

**WELCOME**



## **Doctoral Seminar- I**

# **MANAGEMENT OF AGRICULTURE WASTE IN PROTECTING ENVIRONMENT**

**Dr. K. Narayan gowda**  
**Head, Agri Science Museum and**  
**Associate Director of Extension**  
**Directorate of Extension**  
**UAS, Bangalore**

**Dharmaraj BM**  
**PAMB0027**  
**Ph.D II year**  
**Dept. of Agricultural Extension**  
**UAS, Bangalore**

# Flow of Presentation

Introduction

Agricultural waste generated and its types

Impact on human health and Environment

Agricultural waste management strategies

Government and Non-Govt-Initiations Agricultural waste management

Case studies : On converting agricultural waste into wealth

Research studies

# Introduction

- Agriculture is one of the largest biological sectors that produces the highest biomass, which can be an important input for the **bioeconomy**.

Crop	Production Estimate of Major Crops in India (Mt)
Rice	105
Wheat	94
Sugarcane	361
Oil seeds	30
Cotton	35
Jute	11
Pulses	17
Bamboo	4.6** (1.9 Mt)

- The AW management (AWM) based bioeconomic strategies can prevent underutilization of livestock excrement and reckless/random burning of crop residues to ensure food and health security
- waste valorization to generate value-added products, farmer's livelihood, job opportunities for youth, and sustainability in agriculture

## 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 Million tonne (Mt) of crop residue annually -NPMCR (2019).
- Based on generation of crop residues is highest in the state of **Uttar Pradesh (60 Mt)** followed by **Punjab (51 Mt)** and **Maharashtra (46 Mt)** with a grand total of 500 Mt per year out of which 92 Mt is burned.

Source-NPMCR (2019).

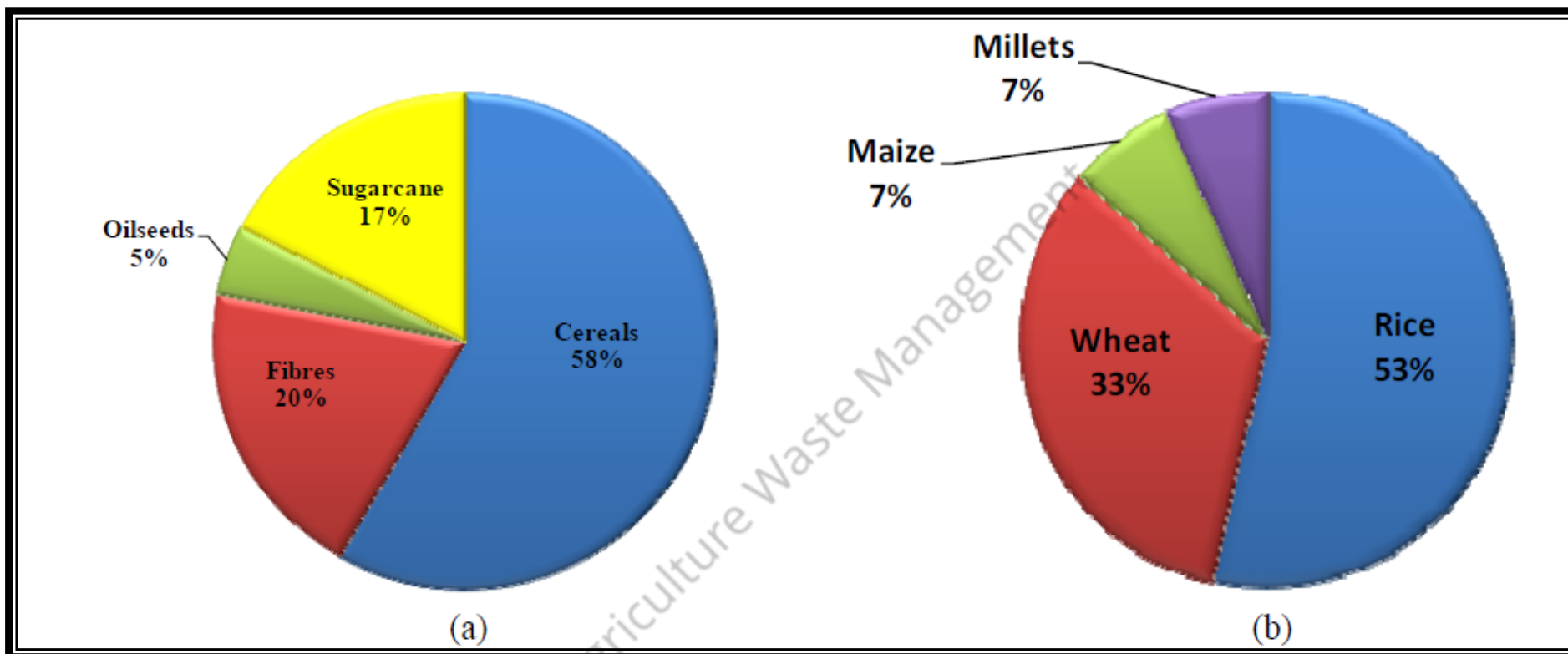
- The majority of crop residue with production estimations contributed by Cereals (352 Mt), fibers (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt)
- Among cereal crops- rice, wheat, maize and millets together contributed 70 % of crop residue followed by fiber crops (13%).
- One-acre land 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 soil.

Source-NPMCR (2019).

**AGRICULTURAL WASTE  
AS  
A SOURCE OF ENERGY**



Agriculture Waste Management



**(a) Contribution of different crops categories in residue generation in India**

**(b) Contribution of different cereal crops in residue generation in India**

Table 1: Total crop residue generation crop wise (tonnes) in different states of India during 2014-15

State/ UT	Rice	Wheat	Coarse Cereal	Pulse	Oilseed	Sugarcane	Cotton	Jute & Mesta	Total
Andhra Pradesh+ Telangana	13.5	0.0	8.1	1.8	1.3	5.2	2.2	0.02	32.1
Bihar	7.5	5.0	3.8	0.7	0.1	5.5	0.0	0.50	23.1
Gujarat	1.9	4.0	2.6	0.9	4.3	5.5	3.6	0.00	22.9
Haryana	4.7	14.7	1.4	0.1	0.8	3.0	0.8	0.00	25.4
Karnataka	4.3	0.3	11.4	2.3	1.1	16.4	0.7	0.00	36.6
Madhya Pradesh	4.2	17.6	5.1	7.3	8.4	1.8	0.6	0.00	45.0
Maharashtra	3.4	1.5	7.6	2.7	3.1	32.1	2.3	0.00	52.7
Punjab	13.0	19.6	0.9	0.1	0.1	2.8	0.5	0.00	36.9
Rajasthan	0.4	12.2	12.9	3.0	5.8	0.2	0.5	0.00	35.1
Tamilnadu	6.8	0.0	5.1	1.0	1.0	9.6	0.3	0.00	23.8
Uttar Pradesh	14.3	31.3	6.1	2.2	0.9	54.4	0.0	0.00	109.2
West Bengal	17.2	1.2	1.1	0.3	1.0	0.8	0.0	3.00	24.6
Others	3.0	0.1	0.8	1.3	0.2	0.4	0.0	0.03	5.8
All-India	122.6	110.3	71.3	26.7	28.9	141.1	11.6	3.85	516.3

Source: Compiled by author. Data provided by Ministry of Statistics and Program Implementation (MOSPI, 2014-15).

# 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.



**Solid waste**



**Liquid waste**

Source: Obi *et al.*(2016)

# Classification of wastes

According to their effects on human health



**Hazardous type**



**Bio-biodegradable**



**Non-Hazardous type**



**Non-biodegradable**

Source: Obi *et al.*(2016)

# 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.

Source: Obi *et al.*(2016)

# TYPES OF AGRICULTURAL WASTES

ANIMAL WASTE  
(DUNG, URINE, SLURRY, DROPPING OF  
BIRDS, DEAD ANIMALS)



FOOD  
PROCESSING  
WASTE



Crop wastes



Hazardous or toxic waste  
(pesticides,  
Insecticides,  
herbicides)



## Fertilizers and pesticides residues - Impact on aquatic ecosystem

Modern agricultural practices require the use of large amount of fertilizers, pesticides

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



# Continued

## Impact on aquatic ecosystem

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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 -impact on 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.



shutterstock.com - 146043914



## Live stock waste impact on soil ,water and air



Air pollution includes odors emerging from cages resulting from the digestion process of livestock wastes



Untreated 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 on 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

## CAPITAL'S NIGHTMARE

Stubble burning could contribute anywhere between 12% and 60% to Delhi's air pollution

**One ton of stubble, on burning, releases**

- 2 kg of SO<sub>2</sub>
- 3 kg of particulate matter
- 60 kg of CO
- 1,460 kg of CO<sub>2</sub>
- 199 kg of ash

### Health Impact

- Winter crop-burning triggers heavy pollution in Delhi
- Can aggravate and trigger respiratory diseases
- Results in loss of soil nutrient and kill soil organisms



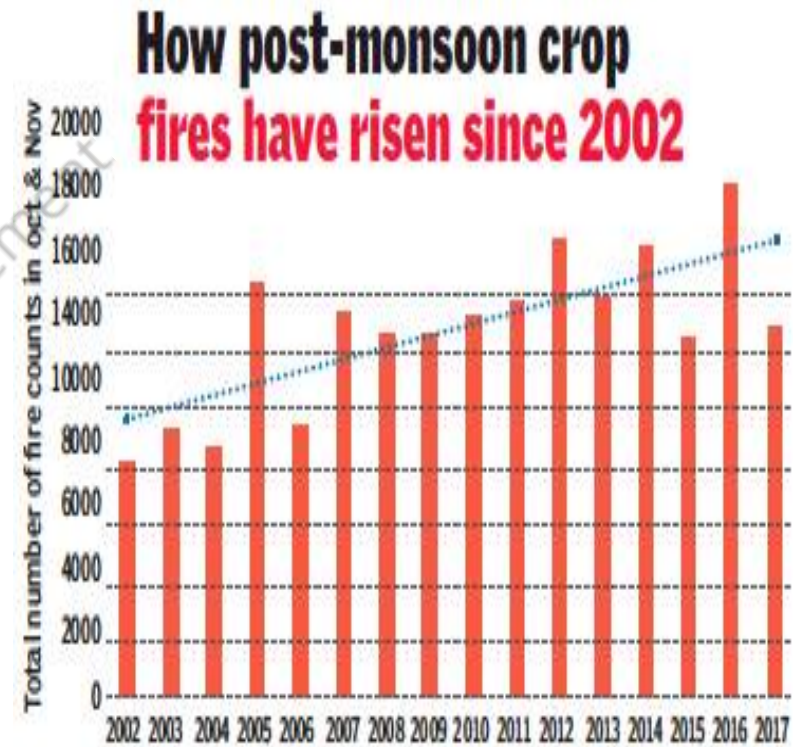
● Dots denote fire incidents on Nasa's mapper



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.

