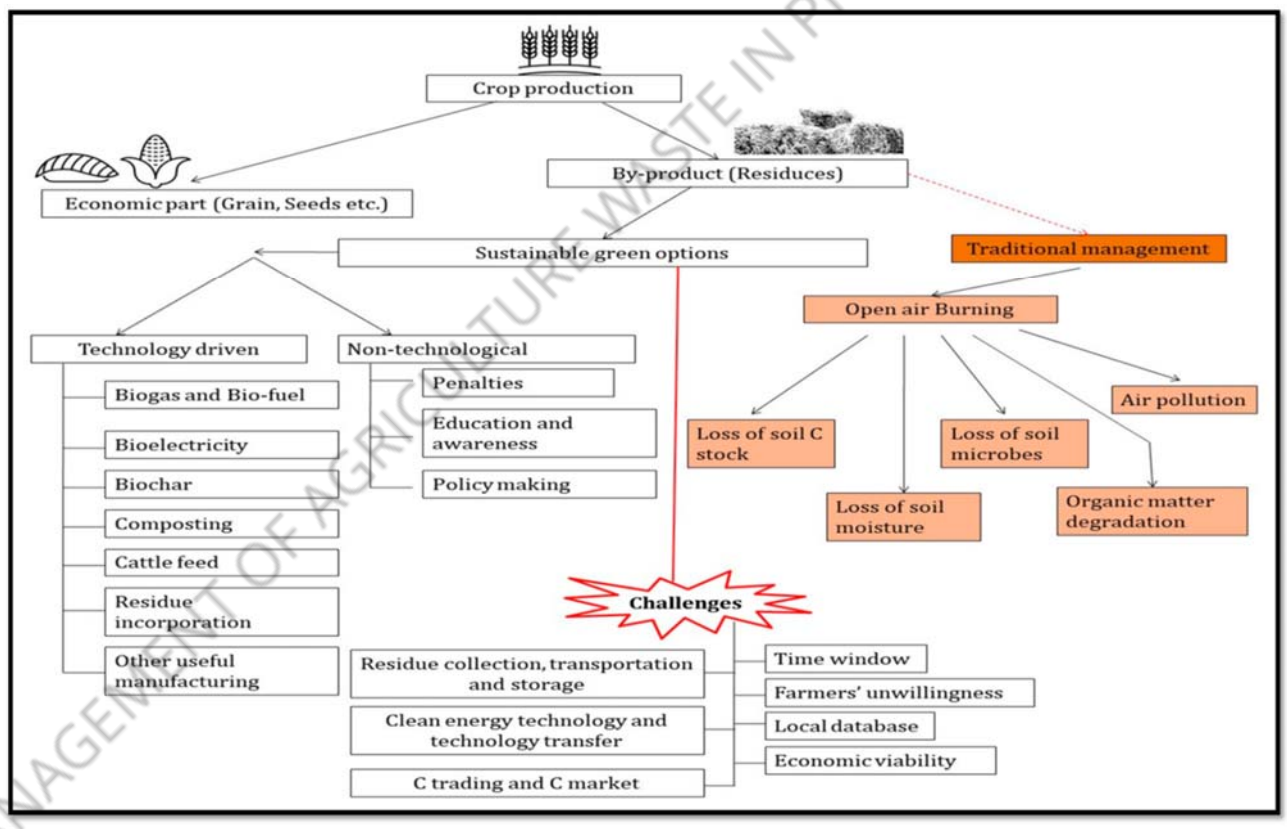
Storage: Litter from poultry operations is stored on the floor of the housing facility or outside the housing facility. When it is removed, it can be transported directly to the field for land application. In some areas the litter may be compacted in a pile and stored in the open for a limited time; however, it

generally is better to cover the manure with a plastic or other waterproof cover until the litter can be used. But if it is needed to be stored for a long time, the litter should be stored in a roofed facility. If the manure from layer operations is kept reasonably dry, it can be stored in a roofed facility. If it is wet, it should be stored in a structural tank or an earthen storage pond.

Treatment: Poultry litter can be composted. This stabilizes the litter into a relatively odorless mass and helps to kill disease organisms so that the litter can be reused as bedding or supplemental feed to livestock. The litter can also be dried and burned directly as a fuel. Liquid manure may be placed into an aerobic digester to produce methane gas.

Transfer: The method used to transfer the waste depends on the total solid content of the waste. Liquid waste can be transferred in pipes, gutters, or tank wagons, and dried litter can be scraped, loaded, hauled as a solid and transported using trucks.

Utilization: The waste from poultry facilities can be used for agricultural land application or sold because of the high nutrient value of the litter. Furthermore, poultry waste can also be used for the production of methane gas, buried directly as a fuel, reused as bedding, or used as a feed supplement to livestock.



Schematic overview and strategies for efficient crop residue management (Sarkar *et al*. 2020)

Agriculture is the mainstay for a large number of populations worldwide. It brings bread for more than two-thirds of the population and provides food for the rest. On the other hand, the global population has been increasing at an alarming rate for the last two to three decades. This increasing rate generates pressure within the agricultural system to grow more food. Furthermore, the indiscriminate undermining of natural resources leads to the limitation of these resources. This emphasizes the need for the universal adoption and expansion of improved conservation technologies. The conservation technologies in agriculture are considered the most valuable technologies to sustain food production as well as to conserve resources. Modern intensive agricultural practices are highly input-sensitive, and uneven depletion of various natural resources results in their deficiency in many areas across the globe. Crop residue management not only improves soil physical, chemical, and biological status, but also helps in protecting the soil surface from nutrient loss.

