



# “Minimizing Waste, Maximizing Feed Approaches To Repurposing Food Scraps”

Priyanka Singh rajora<sup>1</sup>, Sujal<sup>1</sup>, Rajesh Meena<sup>2</sup>, Tarique<sup>3</sup>

Assistant professor<sup>1</sup>, B.sc forensic science student<sup>1</sup>, B.pharma student<sup>2</sup>, B.tech(cse) student<sup>3</sup>

Department of pharmacy<sup>1</sup>, Department of forensic science<sup>1</sup>

Vivekanand global university Jaipur, Rajasthan, India

## Abstract:-

Minimizing waste while boosting feed through the reusing of food scraps is a significant procedure in advancing manageability inside food frameworks. This approach tends to ecological worries as well as upgrades asset productivity and supports food security. Here is an outline of compelling techniques and practices for reusing food scraps into creature feed and other valuable purposes. Food squander creation has expanded because of the rising populace and interest in good food. The vast majority overall expendable food they don't eat, however discarding food can hurt the climate, causing serious ecological and financial effects. One method for decreasing this misfortune is to change over extra food into practical creature feed, which helps the climate as well as makes animal creation less expensive. It assists us with killing waste by providing creatures with another wellspring of protein and reusing disposed of food. Moreover, this approach can likewise add to the roundabout economy by making a shut-circle framework that limits the utilization of regular assets and decreases ecological contamination. At long last, the survey infers that the utilization of food squandering as creature feed can give a practical answer for food squandering the board, food security, protection of assets, lessening ecological effects, and adding to a round economy.

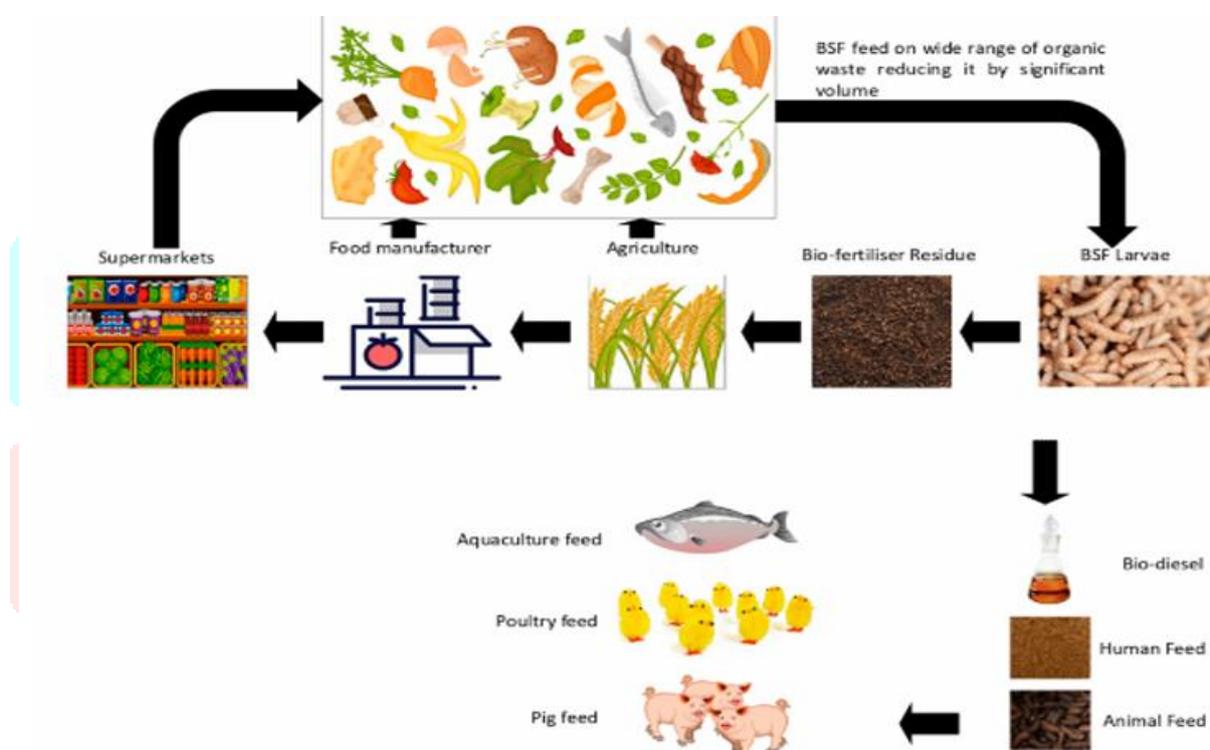
## Key words :-

- Food waste
- Waste management
- Drying and pelletizing
- Nutrient enhancement
- Greenhouse gas emissions
- Methane reduction
- Resource conservation
- Waste reduction
- Feed safety regulations
- Quality assurance in feed production

## 1. Introduction:-

In a world trying to deal with the problem of food wastage and the constant need for animal feed, the idea of converting waste food into nutritious food for animals has become a good and sustainable answer. A lot of food is thrown away every year. This creates problems for the environment and wastes resources. Also, the animal farm industry always faces difficulty in finding low-cost and good food to meet the increasing needs of animals.