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.



Data: Aqua/MODIS 1-Km Thermal Anomalies/Fires Product;  
<http://earthdata.nasa.gov/earth-observation-data/near-real-time/firms>

SOURCE: Directorate of Economics and Statistics, department of agriculture

Wastes	C (%)	References
Coconut shell	63.45	Tsai et al. (2006)
Coffee grounds	54.61	Bok et al. (2012)
Corn stalks	50.02	Uzun and Sarioğlu (2009)
Cotton stalk	49.35	Fu et al. (2012)
Ordinary plywood	45.40	Jung et al. (2012)
Palm bark	50.10	Ngo et al. (2014)
Peanut shell	46.15	Wang et al. (2012)
Rice straw	50.93	Tsaia et al. (2006)
Sawdust	52.71	Lin and Kuo (2012)
Square timber	47.20	Jung et al. (2012)
Sugarcane bagasse	58.14	Tsaia et al. (2006)
Wood chip	51.07	Cao et al. (2011)



Carbon sources of agriculture  
and forest wastes

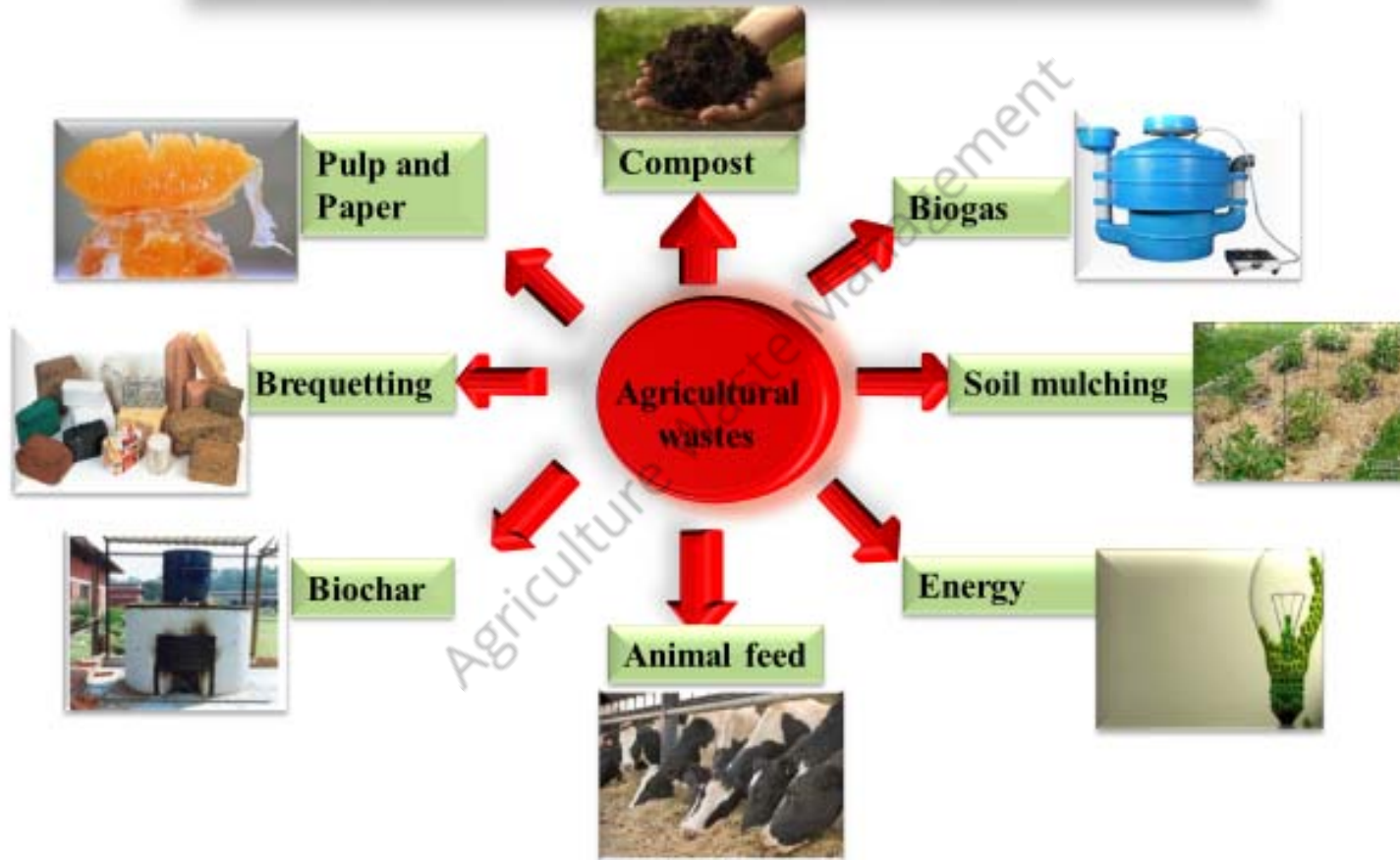
M. Prasad *et al.*(2020)

# Agricultural Waste Management System (AWMS)

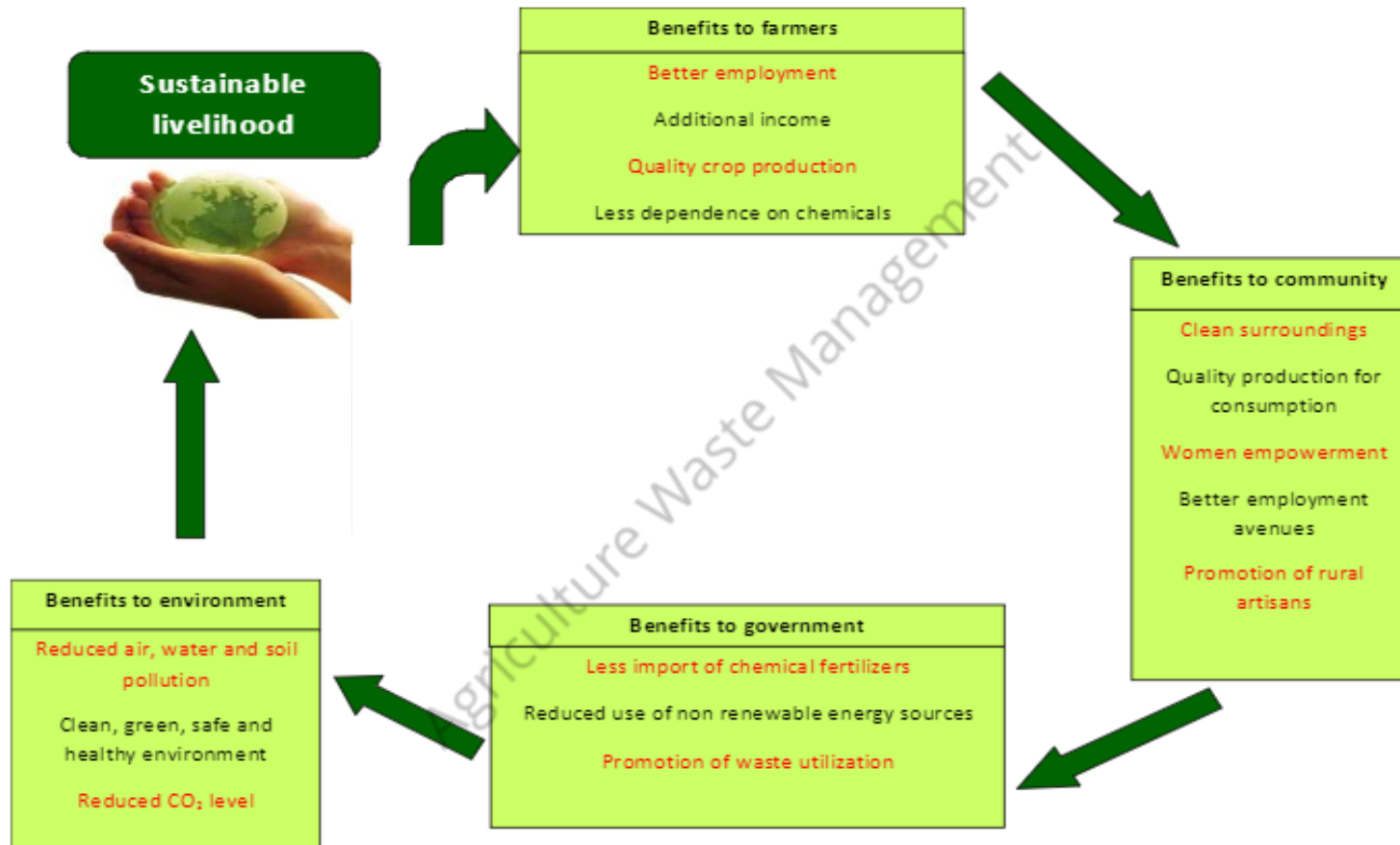
Planned system in which all necessary components are installed and managed to control and use by products of agricultural production in a manner that sustains or enhances the quality of air, water, soil, plant, and animal resources.