Crop residues are often considered as waste material in terms of their economic importance, but they provide elemental carbon in soil and oer a variety of mechanisms for nutrient recycling in soil. Crop residue management helps in maintaining soil moisture content by protecting the soil

Surface and increasing irrigation efficiency.

ICAR-INITIATIONS WASTE MANAGEMENT

Technologies for Converting Wastes from Crops/ Crop By-Products into High Value Products
Preparation of Handmade Paper from Jute Waste
Lac Dye from Effluent of Sticklac Washing
Lac Mud as Organic Manure
Preparation of Value-Added Products from Gummy Mass (Gm) – A
Fortified Rice Analogues from Broken Rice and Dal
Technologies for Converting Wastes from Horticultural Crops/Crop By-Products into High Value Products
Tamarind Seed Husk Reduces Enteric Methane Emission
Pineapple Fruit Residue Silage as Fodder Source for Livestock
Alcoholic Beverage with Nutraceutical Properties from Kinnow peels
Oil Palm Factory Waste for Mushroom Production
Technologies for Converting Fisheries & Animal Wastes into High Value Products
Chitin and Chitosan from Prawn Shell Waste
Calcium from Fish Bones
Absorbable Surgical Suture from Fish Guts

Preparation of Handmade Paper from Jute Waste

Development of a technology of making handmade paper from jute fibre especially jute residue will open up a new area where substantial quantity of thrown away jute waste can be used for making handmade paper of good commercial value. A new avenue of utilization of jute wastesis opened up, which would otherwise be burnt by farmers or thrown away creating disposal problem.

Salient Features:

The handmade paper/paper board is made from low grade jute fibre and can be suitably blended with other lignocellulosic fibres by adopting an inexpensive pulping process with minimum use of cooking chemicals like caustic soda, sodium carbonate, lime etc. Most of the properties are same as normal handmade paper and even better in some of the cases. There are diversified uses of it such as in Files, Folders, Greetings Card, shopping bags, Visiting Card, Posters, writing grade paper, paper boards, file covers, greeting card etc.

Benefit:

- Handmade paper products conserve resources and generate less pollution
- Producing handmade paper uses much less total energy than producing virgin paper
- Reduces total number of trees cut down to make paper
- Cost involved: Cost of Machine and Equipment: Rs. 70 lakhs (Approx.)

Developer: S N Chattopadhyay, ICAR-NINFET, Kolkata

Contact Details: Director, (email: director.ninfet@icar.gov.in), ICAR-National Institute of Natural Fibre Engineering & Technology, Kolkata-700 040 West Bengal (www.nirjaft.res.in)

Biochar From Agricultural Waste Material

Developer: Division of Agricultural Engineering

Features:

- Biochar are produced from the agricultural waste(maize stalk, pine needle)and weed by using pyrolysis method.
- Agricultural biomass can be converted into biochar within two hours
- Improve soil fertility and crop yield.
- Increased fertilizer use efficiency.
- Improve water retention, aeration and soil tilth.
- Higher cation exchange capacity and less nutrient runoff.
- Application of biochar improved soil pH by 0.26 to 0.30 units within two months

Foliar Spray from Fish Waste

Developer: A.A. Zynudheen and Binsi Pillai, ICAR-CIFT, Kochi

- **Features:**

• Foliar spray is a fish waste-derived liquid product that contains peptides and amino acids.

- Stable product under room temperature.
- Can be directly applied after dilution on a wide variety of plants.
- Enhances the productivity of the plants immediately andpossess pest repellent properties.
- High demand for the product and is gainful employment with a high return of margin.

Indian Agricultural Research Institute, New Delhi developed PUSA Decomposer capsules

Stubbles can also be handled properly through accelerated decomposition process. Recently, Indian decompose residues into compost through accelerated decomposition. It involves making a liquid formulation using decomposer capsules followed by its fermentation and then spraying on the field with stubbles to ensure speedy decomposition. Microbial agents in that capsule or solution act on the straw to make it soft, breaks its molecular components and release nutrients in the field. Reportedly it takes around 25 days for the degradation process to be completed (Bhatnagar, 2020) and costs less than Rs 1000 per acre (Reddy, 2020). For rapid breakdown of hard stubbles IARI has identified seven strains of fungi, which are packed in four capsules. It costs about Rs 20 per packet of four capsules. According to a report of The Hindu (dated 24th September, 2020), for processing the solution 25 liters of water is boiled with 150 grams of jiggery, which helps in fungal multiplication.

Turning banana farm waste into income

Banana growers in Mysuru can now use waste generated in banana plantations to make additional income. Approximately **30 tonnes** of waste is generated per acre banana stem alone. This has become a worrying factor for growers dump such large amounts of waste.

CFTRI have now come to their aid and developed a model that gives commercial value to waste.

- Banana fibre also finds use in high-quality security/currency paper, packing cloth for agriculture produce, ship-towing ropes, wet drilling cables, etc.
- The juice extracted from stem has many medicinal benefits. The model is expected to give substantial income with little capital investment, said CFTRI Director Ram Rajashekaran.