This new approach attempts to fix these associated problems by turning waste food into something useful for animal feed. By using food that would otherwise go to landfill, we help limit the damage we do to our environment and also add to the cycle of using and reusing things. Turning leftover food into animal feed is a smart way to solve both environmental and money problems. Repurposing food waste, this smart method reduces the amount of waste in landfills, cuts greenhouse gas emissions, and provides farmers with a cheaper alternative. This work not only helps us make good use of resources but also creates good food for animals. This keeps our livestock healthy. This approach aligns with circular economy ideas, helping to create a greener and more responsible way of producing food. Therefore, turning food waste into animal feed is a smart way to reduce waste. It also helps in improving farming and making the world healthier.



( Figure 1 :- Overview of classification of Food Waste. )

This approach aligns with circular economy concepts, helping to make the food preparation process greener and more responsible. Therefore, the idea of converting food waste into animal feed is a smart way to get rid of waste. It also helps in farming and also plays its role in making the world healthy.

The qualities and synthesis of food squandered in different examinations are likewise summed up during the time spent assessing arrangements and treatment choices considering their significance in picking the best avoidance strategies and treatment draws near. While the last option is investigated with regards to the food squander order of recuperation (reuse and reusing) and removal, the previous is delineated through the examination of the arrangements and guideline frameworks.

## 2. Definition of Food Scraps:-

High cook and prep load meals tend to create large volumes of food scraps about the final meal volume and should take dedicated note of food scraps as a separate resource of utility from meals and waste. This should be done by preparing the meal plan as a sequence of events starting from raw ingredients and finishing serving the meal. By assigning the prepared meals and waste to the original raw ingredients, alternate methods for consuming the utility of the prepared meals and waste can be detected by comparison

of the prepared meal and waste to the raw ingredients used to produce them. This forms the subject of food scrap repurposing about the prepared meals and waste causes, which will be covered in upcoming posts.

The definition of food scraps is necessary to understand before meals and food waste can be broken into separate parts. Food scraps are generally considered to be the parts of food that are discarded after the initial preparation of a meal. This can include peels, rinds, trimmings, expired food, and leftovers. When the food is originally prepared, these scraps hold little value to the preparer and are often thrown away without a second thought to their remaining utility. This is partially due to the perception that the food scraps provide lower utility than the resources that would be required to repurpose them and partially due to ignorance of their remaining utility in the form of meals and compost.