Source: Obi *et al.*(2016)

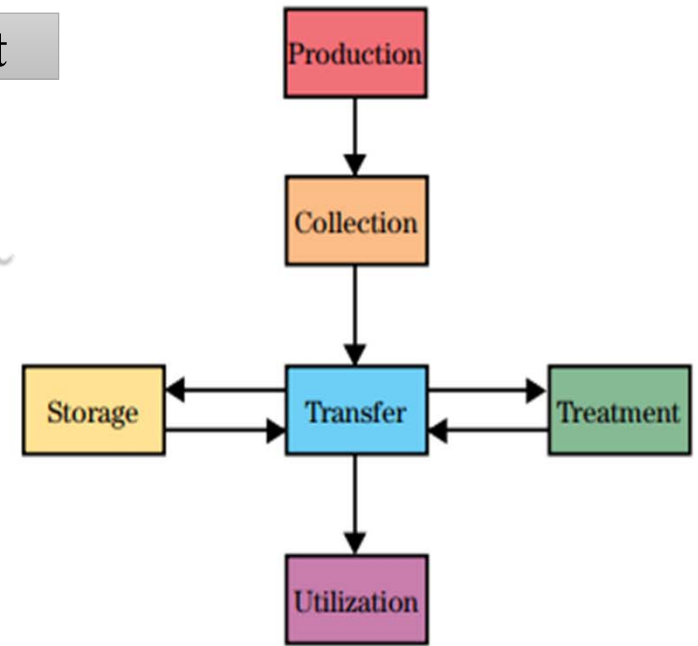
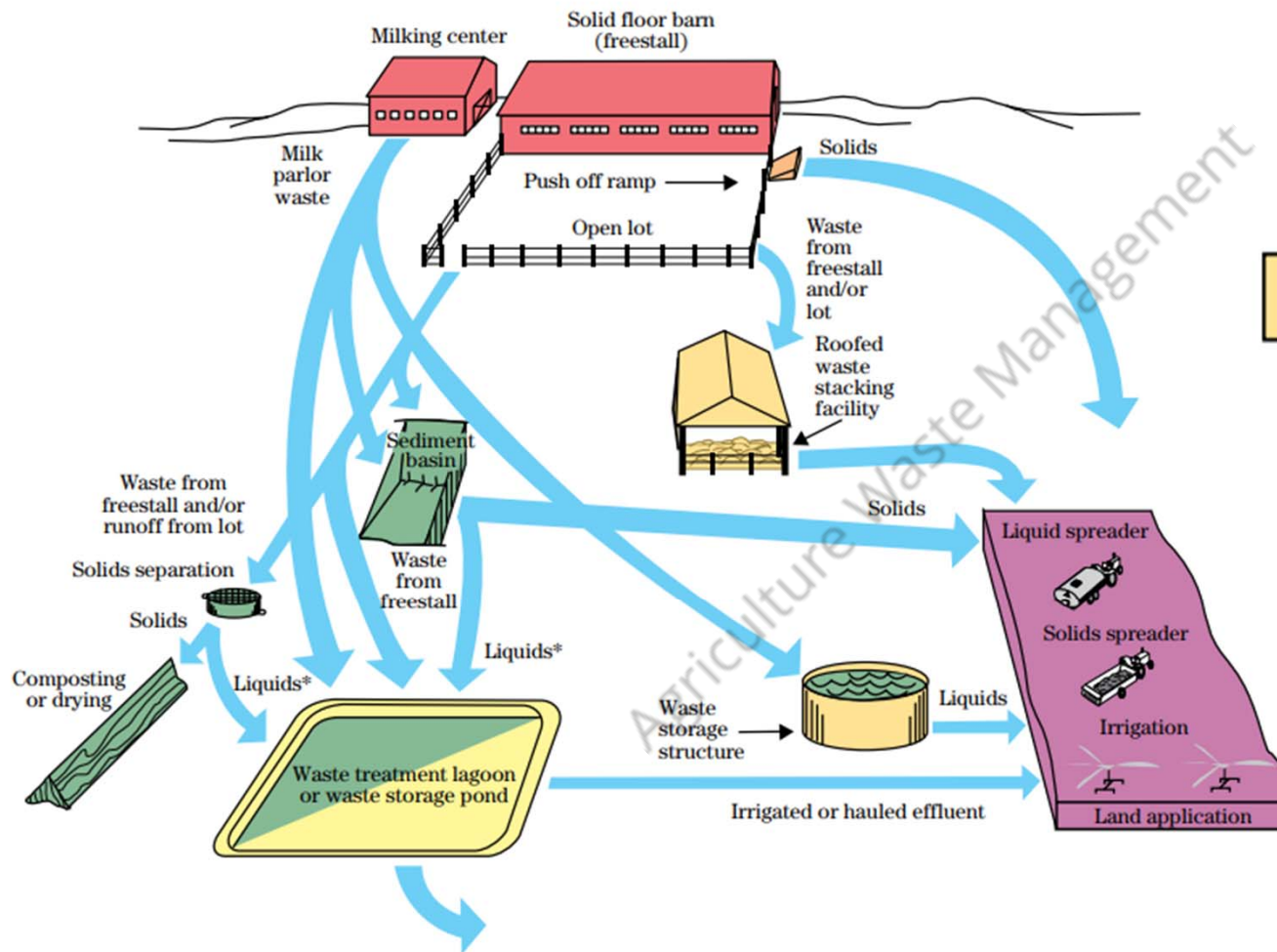
# How to manage Agricultural waste



## Suggested Model For Agri Waste Utilization For Sustainable Development



## Six basic functions in waste management



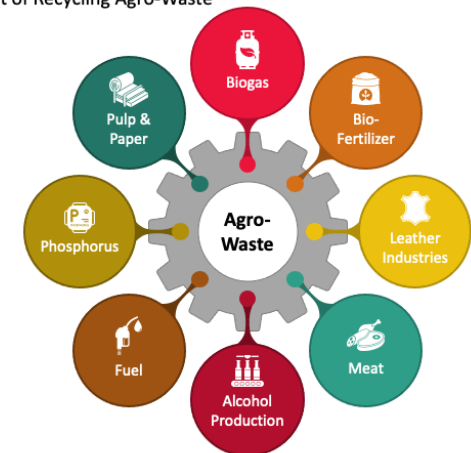
Prasad et al .(2020)

Waste minimization efficiency is stated to be better achieved applying 3Rs in a hierarchical order- Reduce, Reuse and Recycle

Agriculture Waste Management

### RECYCLING OF AGRICULTURAL WASTE

Management of Recycling Agro-Waste



The aim of the waste minimizing hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste

most favoured option

least favoured option

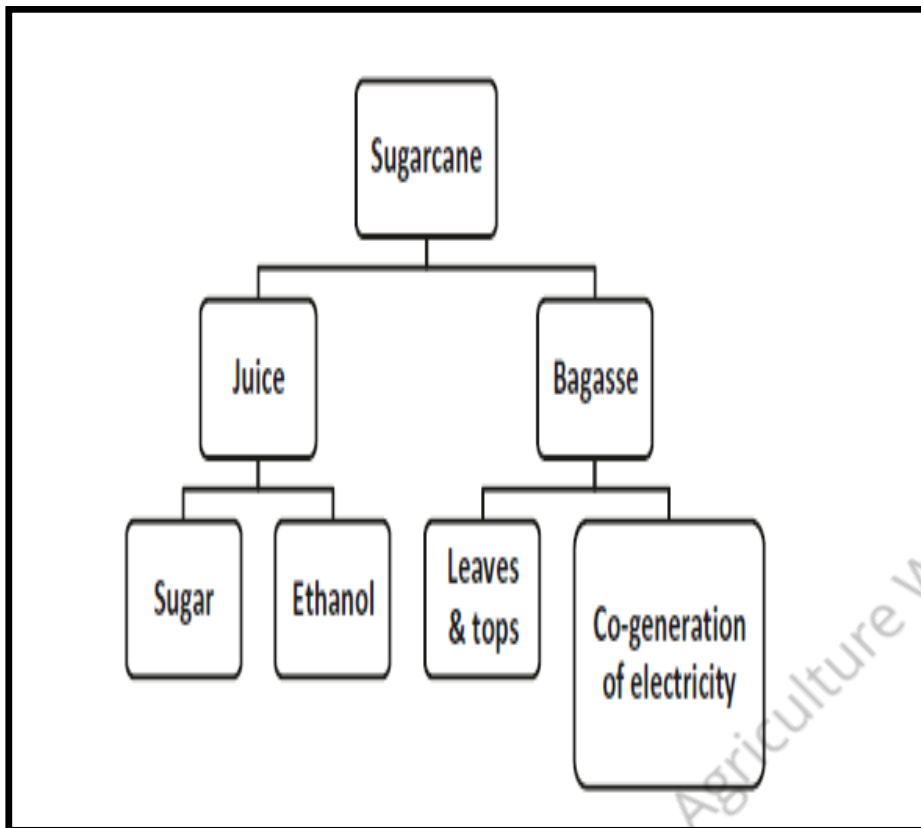


Source: Obi *et al.*(2016)