- Sports beverage from banana stem juice.

IVRI Waste Management Guide App

Features: 1.This app will give the complete information about Organic waste, Composting, Vermicomposting, Biogas production, new alternatives, crop residue management technologies, initiatives for organic waste, management India. How to handle the waste what are the parameters, costs, benefits etc...Information is available.

UAS DHARAWAD:

1. Vermicompost –converting cattle dung and feeding waste into vermicompost and selling to farmers 8 rupees /kg.

2. Compost culture -Institute of organic farming invented compost culture it will helps to decompose the waste within 85 days completely

3. Biogas plant- UAS DHARWAD all hostels food wastes converting into biogas

STRATEGIES FOR WASTE MANAGEMENT

Strategies for paddy and wheat waste management

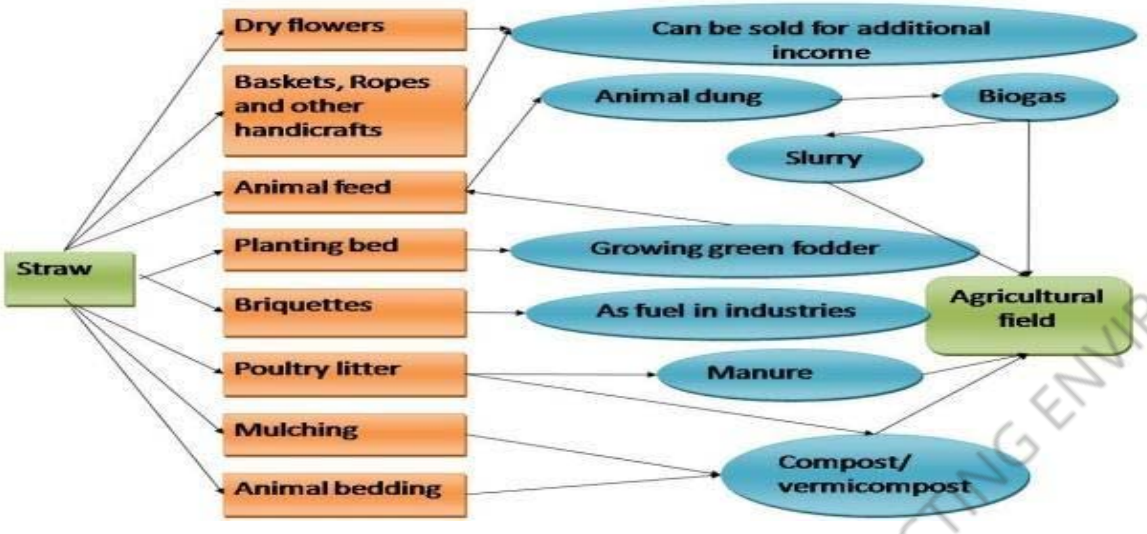


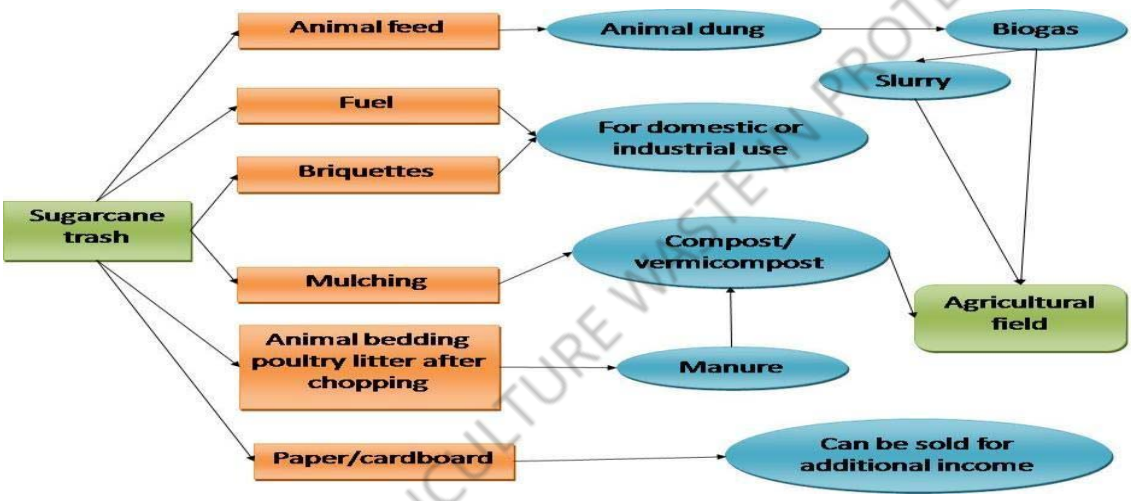
Figure1 explains the various possible methods of using paddy and wheat straw. It is a chain process starting with its use as animal, animal waste like dung can be used for generating biogas and biogas slurry which comes out of biogas plant can be used as manure. Straw can also be used to make planting bed to grow green fodder; the straw along with green fodder can be chopped and fed to animals. Wheat straw can be used as poultry litter which can further be used as manure or converted into compost. If wheat straw is used as animal bedding, after its use it can be composted and turned into manure. Another important use of straw is to make briquettes, which is an excellent fuel. It can be used either for domestic purpose or for industrial purpose. This waste management system is completely sustainable as every waste material is fully utilized without creating any environmental pollution. Garay [4] reported that Particle board can be made with crop residues mixed with wood from *pinus radit,* all the crop residues like wheat straw, corn and rice straw are suitable for making particle boards but best results were with wheat straw and corn stubbles.