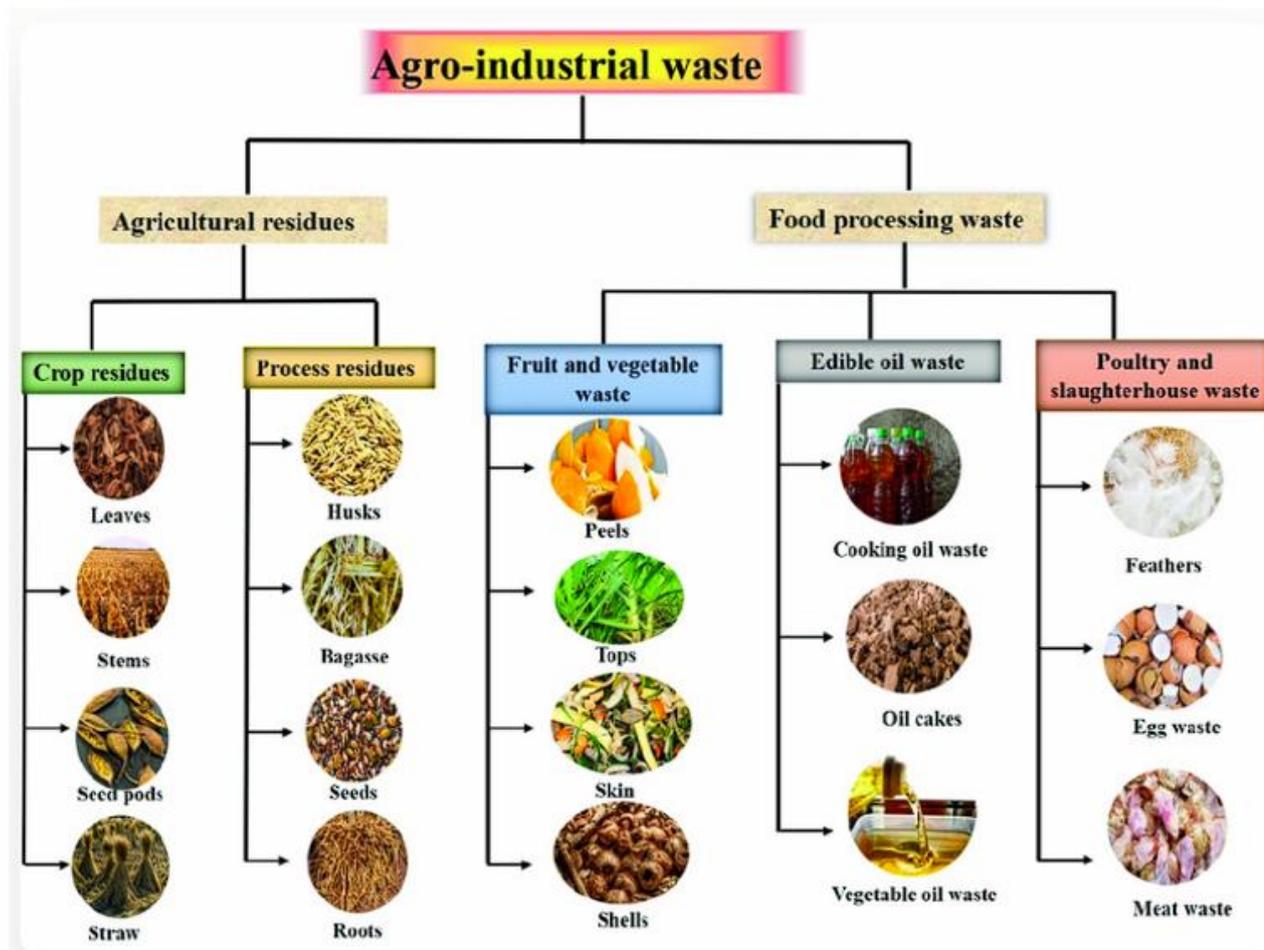
### 3. Food waste and Types:-

Food waste can be characterized in various ways relying upon its tendency and beginning. Nearly, food or uncooked food, prepared food waste, or semi-prepared food squandered, might be arranged in light of the way of cooking. During the creation cycle, there are many courses through which food is moved from the maker to the client, and waste is produced at every one of these intersections. - Horticulture is the main in the established pecking order. Consequently, cultivators are viewed as the essential makers.

Type	Description	Examples
<b>Avoidable Food Waste</b>	Consumable food disposed of due to different factor	Leftovers, spoiled fruits
<b>unavoidable Food Waste</b>	Unpalatable pieces of food that can't be eaten	Peels, bones, coffee grounds
<b>Food Loss</b>	Food squandered at any stage prior to arriving at customers	Spoiled produce, unsold items

(table 1:- Summary of Food Waste Types)

- Food Wastes (includes non-edible portions of fruits and vegetables, animal feed components, and inedible parts such as leaves, straws, and stalks. Also, direct residues of fertilizers and pesticides).
- The industrial food wastes generated by vendors and processors are among the 34 percent of the total food waste that originates from the Post-harvest, processing, and retail sectors.
- Utilization of Potential Markets for Food Waste—displaying fresh and processed food of retailers and institutional providers.
- Street Hotel/Restaurant waste: besides the mixed produce wastes generated by secondary distributors in the form of ready meals and other home-cooked products that are purchased in packaging.
- the ordinary degrees of Business Food Squander — created through the most common way of buying food. Food Squander is partitioned into three kinds in light of their actual state: strong, semisolid, and fluid Food Squanders are undeniably ordered into a solitary stream of Food Squander streams.
- Pre-consumer food waste:- This waste includes that which occurs during food processing, manufacturing, and production before the product is sold. It may stem from surplus production, spoilage, contamination, expiry dates, etc.
- Post-shopper food squander is the food that is left after a client has gotten it, and this records for around 26% of complete food squander. It is the waste created by customers.
- Avoidable food waste:- For instance, there are spoiled items like produce not used before expiry dates, uneaten meals due to over-purchasing, improper preparation, and wrong portion sizes. This type of waste could have been avoided.
- Unavoidable food waste:- This is derived from food or drink preparation that is not required to be consumed under normal circumstances like peels, bones, shells, or coffee grounds.
- By-product food waste:- This can be classified as either solid or liquid food waste that is produced during these processes or agricultural practices



(Figure 2:- Type of Food waste )

#### 4. Nutritive Attributes of Food Waste:-

Every day the amount of food waste and loss has been told to be around 1200-1500 food calories per day. Around 35 to 60 percent of Food Waste is carbohydrates with proteins at about 5% and fats ranging between 10 and 40%.

The nutrients that are contained in fruits, vegetables, and other products that are discarded being a result of lack of consumption are wasted. The age of Food Squander, estimated in grams per individual each day, can be separated into the accompanying classifications: food with coordinated parts, for instance, vegetables (18%), organic products (16%), dairy items (3%), and cereals (4%). Much food wastage is recovered to feed livestock which is a good source of protein.

Food Waste might be creature feed as a low-estimated other option. Research shows that 1 dry Food Waste ton might be converted to be grain protein rich instead of maize grain supplied to an animal. Waste is a big source of protein for livestock and thus maize which is the most widely used feed source that gives 8 to 10 percent protein can be processed. Organic trash is currently being composted with the aid of insects, which even includes hardly-known technologies. It should be noted that the insects are no longer used as animal food only but also they are rich with all the necessary constituents for the animals. The crude fact that an adult larva of the black soldier fly as *Her metalocene* has as much as 40 to 45 % proteins and even up to 35 percent fat in its entire body simply means that the larva is superior to other feed sources.

The research about *H. illusions* showed that the fly can eat various wastes which include poultry, pig liver, pig sweet manure, kitchen waste, vegetables and fruits, and fish rendering off along with kitchen waste which gives rise to the maximum fly biomass production. In organic compounds, along with bioactive chemicals and polyphenol concentration, there is two times less compared to feed produced from edible components.

## 5. Food waste in Animal Feed Production:-

Animal feed can be effectively reused at every stage of food waste valorization, offering multiple benefits. As the food waste is converted into animal feed, various kinds of feed can be generated including poultry feed, fish feed, cattle feed, and swine feed. It is the method that reduces the volume of waste reaching the landfills lessening methane emissions and combating climate change. Furthermore, it serves as a low-cost alternative to traditional feed, thus cutting down on livestock rear prices and creating new income-generating ventures. Processing and treatment are vital to ensure the safety of animal feed made of food waste.