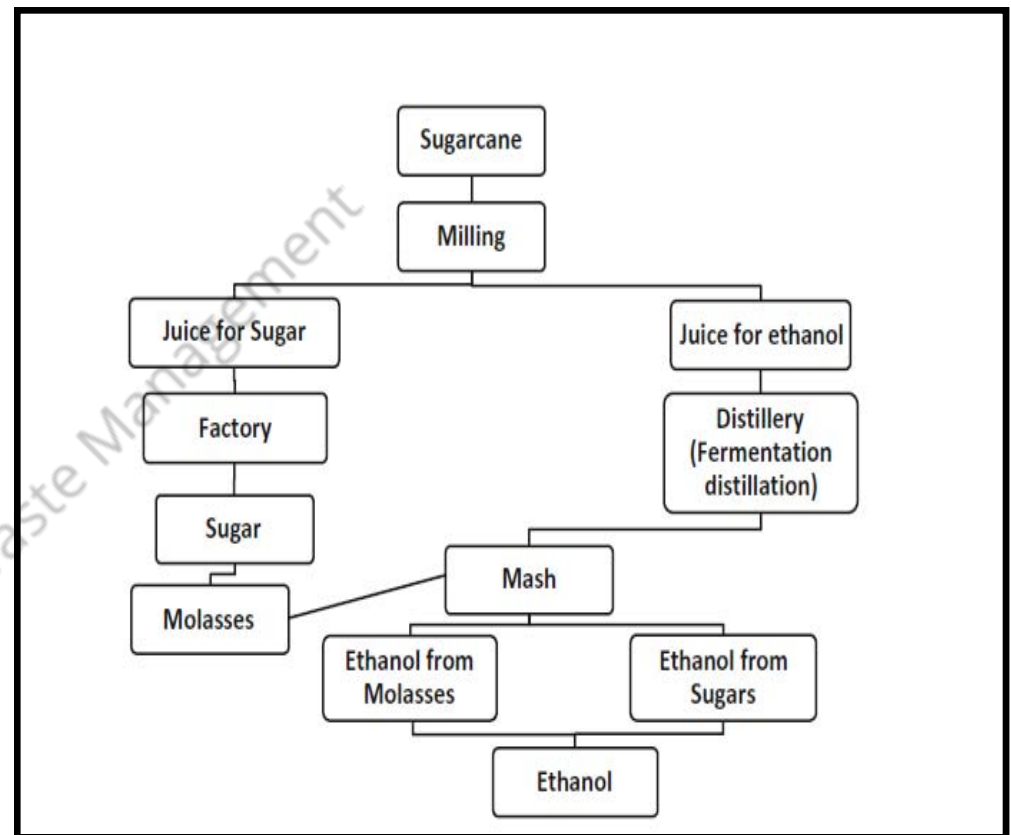


**STRATEGIES FOR WASTE  
MANAGEMENT**

Agriculture Waste Management

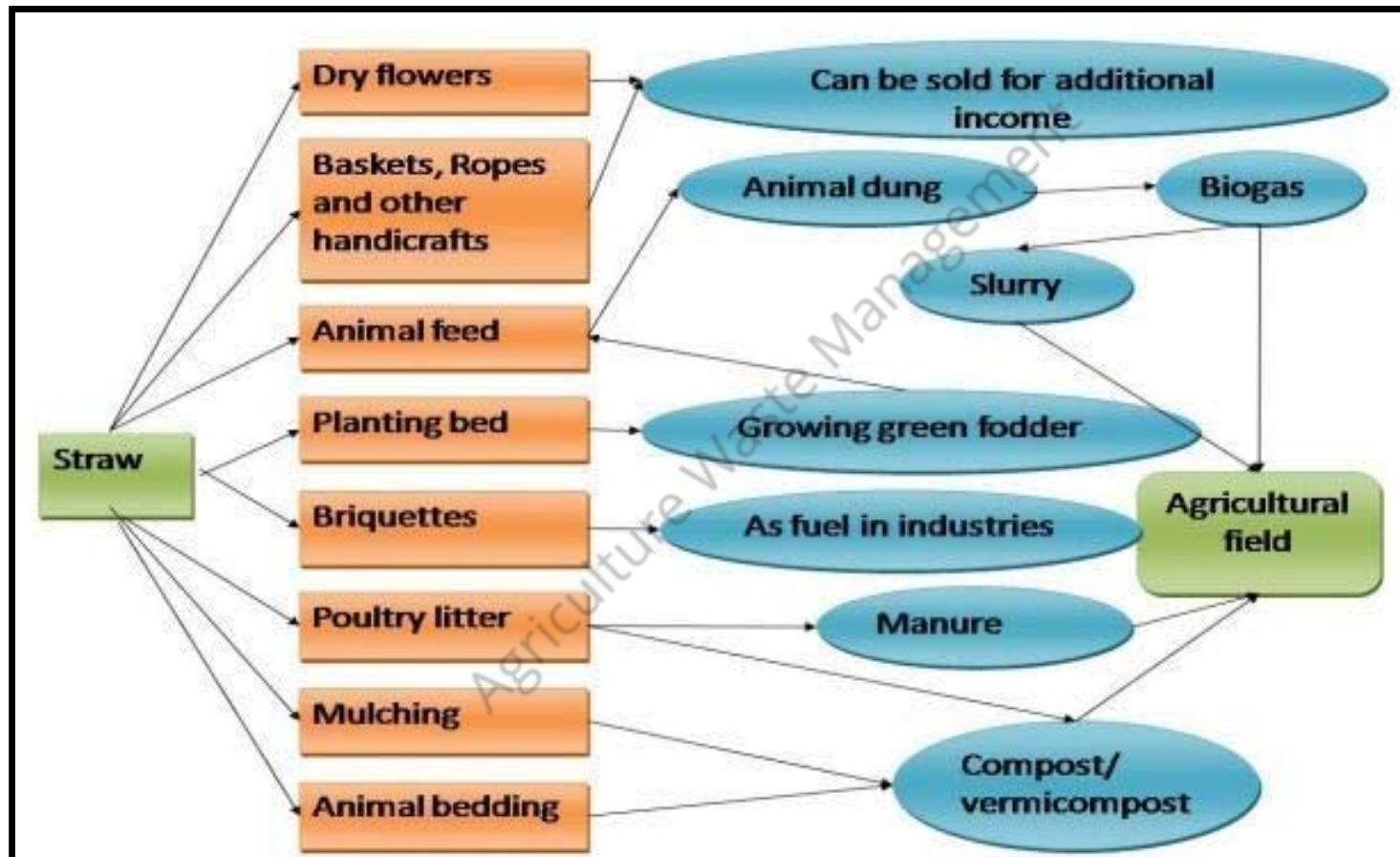


Source of green energy (sugarcane)