Sugarcane waste management system: Following are the sugarcane crop wastes management modalities suggested.

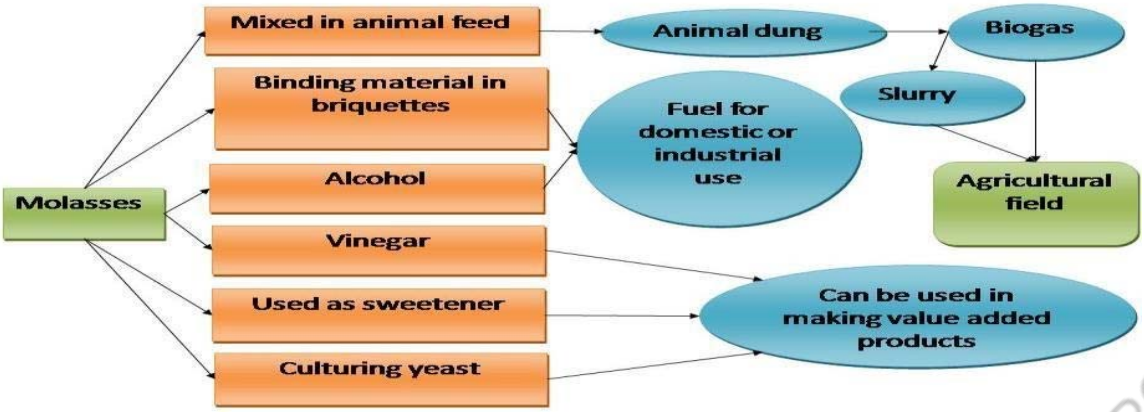
Sugarcane bagasse: Sugarcane bagasse management system. It is also a chain process starting from its use as planting bed to grow vegetables like chilli, capsicum, tomato, okra, etc. fruits like strawberry can also be grown on it. Beside this green fodder can be grown on it, chopped along with bagasse and then fed to milch animals this will help to increase the milk yield. It can be used to make alcohol for fuel purpose. Making briquettes is another important use of bagasse and it can also be used in making vinegar and other beverages that are useful products and fetch high prices in market. Bagasse is an

excellent mulching material which can further be used for composting and making manure, its use as animal bedding and poultry litter is also possible, this litter can be used for composting, manure or fed to biogas plant for generation of biogas, which is an excellent fuel. Use of bagasse in making paper is quite common. Handmade paper industry can be developed on village level which will not only utilize waste but also provide employment to rural population.

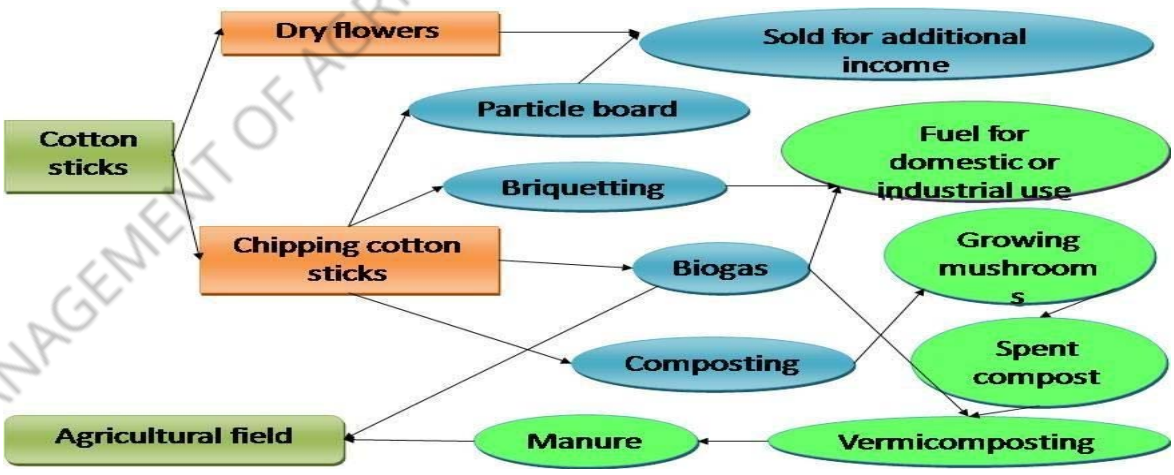
Sugarcane trash: Sugarcane trash is usually fed to animals by all the farmers. Figure 3 shows other possible ways of utilizing sugarcane trash. Sugarcane trash can be used as source of energy in sugar industries or any other industry. It can also be used to make briquettes, which can further be used as fuel. Sugarcane trash has been used as mulching material since ages, after it has been used for mulching it can be converted into compost and mushrooms can be grown on it. Another possible use is using it for animal bedding and poultry litter. The animal bedding and poultry can again be used as manure or fed to biogas plant in order to generate biogas. It is also advisable to use it in making cardboard and paper.