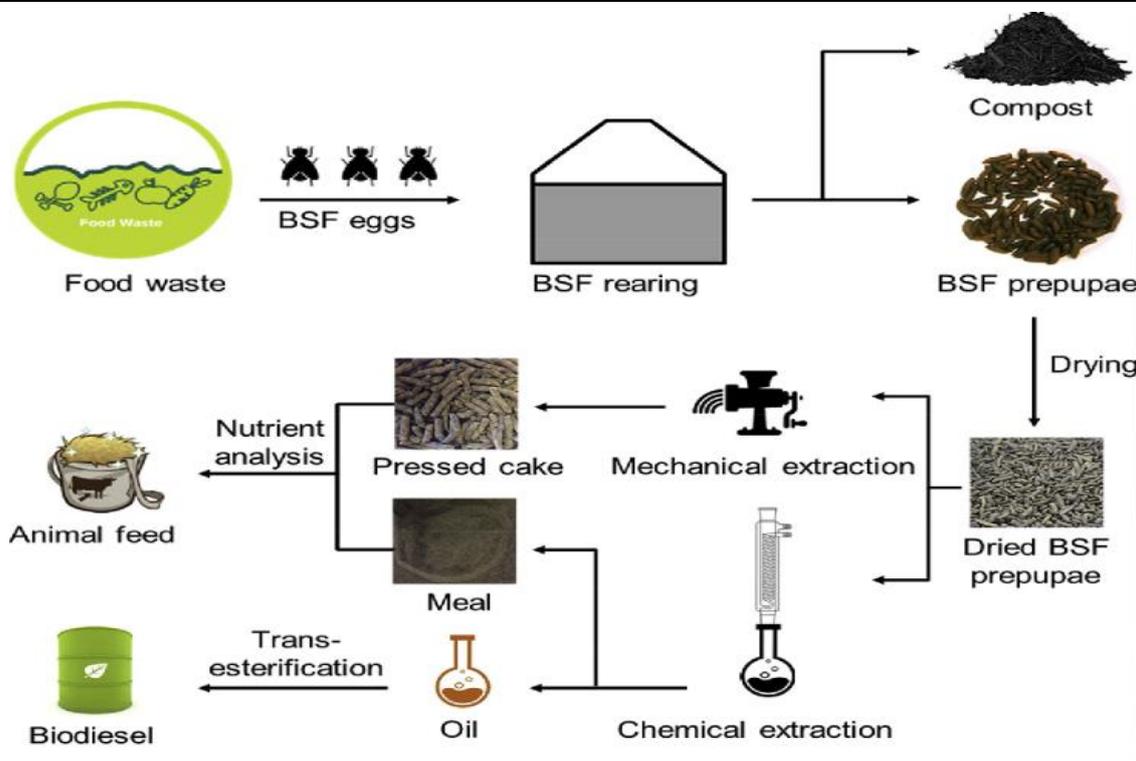
Country	Study area	Food waste (kg/capital)
India	Andhra Pradesh, Rajma	58
Pakistan	Gujranwala	88
Australia	Nationwide	102
China	Urban China	150
Japan	Nationwide	64
Viet Nam	Da Nang	67
Israel	Nationwide	105
Lebanon	Beirut	105
USA	Not specific	59
Nigeria	Sapele	189
Kenya	Nairobi	99
South Africa	Nationwide	134
Spain	Not specific	78

(Table :-2-0 country and households food waste)

## 6. PROCESS:-

Transforming leftovers into food for animals consists of a few main steps. This involves separating waste and then mixing it into healthy feed among other things. Below is the step-by-step procedure.

- **Waste Collection and Segregation:-** The positive effects of volunteerism lie not only in the assistance provided to individuals in need but also in the sense of belonging and purpose that it fosters for volunteers themselves. Find locations of food waste, including home kitchens, eateries, and factories. Set up a procedure for proper and easy waste collection. In the beginning, start a sorting process to separate food waste from animals from those things that will not decay.
- **Transportation:-** Develop a scheme for the transportation of collected garbage from the place it is gotten to locations where it can be processed. Change routes to lessen the damage to the environment and to save money on the cost of travelling.



( Figure 3:- Utilization of Food Waste to animal feeding by producers )

- **Processing and Sorting:-** Instal plants for garbage treatment that have sorting units to make the collected garbage even cleaner. Tool to separate various kinds of trash, especially organic rubbish that animals can eat.
- **Nutrient Analysis:-** Test the nutrients in sorted food waste to discover how much food value food waste has. Identify the key points such as protein, carbohydrates, fats, vitamins and minerals, etc.
- **Processing into Animal Feed:-** instances of censorship often trigger debates about the limits of free expression and the bounds of acceptable speech. Implement the procedure of the chosen feed mix formula.

Common techniques include:-

- Drying: Preserve the dryness to prolong the shelf life.
  - Ensiling: Maintain the feed using fermentation.
  - Pelletizing: Use ball-shaped containers that will be easy to lift and move.
- **Quality Control:-** Set up safety rules to make sure that food for animals is always safe and marked. Make sure that there are no toxic substances in food and know the rules of food safety.
  - **Packaging and Labelling:** A varied choice of snacks and meals should be available to cater to different dietary preferences and needs.