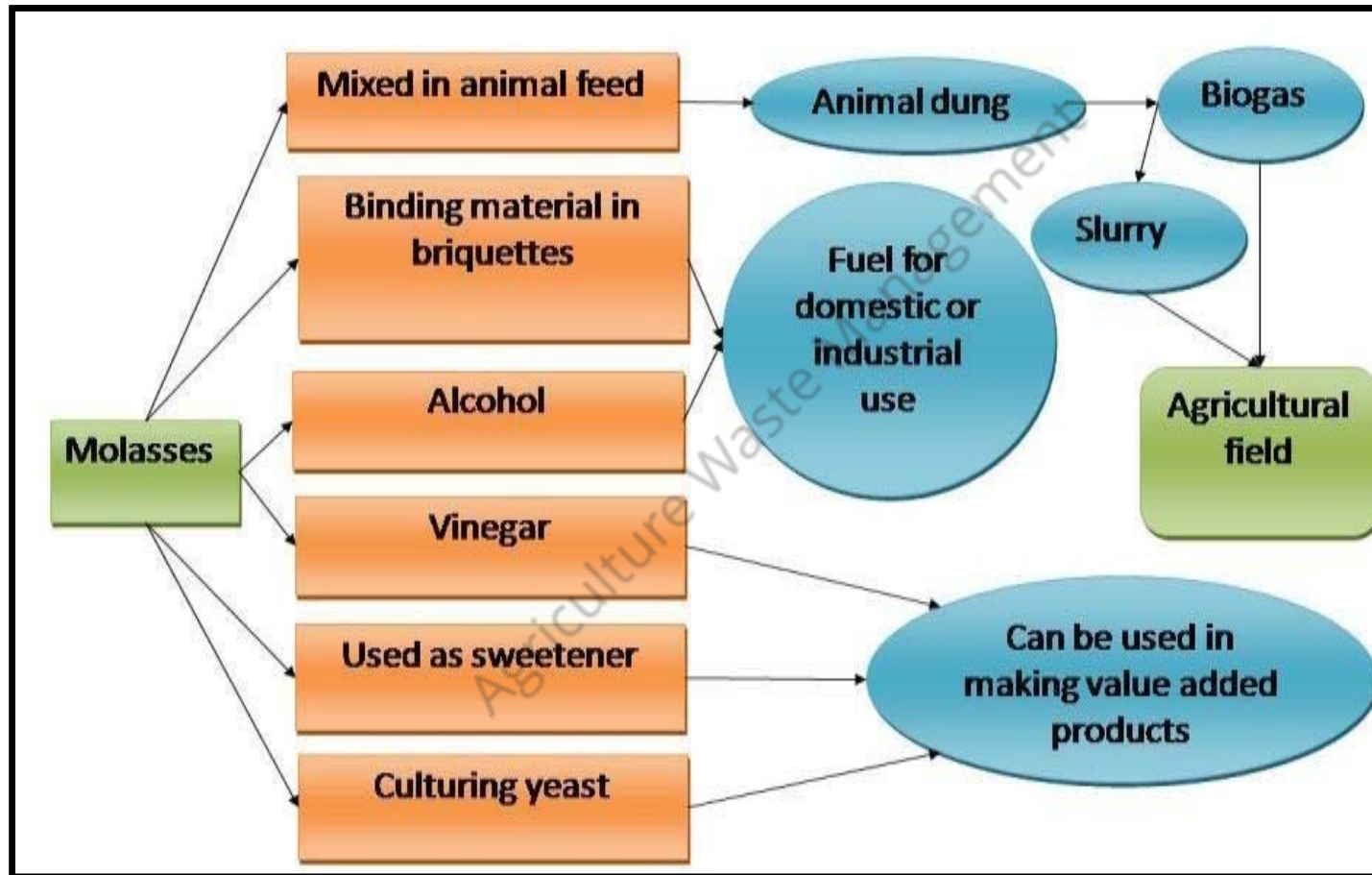


Production of ethanol from molasses and juice

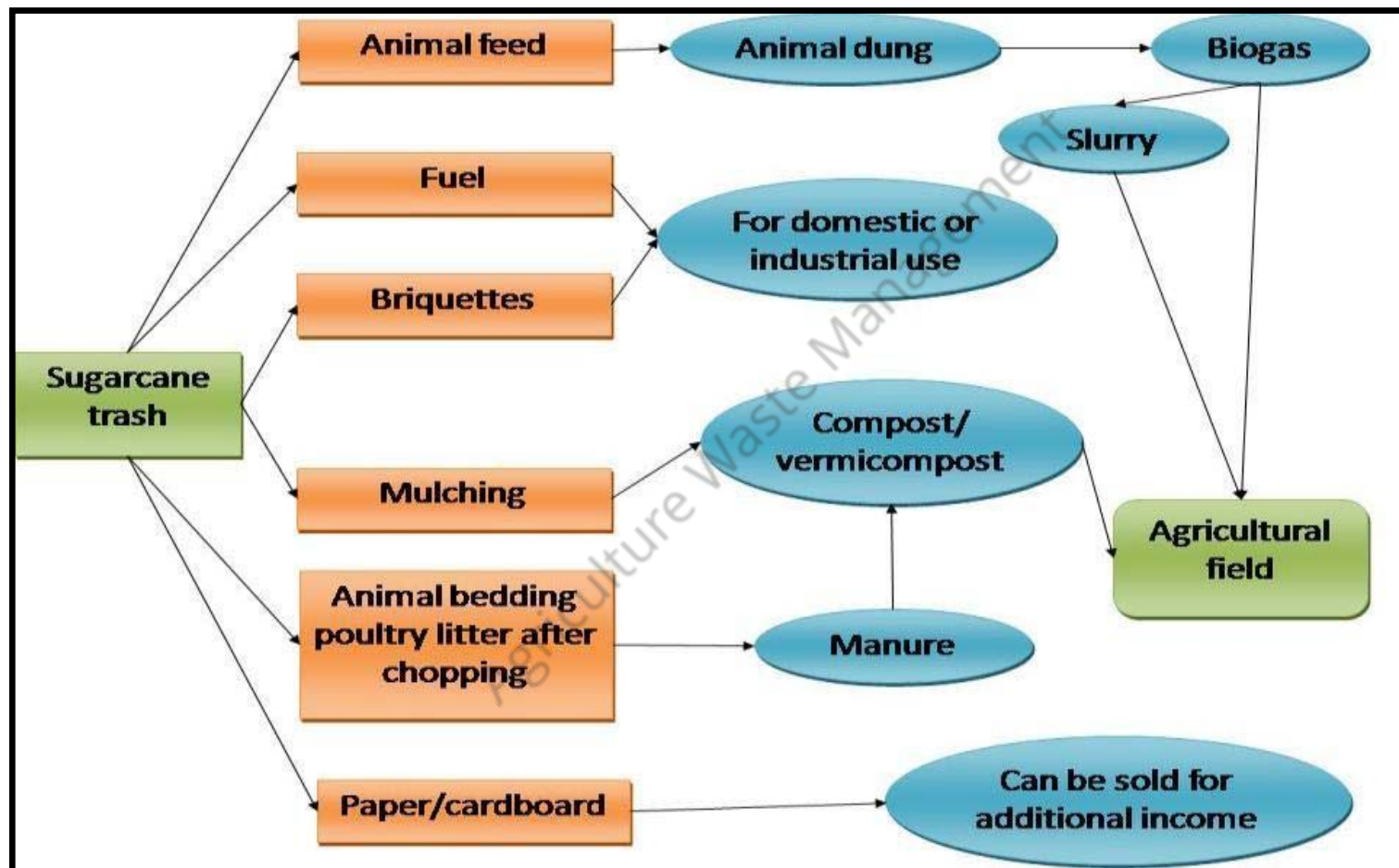
## Strategies for paddy and wheat waste management



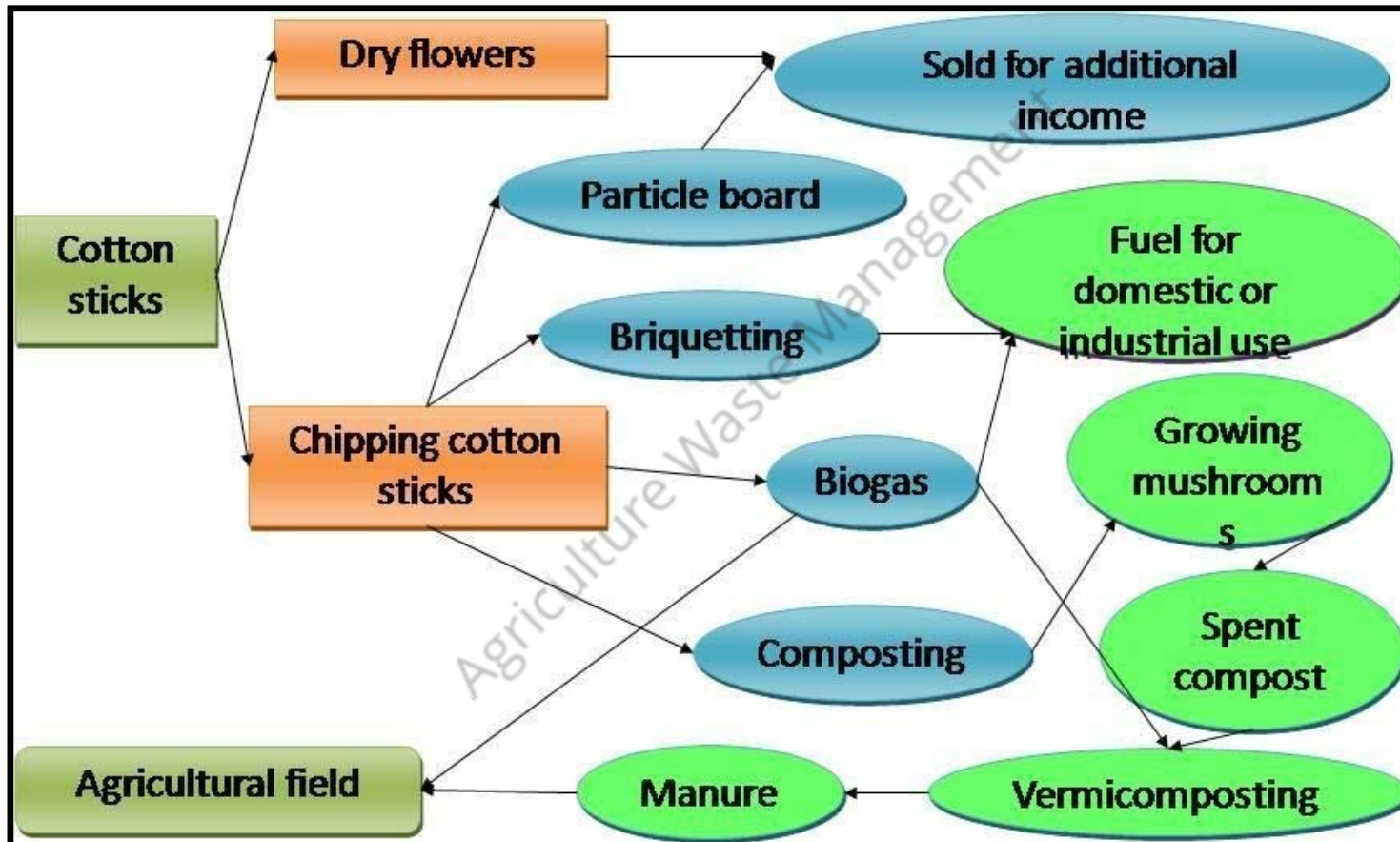
## Molasses waste management



# Sugarcane trash waste management



## Cotton waste management system



# Some of the Government and Non-Government Initiatives

## 1. Government Initiatives

### ICAR Initiatives

- Biochar From Agricultural Waste Material
- Soil less Planting Media using Sugar Industry Residue
- Foliar Spray from Fish Waste
- **PUSA Decomposer capsules**

### CFTRI Initiatives

- Turning banana farm waste into income

## 2. Non-Government/Private Initiatives

- Bio-Lutions India Pvt Ltd
- Fermentech Labs





# *Creating Wealth from Agricultural Waste*

## ICAR-INITIATIONS

[Creating-Wealth-From-Agricultural-Waste \(1\).pdf](#)

# 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



# Soil less Planting Media using Sugar Industry Residue

Developer: F. Pushparaj Anjelo and Shinoj Subramannian, KVK, Ernakulam

## Features

- The press mud, a residual product in Sugar Industry that is available abundantly at the rate of 2 percent of the cane crushed
- Better moisture retention and less frequent irrigation requirement.
- Better root anchorage and reduced plant lodging.
- Enhanced nutrient value and no need of basal manure dose.
- Can be re-used for more than 3 plantings.
- Commercial scale planting media production from press mud is a promising enterprise for youngsters while ensuring nutritionally rich planting solution to urban farmers



## 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.
- It can be fortified with the deficient components if required
- Enhances the productivity of the plants immediately and
- possess 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

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.