Molasses: Molasses is a great sweetener and a good source of calcium and iron. Figure 4 shows the waste management system of molasses. It can be mixed in animal feed as a nutrient supplement. Alcohol, vinegar and other beverages can also be made by using molasses. It can also be used in culturing yeast. Most important use of molasses is its use as binding material to make briquettes. Anastassiadis [1] conducted a study on the production of citric acids and stated that many inexpensive by-products and residues of the agro-industry (e.g. molasses, glycerin etc.) can be economically utilized as substrates in the production of citric acid. There are also health beneficial effects of apple vinegar such as anti-bacterial and antioxidant, blood pressure reducing activity, prevention from cardiovascular diseases Ozturk .

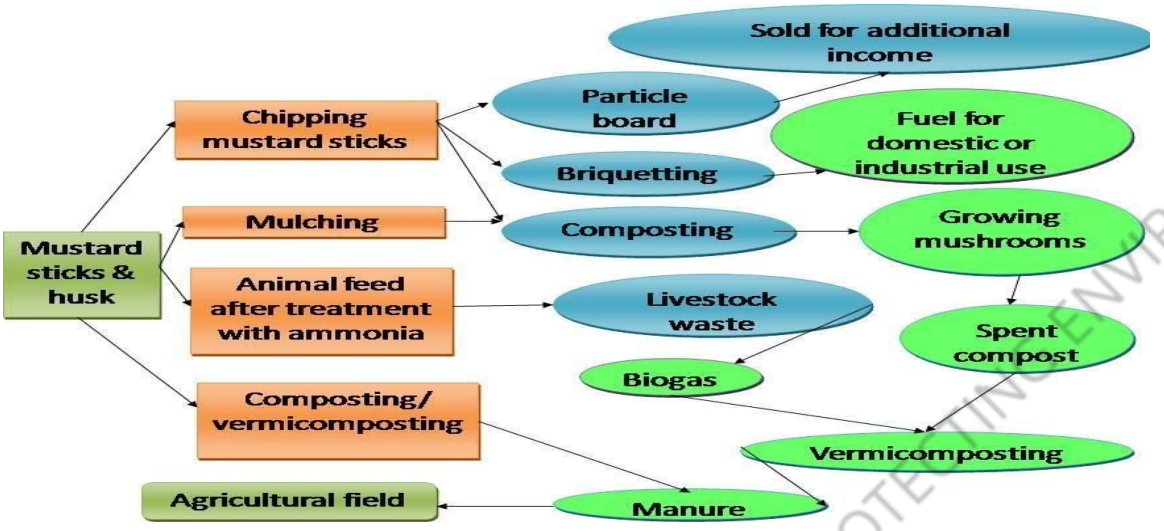


Cotton waste management system: Other possible ways of cotton waste utilization is described in figure 5. Cotton sticks can be used to make decorative items like dry flowers that can fetch high prices in market. Cotton sticks can be chipped and then used to make particle board which is further used for making furniture. Chipped cotton sticks can also be used to make briquettes and to make compost. Compost made from cotton sticks is best for mushroom cultivation. Mehta [8] reported that all the respondents in hisar and fathabad district were using cotton sticks and cow dung cake as a working fuel in traditional chulha. All the respondents were making the cow dung cake daily which is not healthy for human as well as environment. Researchers have shown that biogas can be generated from waste cotton sticks thus it can be fed to biogas plant. Isci and Demirer [6] conducted an experiment on biogas production potential from cotton wastes and reported that cotton waste can be treated anaerobically and are a good source of biogas. Approximately 65, 86 and 78 ml CH_4 were produced in 23 days from 1 g of cotton stalks, cotton seed hull and cotton oil cake in the presence of basal medium (BM), respectively.



Mustard waste management system: Figure 6 shows other possible ways of utilizing mustard sticks.

Mustard sticks can be easily chipped and used for making briquettes and particleboard. It can also be used to make animal feed after physical, chemical or biological treatment. By treating chemically with ammonia its digestibility can be increased and mixed with green fodder and fed to animals. Mustard sticks can also be converted into compost for growing mushrooms or can be used as planting bed.



Butnar reported that the overall assessment includes the cultivation and collection of biomass, its transport and the processes of its energy transformation. The results showed that, the transportation of biomass from the field to the power plant is an important stage that has to be carefully planned in order to get the maximum amount of electricity with a minimum environmental impact. Compared to electricity from natural gas or the Spanish electricity mix, the electricity obtained from biomass is more impacting.

Electricity from Agricultural Waste in India

The Ministry has been implementing biomass power/co-generation programme since mid-nineties.

Over 800 biomass power and bagasse cogeneration projects aggregating to 10170 MW capacity have been installed in the country for feeding power to the grid.

States which have taken leadership position in implementation of bagasse cogeneration projects are Maharashtra, Karnataka, Uttar Pradesh, Tamil Nadu and Andhra Pradesh. The leading States for biomass power projects are Chhattisgarh, Madhya Pradesh, Gujarat, Rajasthan and Tamil Nadu. **Source: Ministry of New and Renewable Energy (MNRE**).

Project type: Biomass

Project location: Karnataka, India

The purpose of the project is to utilize available biomass in the region as an efficient fuel for energy production. For the local population, this project located in the South of India brings both social and

ecological advantages: The project creates over 400 jobs in the region. The farmers receive an additional income for providing the power plant with their agricultural waste.

Case studies:

1. Mushroom cultivation

By using farm waste for the small and marginal farmers of Nagaland Mushroom production can generate a good source of income for small and marginal farmers.