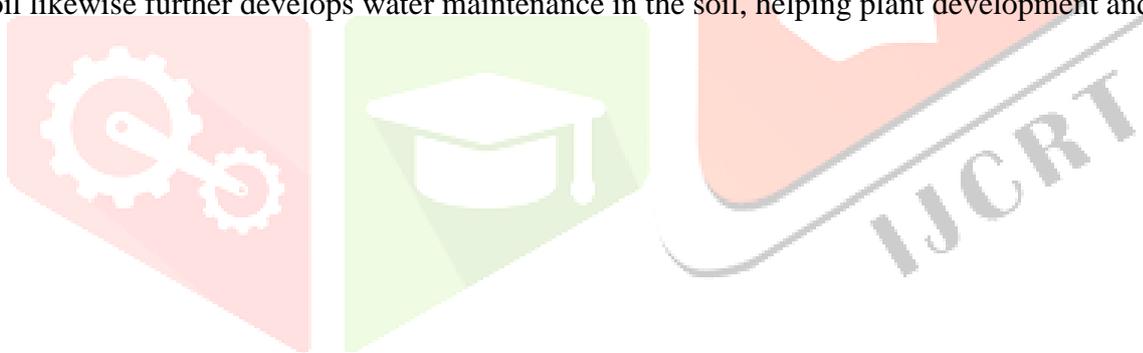
## 7. Safety Considerations for Animal Feed:-

- **Toxicity:-** Some foods are poisonous for the animals. For instance, some fruits such as grapes, and a few vegetables like onions could be poisonous for dogs. As you feed pets, don't give them any scraps containing ingredients that are toxic to them.
- **Chemical Contamination:-** Food scraps are oftentimes affected by chemicals like pesticides, herbicides, or cleaning products. Be certain that in the scraps chemical contamination is either minimal or absent. Discards should not be sourced from such houses that use a lot of chemical cleaning agents or commercial establishments with food getting close to cleaning chemicals.
- **Spoilage:-** Rotting of the leftovers takes place more quickly considering warm temperatures. No matter how hard you try to waste if you feed the animals mouldy or rotten scraps they may become ill or have digestive problems. Proper storage methods and handling procedures must be used to keep goods from getting contaminated.
- **Processing:-** Some types of food waste will need processing before animal consumption, while others are ready for feeding. For instance, large foods may need to be cut or pulsed to prevent choking. However, there may be a need to cook certain foods to make them more digestible or to inactivate toxic microorganisms in some instances.

- **Balanced Nutrition:-** Even though food waste can supply the animals with necessary nutrients, they must have a balanced diet that is from it. The scraps that will be fed to the animals will be in addition to the existing feed and will promote an array of nutritional needs. By seeking the recommendation of a veterinarian or animal nutritionist, the nutrition requirement for the animals can be properly met.

#### **8. Importance of Repurposing Food Scrapes:-**

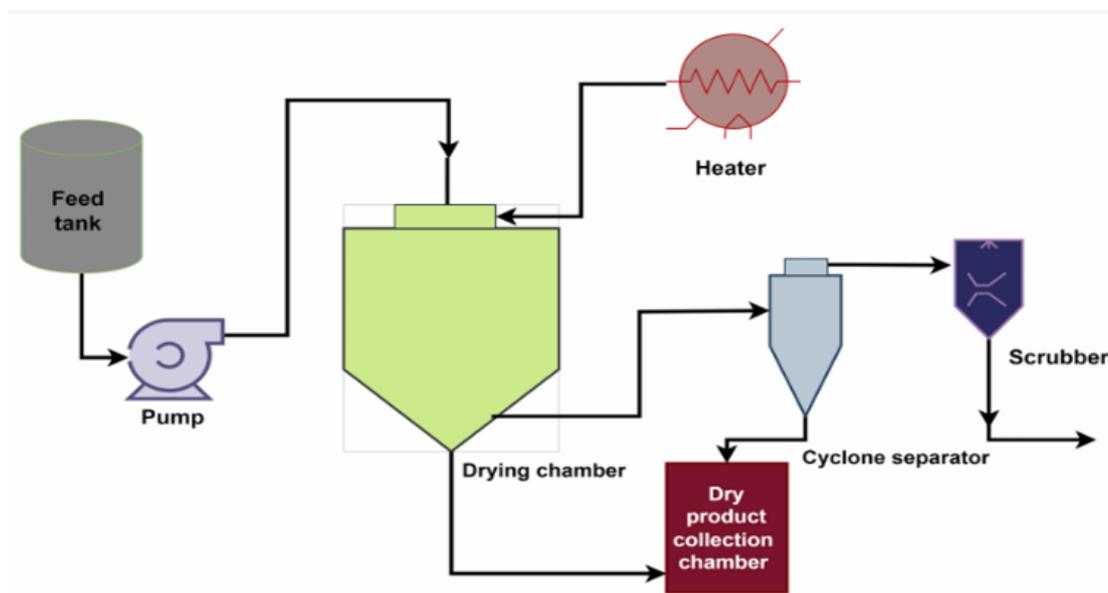
- **Conserving Resources:** - Delivering food requires huge assets like water, land, and energy. When food scraps are repurposed instead of being discarded, these resources are conserved.
- **Saving Money:-** Repurposing food scraps can save households and businesses money by reducing the amount of food that needs to be purchased. For example, vegetable scraps can be used to make homemade broth instead of buying packaged broth.
- **Nutritional Benefits:** -Many food scraps are rich in nutrients and can be used to create nutritious meals and snacks. For example, vegetable scraps can be used to make vegetable stock, fruit scraps can be used to make smoothies or fruit-infused water, and bread scraps can be used to make breadcrumbs or croutons.
- **Promoting Creativity:-** Repurposing food scraps encourages creativity in the kitchen. Instead of throwing away scraps, individuals can experiment with new recipes and cooking techniques to make delicious meals out of ingredients that might otherwise be discarded.
- **Food Uncertainty Moderation:-** Reusing food scraps can assist with mitigating hunger by rearranging surplus food for those out of luck. Drives include giving an abundance of food to diminish squandering as well as help local area government assistance.
- **Work Creation:-** Progressing to a roundabout economy through reusing food waste can produce new positions and open doors in reusing, treating the soil, and supportable farming areas. Organizations can investigate imaginative business sectors for food byproducts, making monetary development while resolving waste issues.
- **Soil Enhancement:** Fertilizing the soil food scraps returns supplements to the dirt, upgrading soil richness and design. This training diminishes the dependence on substance manures, which can hurt the climate. Fertilizing the soil likewise further develops water maintenance in the soil, helping plant development and biodiversity.