It takes around 25 days for the degradation process to be completed (Bhatnagar, 2020) and costs less than Rs 1000 per acre (Reddy, 2020).



### Decomposer Mixture:

The farmers can prepare 25 litre of liquid mixture with 4 capsules, jaggery and chickpea flour. The mixture is sufficient to cover 1 hectare of land.

### Benefits:

The decomposer improves the **fertility and productivity of the soil** as the stubble works as manure and compost for the crops and lesser fertiliser consumption is required in the future.

<https://youtu.be/NoabQkxsR1w>

Source: <https://www.drishtias.com/daily-updates/daily-news-analysis/pusa-decomposer-to-curb-stubble-burning>

## Bio-Decomposer a Success, Other States Should Implement it to Curb Stubble Burning: Kejriwal

The chief minister said the Delhi government spent Rs 20 lakh to check the efficacy of the IARI-developed organic solution, and it converted 90% of stubble into manure within 20 days.

**New Delhi:** Delhi chief minister Arvind Kejriwal on Wednesday declared that the bio-composting solution developed by the Indian Agricultural Research Institute at Pusa and referred to as the “Pusa Decomposer” has proved to be a success in addressing the problem of stubble burning. He also urged other states like Punjab and Haryana to implement it and hoped that “this is the last year when we have to suffer from (air) pollution”.

Following a visit to Hiranki village in North West Delhi, where a pilot project was undertaken to check the efficacy of the bio-decomposer, Kejriwal said, “To provide an alternative to stubble burning, the Delhi government has taken a crucial step in association with the PUSA Institute. We had sprayed the bio-decomposer solution on the farmlands across Delhi around October 13, which was developed by the Delhi government under the guidance of the PUSA Institute. Today is November 4, the entire stubble has converted into manure and the fields are ready for sowing again.”

### Pusa tablets — the microbial cocktail that gives farmers an alternative to stubble burning

'Pusa capsules', developed by Indian Agriculture Research Institute, can accelerate decomposition process in plants and clear stubble without needing to burn it.

ANGANA CHAKRABARTI

19 November, 2020 7:30 am IST



Fields being sprayed with the decomposer tablets solution | By special arrangement

Text Size: **A-** **A+**

**New Delhi:** Gurmeet Singh, a 40-year-old farmer from Punjab's Katianwali village, has not set fire to his stubble even once in the past five years. This is because he has been using the much-talked about 'decomposer' capsules that were developed by the Indian Agricultural Research Institute (IARI).

The capsules, also known as the Pusa tablets after the area in Delhi where the institute is located, consists of a combination of microbes that hastens the process of decomposition of stubble.

<https://thewire.in/environment/pusa-decomposer-success-stubble-burning-arvind-kejriwal>

## 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.



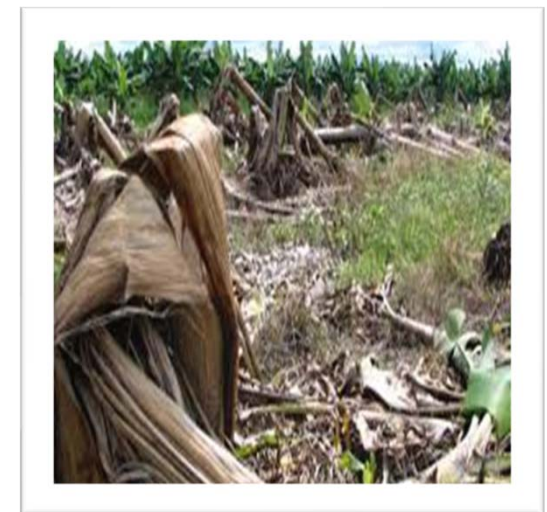
SOURCE: [www.thehindu.com/news/national/karnataka/Turning-banana-farm-waste-into-income/article144](http://www.thehindu.com/news/national/karnataka/Turning-banana-farm-waste-into-income/article144)

Continued...

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 Rajashekar.

Institute are working on a road map to make a **sports beverage from banana stem juice.**



SOURCE: [www.thehindu.com/news/national/karnataka/Turning-banana-farm-waste-into-income/article144](http://www.thehindu.com/news/national/karnataka/Turning-banana-farm-waste-into-income/article144)



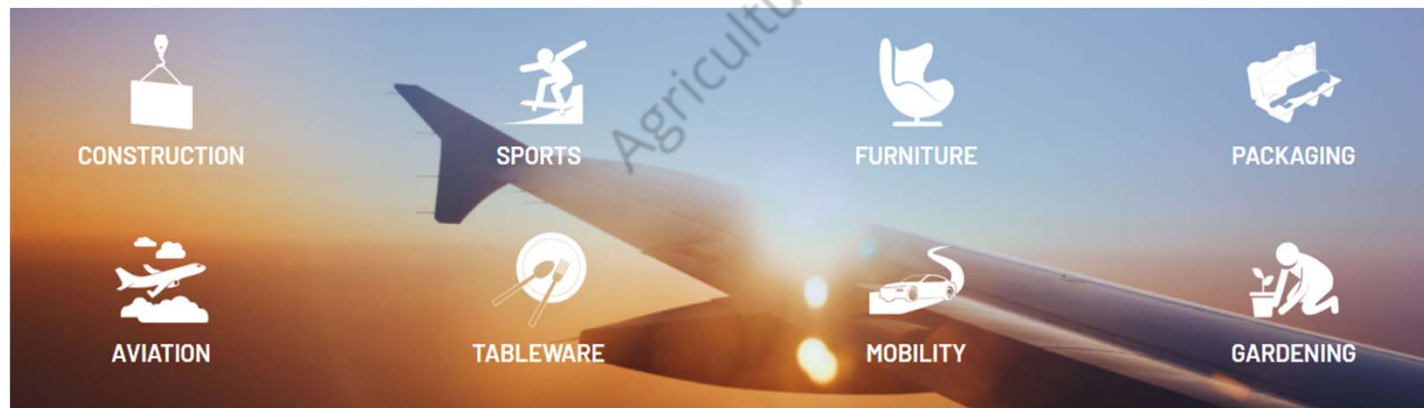
IVRI Waste Management Guide App



# BIO-LUTIONS Pvt. Ltd.



- BIO-LUTIONS is a Hamburg-based Clean Tech company that mechanically converts agricultural residues into unique, self-binding, durable **fibcro®** natural fibres.
- This patented method eliminates the need for binding agents or chemical cellulose extraction.
- BIO-LUTIONS is operating in the Ramanagara district



# Fermentech Labs Pvt. Ltd.



- Fermentech company is located in TIDES Business Incubator, IIT Roorkee, Uttarakhand
- Fermentech Labs is involved in the production of industrial enzymes of commercial interest using agro-industrial wastes.
- Presently the company is involved in the production of five enzymes i.e., **pectinase**, **cellulases**, **xylanase**, **phytase**, and **amylase**.
- These enzymes find wide applications ranging across **fruit juice and wine clarification**, **textile processing**, **biofuel production**, **pharmaceuticals**, **animal feed supplement**, **pulp**, and **paper processing**.

# Case Studies

Agriculture & Management

## Oyster 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.



## Success story on rural entrepreneurship development through pig farming Sri Mandip Rai, Jalpaiguri District, Sikkim

- 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..



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

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 1 <sup>st</sup> 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

Source: State Specific Strategies for Doubling Farmers Income - 2022

## **Vermicomposting** technology implemented by University of Mysore, Karnataka.

The demonstrations of vermicomposting process including collection of bio-waste such as paddy straw, corn waste, vegetable wastes etc...



The preparation of vermicompost bed using partially decomposed wastes with cow dung, introduction of earthworms, maintenance of moisture and harvesting of vermicompost was also carried out in the pilot plants using audio visual aids and practical demonstration.

A group of 8-10 people harvested 900- 1000 kilograms per unit and fetching Rs.5000-6000/- within a period of 45 days.

## Electricity from Agricultural Waste in 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 farms receive an additional income for providing the power plant with their agricultural waste.

Project type: Biomass  
Project location: Karnataka, India  
Project status: Operation  
Annual CO<sub>2</sub> reduction: 20,000 t  
Situation without project  
Regional fuel mix



## **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.

**Table 1.** Comparative economic analysis of vermicomposting, composting and biogas production.

Cost component (all figures in Indian National Rupee)	Vermicomposting	Composting	Biogas 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
<b>Total returns</b>	<b>54000.00</b>	<b>11132.5</b>	<b>33915.68</b>
<b>Net returns</b>	<b>27697.71</b>	<b>2030.25</b>	<b>14688.42</b>
Profitability ranking	<b>I</b>	<b>III</b>	<b>II</b>

*Note:* average dung per cattle equivalent = 4.95 metric tonnes per year.