In Nagaland, rice is the staple crop which is growing in low land area, occupies about 70% of the total area under cultivation during rainy season.

The increase in net income of Rs. 27,540.00 was achieved by the small farmers in a thatched roof of 3m x 6m size of Mushroom cropping room with a capacity of 250 beds having B:C ration of 1.8.

(Source: Instapdf.in/strategies-for-doubling-farmers-income-by-2022)

2. Success story on rural entrepreneurship development through pig farming Sri Mandip Rai Sikkim district.

Initially, KVK supplied a total of 45 piglets among 15 farmers i.e. 3 nos. of weaned piglets of 2 months old (2: female + 1: male) to each beneficiaries of the adopted village as first line beneficiaries.

He used locally available feed resources for feeding his piglets like cereals (Maize, paddy husk and rice bran), kitchen waste, vegetable wastes..

At first farrowing he got a total of 14 piglets from his 2 sows after 12 months of rearing.

Income generated per annum by selling the product vis-à-vis cost of production per unit:

Enterprise	Breed	No. of pig	Expenditure (Rs.) in cost of piglets and conc. feed	Income (Rs.) From sale of piglets of 1st farrowing	Profit (Rs.)	B:C ratio
Small scale pig breeding farm	Large White Yorkshire (LWY)	2 (Female +1 (Male)	18,300/-	44,800/-	26,500/-	2.45

3. Success story of vermicompost.

Sri Dinesh prasd singh from Banka district UP he constructed 96 pits of 20ft length,4th width, depth ,3.5 ft. Depth,3.5ft.depth in which he produces about 7500 quintal of enriched vermicompost per pit. His family annual income now Rs.10 lakh rupees per annum.He is now the leading vermicompost producer in banka district

Research studies

Study1. Augmentation of farmers' income in India through sustainable waste management techniques

Singh *et al.,* 2020

Study area: Ludhiana District of Punjab

Sampling method : Case study method

Respondents: Three dairy farmers, each pursuing vermicomposting, biogas production and traditional composting.

Table1. Comparative economic analysis of vermicomposting, composting and biogas production.

Cost component (all figures in Indian National Rupee	Vermicomposting	Composting	iogas production
	Based on case study tonn (Mt) Per cattle		
Total fixed investment	24000.00	500.00	30450.00
Total fixed cost	5200.00	156.25	6155.62
Total variable cost	21102.29	8946.00	13071.64
Total cost	26302.29	9102.25	19227.26
Total returns	54000.00	11132.5	33915.68
Net returns	27697.71	2030.25	14688.42
Profitability ranking	I	III	II

Table 1.reveals that highest net returns per Mt of dung were obtained from vermicomposting (INR 2224.72, USD 29.42), followed by biogas production- Family and casual labour 7096.64

Biogas maintenance charge 500 Total variable cost (TVC) 13071.64d.Total cost (TC= TFC+TVC)19227.26 e. Returns Value of obtained biogas 27071.68

Sale of slurry compost 6844 Total returns (TR) 33915.68 f.Net returns (NR = TR-TC) 14688.42 from vermicomposting (INR 11012.34, USD 145.64), followed by biogas production (INR 2656.74, USD 35.14) and composting (INR 225.68, USD 2.98). Based on the returns, profitability ranking of the practices has been done in which vermicomposting attained rank I, biogas production attained rank II and composting attained rank III. High profitability was accorded to ver- micomposting because vermicompost is sold at remunerative prices. Other products obtained from vermicomposting such as. Net returns (biogas produced per metric tonne of dung) 536.66 vermiculture and vermiwash are high value products.

Study 2. Agricultural waste awareness and utilization for healthy environment and sustainable livelihood