## 9. Methods of Converting FWs into Animal Feed

### 9.1 •Spray Drying

One of the simplest ways of prolonging the shelf life of liquid extracts and improving the taste and texture of food products is the spray drying technique which in turn converts extracts into the form of a stable powdery substance. With spray drying, the liquid feeds are converted into the form of atomized air within the drying chamber. Then, the vapor air stream evaporates the droplets by drying the liquid feed. The evaporation of water happens more rapidly since when the droplets are smaller themselves, this condition has a higher surface-to-mass ratio. Particularly in the speed and intensity at which this method is carried out, not much heat damage occurs that can harm delicate material.



( Figure 4:- Spray dryer working procedure )

Several works with spray drying techniques including microencapsulation have been developed to gain anthocyanin concentrate from many sources like grapes, cranberries, hibiscus extracts, rose black carrots, roselle black carrots, etc. In the production of the plants used in the food, beverage, cosmetic, and pharmaceutical industries millions of left-out stuff and by-products are produced. In the list are cutoffs from peels, husks, unfavorable plant parts, and oil seed cakes. Other than the crop industries, fish and meat processing is the other branch of industrialization that also produces byproducts and waste. According to the FAO, is food that is not being consumed by consumers and this adds up to 13.7% of all retail and consumer waste. The terminology employed when talking about "lost" goods during production, post-harvesting, and processing might be "food wastes", "food losses", or "waste of plant origin". The information differs, with a gap anywhere between 6% and 25% depending on cases, but the food wastes are still reported. 'One of the critical goals is to have minimum or no food waste and its use is reused. Moreover, sectors lose a lot of financial assets as well since wasting by-products.

The Spray drying process includes a few basic advances:

- Atomization: The fluid feed, which can be an answer, suspension, or glue, is atomized into fine drops utilizing spouts or rotational atomizers. This builds the surface region for vanishing, upgrading the drying efficiency
- Blending in with Hot Air: The atomized drops are brought into a drying chamber where they come into contact with a flood of warmed air. The intensity causes fast dissipation of dampness from the beads, changing them into strong particles. The temperature and wind current are painstakingly controlled to improve drying conditions.
- Drying: As dampness vanishes, the drops psychologist and structure strong particles. This cycle happens in two phases:
  - First Stage: Vanishing happens at a consistent rate while adequate dampness stays at the bead surface.
  - Second Stage: Vanishing eases back as the bead frames a dry shell, expecting dampness to diffuse through this shell.
- Partition: In the wake of drying, the strong particles should be isolated from the air stream. This is normally accomplished utilizing typhoons or channels, which gather the dried powder while permitting the air to exit

## 9.2 • Microwave Drying

Microwave drying is a cutting-edge procedure that uses electromagnetic energy to productively eliminate dampness from materials, making it especially profitable for handling food squandered into creature feed. This strategy offers a few advantages over conventional drying methods.

The drying region can benefit uncommonly from three chief factors: its speed, low energy usage, and incredible thing quality. The headway of new developments has made it possible to screen and manage an extended number of limits during the drying framework. These characteristics integrate temperature, weight, power, smell, and others. As demonstrated by Bai et al., the extended relative dampness of convection air may be a basic part that moves back drying while simultaneously saving the idea of the things inside or outside surfaces. The temperamental combinations that are unendingly let out of the material being dried during microwave drying are moved by convection air.

Instrument of Microwave Drying:-

- I. **Dielectric Warming:** Microwaves produce heat by intriguing polar particles, fundamentally water, inside the material. This cycle happens because microwaves make an exchanging electric field that makes water particles waver, creating heat through atomic rubbing.
- II. **Fast Dampness Vanishing:** The intensity delivered inside the material prompts a huge fume pressure differential between the inside and the surface. This distinction drives dampness out rapidly, considering a lot quicker drying contrasted with conventional strategies where intensity is directed from the outside internal.
- III. **Temperature Control:** The interaction considers exact command over temperature and dampness levels, limiting the gamble of overheating and guaranteeing steady item quality.