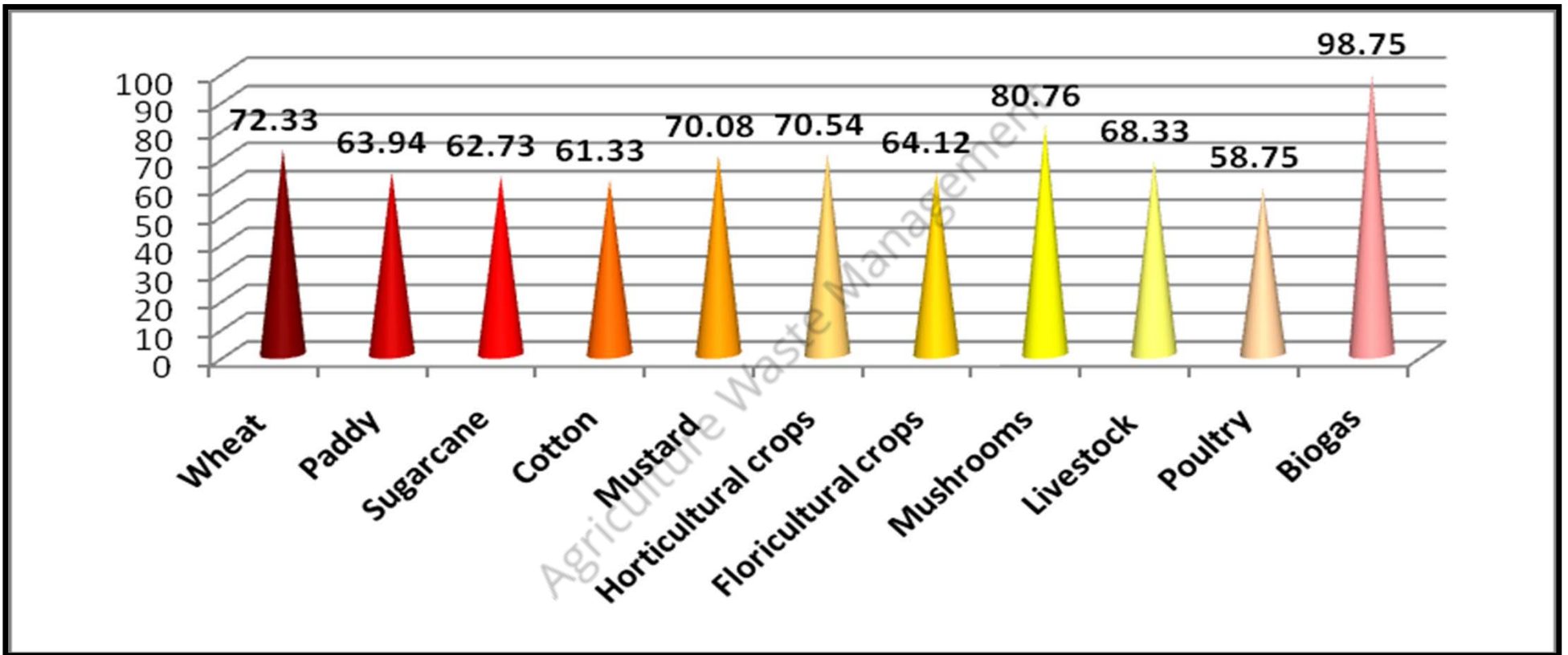


**Figure 1.** Net returns per metric tonne (Mt) of dung (Indian National Rupee/Mt).

# 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**

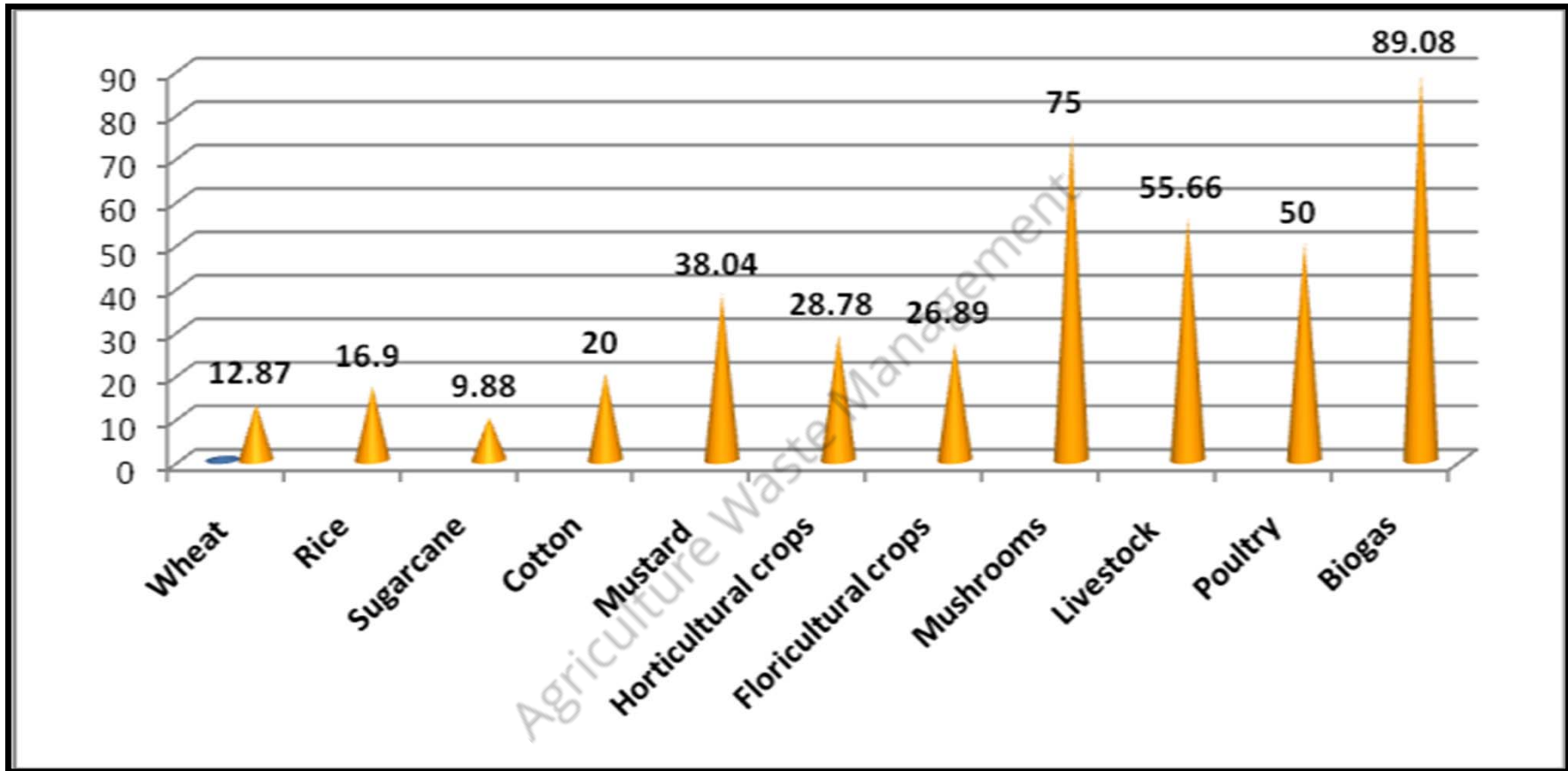


Fig :2. Overall utilization of various agricultural wastes

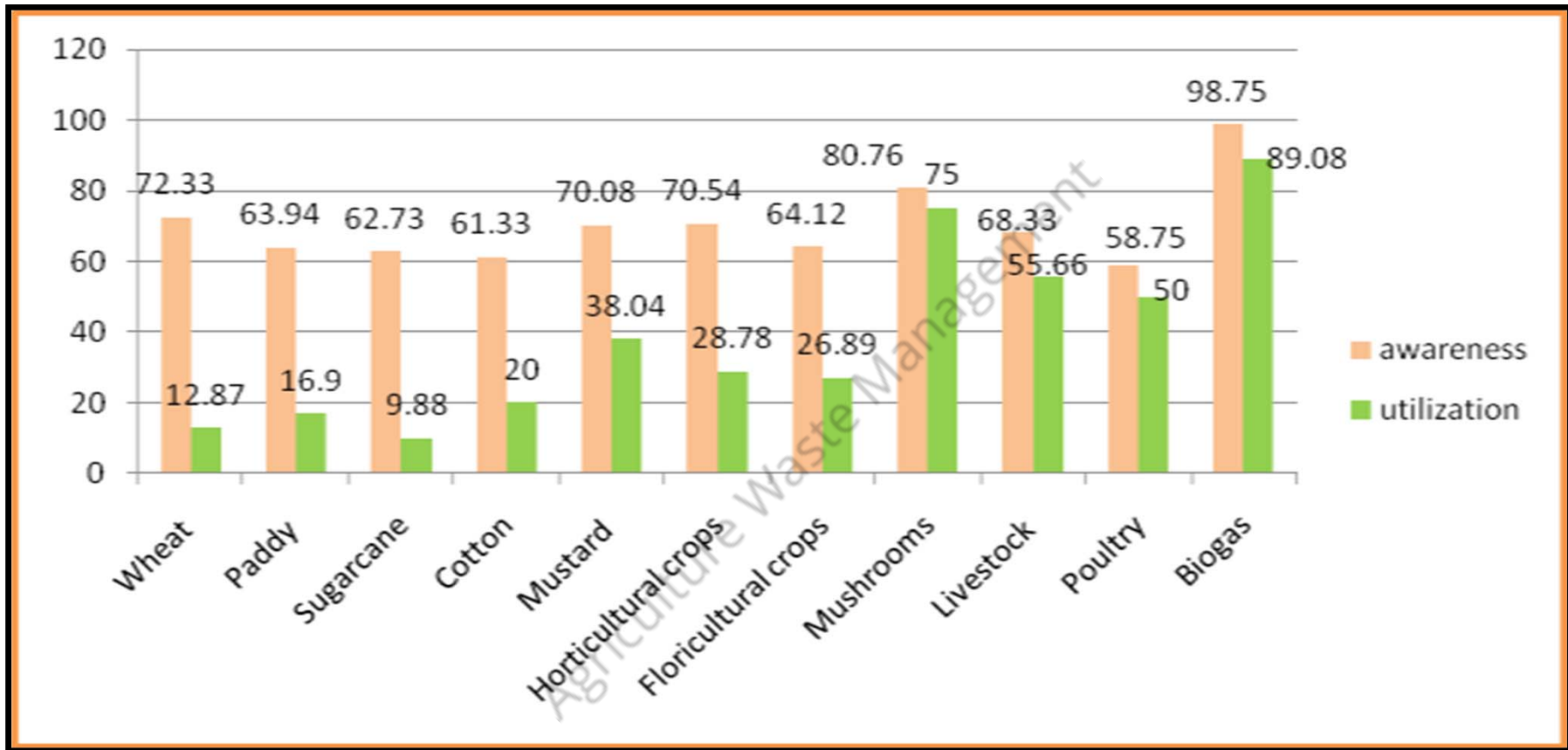


Fig 3.: Gap between awareness and utilization

# **Agricultural Bio-Waste Management in the Bhadravathi Taluk of Karnataka State, India**

*Veeresh et.al.*  
*2011*

**Study area :** Bhadravathi Taluk Karnataka  
**Sampling method :** purposive simple random  
**Sample :** 180

Table 1. Crops harvested waste utilization practices in the study area

Method of Bio waste	Paddy		Sugarcane		Areca nut		coconut		Maize	
	f	%	f	%	f	%	f	%	f	%
<b>Composting</b>	98	54.44	8	4.44	12	6.67	0	0	20	11.11
<b>Vermicomposting</b>	4	2.22	0	0	2	1.11	0	0	0	0
<b>Fuel</b>	0	0	0	0	65	36.11	62	34.44	180	100.00
<b>Fodder</b>	113	62.78	25	13.89	0	0	0	0	36	20.00
<b>Mulch</b>	0	0.00	6	3.33	4	2.22	0	0	0	0
<b>Burning in field</b>	0	0	30	16.67	0	0	0	0	0	0
<b>Other uses</b>	6	3.33	5	2.78	0	0	19	10.56	0	0

Table 2. Livestock waste utilization practices in the study area.

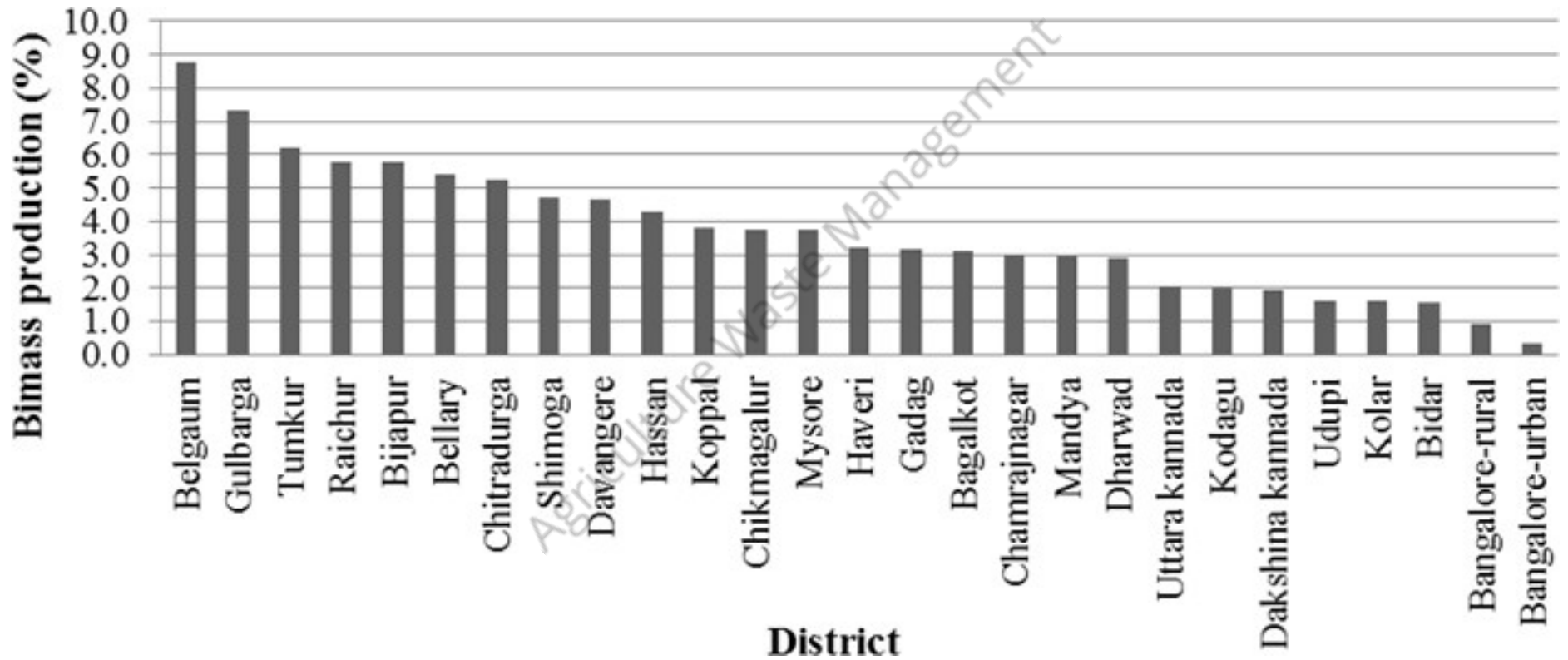
<b>Waste utilization</b>	<b>Frequency</b>	<b>Utilization (%)</b>