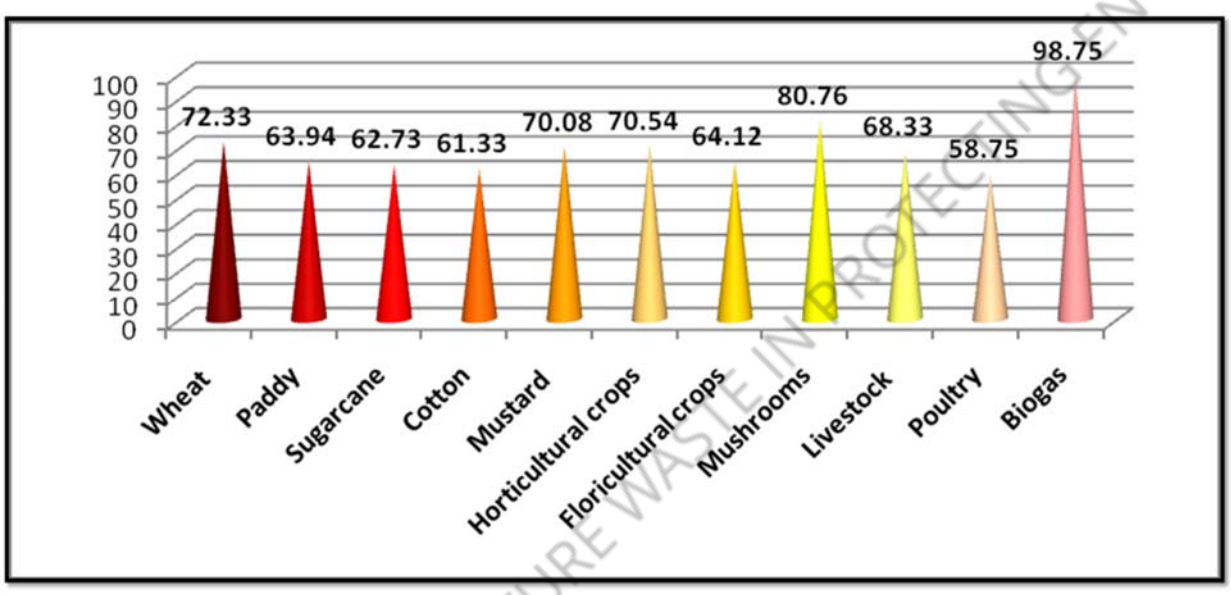
Shehrawat *et.al., 2015*

Study area: The study was conducted in two districts of Haryana state, Hisar and Sonipat,

Sampling method: purposive simple random

Sample: 120

Fig: 1 Overall awareness about utilization of agricultural wastes



The figure clearly describes the awareness about the utilization of different crop waste. Awareness about utilization of wheat straw was 72.33 percent and paddy waste was observed 63.94 percent. Awareness about utilization of sugarcane waste was 62.73 percent. Awareness about utilization of cotton sticks was 61.33 percent and about utilization of mustard sticks was observed 70.08 percent.Awareness about utilization horticultural waste was 70.54, about utilization of floricultural waste was 64.12, utilization of mushroom waste was 72.50 percent, utilization of livestock waste, biogas plant waste and poultry was 68.33, 98.75 and 58.75 percent, respectively.

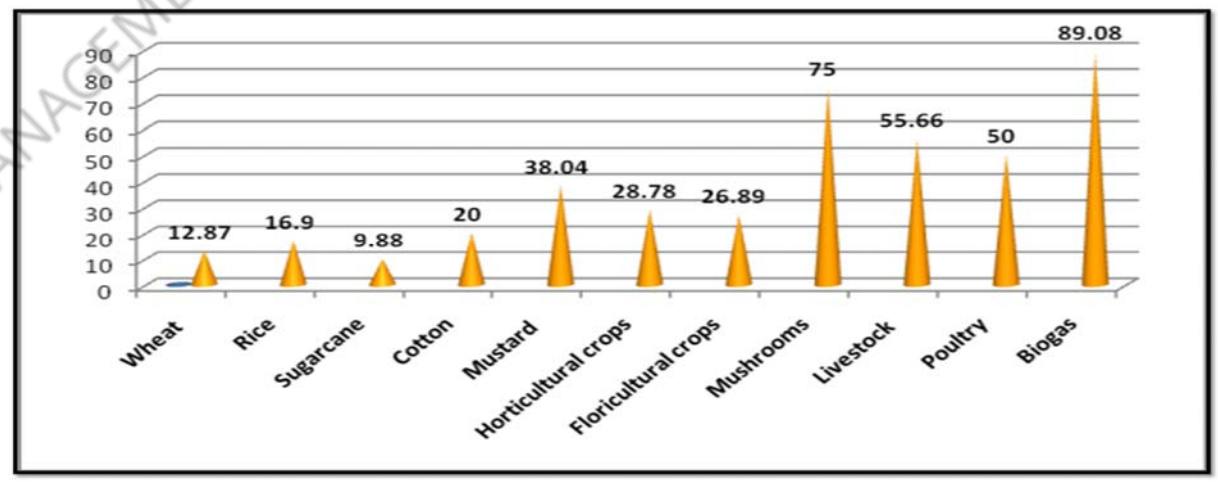


Fig: 2. Overall utilization of various agricultural wastes

The overall awareness was calculated taking N= no. of farmers undertaking the enterprise. Thus result pertaining to utilization of agricultural wastes was observed maximum regarding the use of biogas plant waste (89.02 percent) followed by utilization of livestock waste (55.66 percent), wastes from mushroom cultivation (75.00 percent), poultry waste (50.00 percent), mustard waste (38.04 percent), horticultural waste (28.78 percent), floricultural waste (26.89 percent), cotton waste (20.00 percent), paddy waste (16.9 percent) and wheat waste (12.87).