Benefits of Microwave Drying:-

- I. **Energy Productivity:** Microwave drying can save over 30% energy compared with infrared warming and more than half contrasted with steam warming because of direct warming technique diminishes transmission misfortunes.
- II. **Uniform Warming:** Dissimilar to regular drying techniques that can prompt lopsided warming and possible consumption (coking), microwave drying warms materials consistently, forestalling outer surface harm while guaranteeing intensive interior drying.
- III. **Speed:** The strategy essentially lessens drying times — frequently by 80-90% — making it reasonable for high-throughput creation conditions.
- IV. **Quality Conservation:** Microwave drying holds the wholesome and tactile characteristics of food items better than conventional strategies by limiting openness to high temperatures.
- V. **Conservative Gear:** Microwave drying frameworks normally require less space than regular dryers and can be handily incorporated into existing creation lines for consistent activity

Challenges and considerations :-

While microwave drying presents various benefits, there are difficulties that should be tended to:

- a. **Nourishing Inconstancy:-** The wholesome profile of food waste can fluctuate essentially contingent upon its source, which might influence the nature of the last creature feed product.
- b. **Security Concerns:-** Guaranteeing that the handled feed is ok for creature utilization requires tough quality control estimates all through the handling stages.
- c. **Innovative work:-** Progressing research is important to enhance handling techniques and work on the healthful consistency of food-squander-based feeds.

## 9.3 • Silage

Taking care of harvests after gathering uses microwave drying. The drying region can benefit amazingly from three chief factors: its speed, low energy use, and incredible thing quality. The headway of new advancements has made it possible to screen and manage an extended number of limits during the drying framework. These characteristics consolidate temperature, weight, power, scent, and others. As shown by Bai et al., the extended relative clamminess of convection air may be a basic part that moves back drying while simultaneously saving the idea of the things inside or outside surfaces. The unsound combinations that are industriously let out of the material being dried during microwave drying are delivered by convection air.

The moistness transport condition, whose primary impulse depends upon the obsession contrast, is indistinguishable from the scattering model for flighty manufactured compounds. There is close to no investigation on using high tenacity all through the drying framework. Furthermore, these works solely used ordinary, sun, and convective drying processes; microwave drying was not used. Microwave drying, which could be a significant strategy for cycles, for instance, drying vegetables and natural items in shut groups, requires research on the impact of high clamminess on the drying rate as well as the thing quality. In this survey, work is made to follow and manage the convective air's sogginess to resolve the issue. For this, a cunning microwave drying development was made.

The structure included three subsystems: a one-way wind current control system for killing the vaporous suddenness, a thermostatic microwave warming system with online mass weighting, and a tenacity assessing structure. Since waste food assortments are not difficult to secure and have, especially temperamental manufactured substances, they were picked as the drying tests. For the objective of changing the general clamminess enveloping the models, various plans were made. Examination and discussion were coordinated on the relationship between relative clamminess and drying speed as well as between relative dampness and thing quality. The disclosures will be used to help the case that high moistness deals with the idea of the conveyed things.

#### Steps in the Silage-Making Cycle

- I. Reaping: -Yields ought to be reaped at the ideal stage, commonly when they contain around 30-35% dry matter (DM). Ideal yields incorporate maize, sorghum, and grasses during their blossoming or batter stages. Reaping past the point of no return can decrease sugar content and increment fibre, making the feed less appropriate for silage.
  - II. Hacking:- The gathered material is hacked into little pieces, as a rule between 1 to 3 cm long. More limited slash lengths further develop compaction and diminish air pockets, improving the maturation cycle.
  - III. Filling and Compaction:- The hacked feed is pressed firmly into a storehouse (which can be a pit, channel, or pinnacle) to limit air openness. Legitimate compaction is significant as it diminishes the oxygen content, which is fundamental for successful anaerobic maturation.
  - IV. Fixing:- After filling, the storehouse should be fixed firmly with plastic sheeting or different materials to keep air from entering. This anaerobic climate is fundamental for the aging system to happen without spoilage
- #### Steps in the Silage-Making Cycle
- V. Collecting: - Yields ought to be gathered at the ideal stage, normally when they contain around 30-35% dry matter (DM). Ideal harvests incorporate maize, sorghum, and grasses during their blossoming or batter stages. Collecting past the point of no return can decrease sugar content and increment fibre, making the grain less reasonable for silage.
  - VI. Slashing:- The gathered material is hacked into little pieces, as a rule between 1 to 3 cm long. More limited slash lengths further develop compaction and diminish air pockets, improving the maturation cycle.
  - VII. Filling and Compaction:- The slashed grub is stuffed firmly into a storehouse (which can be a pit, channel, or pinnacle) to limit air openness. Appropriate compaction is essential as it lessens the oxygen content, which is vital for successful anaerobic maturation.
  - VIII. Fixing:- In the wake of filling, the storehouse should be fixed firmly with plastic sheeting or different materials to keep air from entering. This anaerobic climate is fundamental for the aging system to happen without decay.