Bio gas	38	16.31
Regular composting	123	75.54
Vermicomposting	19	8.15

## Agricultural Waste Management in order to sustainable agriculture in Karnataka

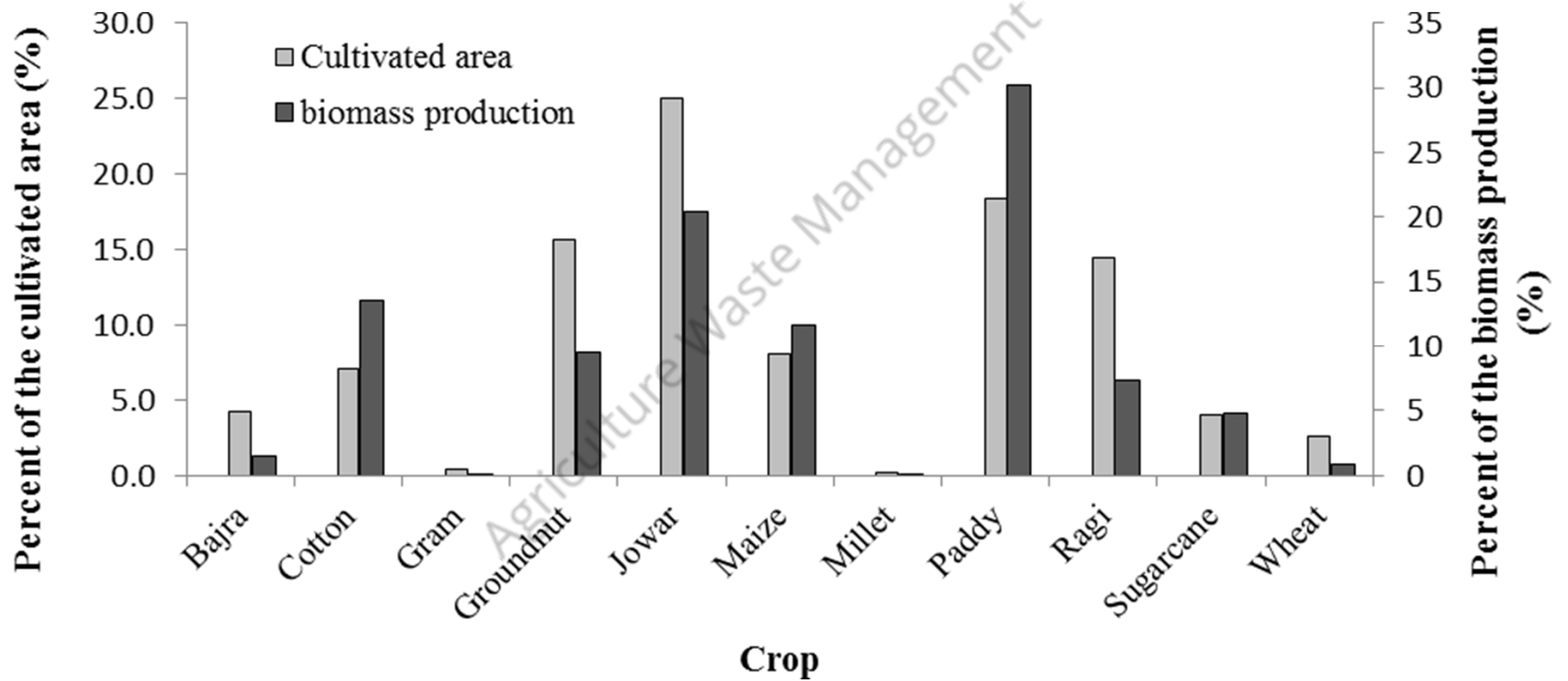
Minooei and  
Mokshapathy  
2017

**Study Area:** This study evaluates agro-residue biomass production in Karnataka.  
**Sampling method :** In the present study, all agriculture residue data, brought up from the Indian biomass atlas (2000-2004). Depends on the data for years of 1998-1999, assumed production ratio have not change in 6 years period and it would be considered as a consistence production

**Fig 2: ANNUALLY AGRO-RESIDUE BIOMASS PRODUCTION**



**Fig 3: CULTIVATED AREA AND BIOMASS PRODUCTION OF MAJOR CROPS IN KARNATAKA**



Agriculture Waste Management

<https://youtu.be/NoabQkxsR1w>



- Agriculture is one of the largest biological sectors that produces the highest biomass, which can be an important input for the bioeconomy.
- The AW management (AWM) based bioeconomic strategies can prevent underutilization of livestock excrement and reckless/random burning of crop residues to ensure food and health security,
- waste valorisation to generate value-added products, farmer's livelihood, job opportunities for youth, and sustainability in agriculture