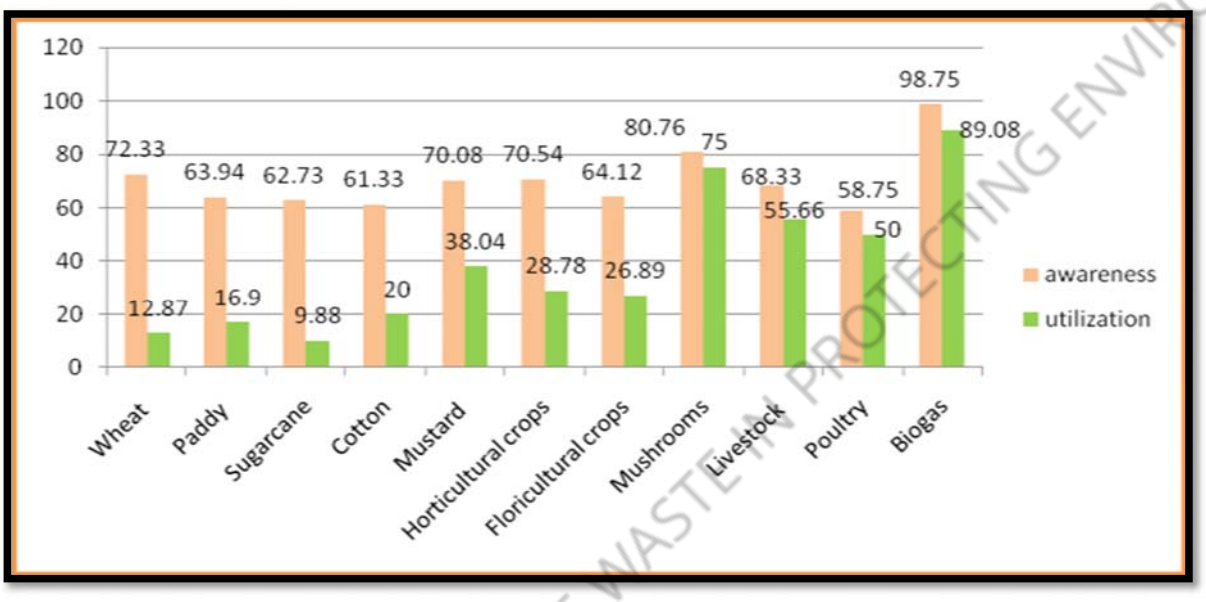


Fig: 3 Gap between awareness and utilization

The overall awareness about the utilization of wheat waste was 72.33 percent and utilization of wheat waste was 12.87 percent. Awareness about utilization of paddy waste 69.94 and utilization was computed as 16.90 percent, awareness about utilization of sugarcane waste was 62.73 percent and utilization was 9.88 percent, awareness about utilization of cotton waste was computed as 61.33 percent and utilization as 20.00 percent, awareness about utilization of mustard waste was 70.08 percent and utilization was 38.04 percent, awareness about utilization of horticultural waste was computed as 70.54 percent and utilization was computed as 28.78, awareness about utilization of floricultural waste was 64.12 percent and utilization was computed as 26.89 percent, awareness about utilization of mushroom waste was 80.76 and utilization was 75.00 percent, awareness about utilization of livestock waste was 68.33 percent and utilization was 55.66 percent, awareness about utilization of poultry waste was 58.75 percent and utilization was 50.00 percent and awareness about utilization on of biogas waste was computed as 98.75 percent and utilization was 89.08 percent.

Study 3.Farm waste utilization among farmers in Irepodun Local Government Area, Kwara State, Nigeria: Implication for extension education service delivery

Oladipo *et.al*.,(2017)

Study area : Kwara state, Nigeria.

Sampling method : purposive simple random

Sample : 120

Table 1.Logistic regression results of the factors influencing respondents' farm waste utilization.

Variables	Coefficient	Standard Error	t-value
Gender	0.129	0.042	0.81
Age	0.423	0.089	0.56
Marital Status	0.023	0.035	1.25
Educational Level	0.321**	0.219	2.42**
Household Size	0.457	0.271	0.18
Years of Experience	0.523**	0.034	2.16**

Logistic regression results of determinants of respondents' farm waste utilization revealed that the coefficient of educational level and years of experience were significant at 5 percent level of significance indicating that these two variables significantly influence the utilization of farm waste by the farmers (Table 1). The variables of age, gender, marital status and household size were not significant even at 10 per cent indicating that these variables do not significantly influence the respondents' farm waste utilization in the study area.

The coefficients of educational level (0.321) positively and significantly ($p<0.05$) determine the utilization of farm waste by the respondents in the study area. This implies that an increase in the educational level of the farmers in the study area is going to lead to an increase in the way they will adopt farm waste utilization initiatives. Furthermore, the parameter of the respondents' years of farming experience (0.523) was also seen to positively and significantly ($p<0.05$) influence the farm waste utilization of the respondents'. This indicates that an increase in the years of experience of the respondents' increases their likelihood to adopting and utilizing more farm waste innovation.

Table 2: Constraints to farm wastes utilization.

Constraints	Mean score
Low knowledge on usage	2.37
Bad odour from wastes	2.23
inadequate of awareness of benefits	2.53
Stress of transportation	2.32
Inadequate facilities for processing some wastes	2.53
Alternative products	2.03
Inadequate access to extension services	2.64
Limited labour	2.10

From the findings in Table 2, it was observed according to the mean scores that the major/severe constraints militating against the utilization of farm waste indicated by the respondents include inadequate access to extension services, inadequate awareness of benefits, inadequate facilities for processing some waste, and low knowledge on usage. The implication of this finding is that the famers need access to more effective extension services that will help improve their knowledge on the benefits and farm waste utilization techniques they can adopt for better waste management and usage in the study area.

Conclusion

Indian population is increasing year by year also increasing food demand. Production of food increases, significantly agriculture waste residue also generating. Several studies reported that Indian farmers are not utilising agriculture wastes properly its contributing the environment impact as well as farmer's income and also Indian economy. There was a huge difference between the awareness and utilization of agricultural waste. This difference existed due to lack of interest among the framers. Thus there is need to motivate farmers which can be made possible by organizing trainings, lectures, showing films to farmers or demonstrating waste management techniques on field..and also motivate the rural youths as well as urban youths it may create to the employment opportunities and additional income to the small and marginal farmers .

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