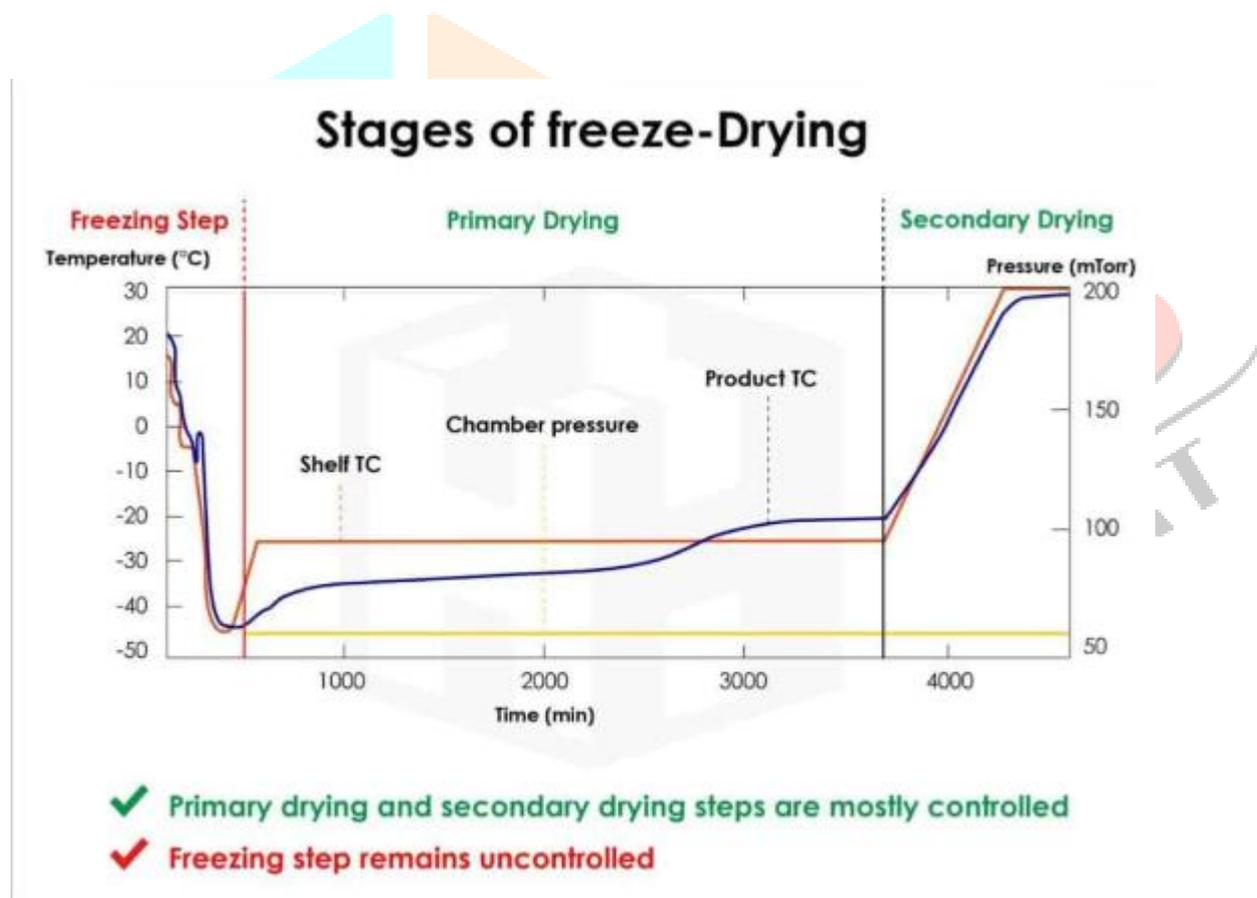
#### 9.4 • Freeze Drying

More often than not dried great foods grown from the ground are analysed with the technique of freeze-drying. Freeze-drying the water's strong states, low temperatures, and dampness disintegrates processes saves, for the most part, the first design and state of the items, expanding the deficiency of porosity and quicker rehydration. To expel the thawed dissolvable from the fluid, a desorption cycle should be embraced after the dissolvable is removed, frenched, and passed to the low-pressure climate to permit sublimation. Subsequently, the most common way of drying can be separated into two phases: sublimation (called desorption of liquid) and parching (called endothelium of liquid). This is because the two phases include two cycles that are similarly critical: the cycles of freezing, where virtually the dissolvable is all reduced into strong particles that are like this drenched; as well as drying, in which practically the whole dissolvable is taken out.

When freeze-drying occurs, the food is initially frozen, a stage referred to as the freezing step and consolidation (the last step in the freeze-drying techniques).

The size and composition of their ice crystals are dependent on the freezing addition the slower the process, the bigger or smaller the particles of ice will be. Manufacturers of food products usually assign their valued food products such as coffee, essential raw materials for ready-to-eat meals and aromatic herbs to be freeze-dried in the industry of the food. Extensive research and development of MEADOW, an integrated stabilization-processing device for various forms of solid waste, has been conducted to handle the solid waste marked by long and complicated human-crewed space travels. The two direct-drying techniques freeze-drying and vacuum-drying were studied. A Peltier condenser conditions both wastewater vapor staying in its evaporation and transformation mode and turns it back to rather pure water.

The process of evaporation of moisture has caused the water activity of the final output will be less than is a requirement for bacteria to keep on to their metabolic activity. The stabilization of the treated waste depends on when water is not to be reabsorbed in keeping the product in storage with them being properly monitored. Many research works are pretty obvious that freeze-drying is a method that helps minimize food waste. Nevertheless, they claimed that freeze-drying was somehow not the most suitable way to deal with the garbage, in constant consideration of its high cost. Despite this, the specific production circumstances control the scale of waste produced for animal feed consumption.



(Figure 5:- Stages of freeze- drying )

Steps in the Freeze Drying Cycle :-

- I. **Pre-Freezing:-** The material is at first stuck to a temperature underneath its triple point, guaranteeing that all water is in a strong structure. This step is basic as it impacts the size of the ice gems; bigger precious stones work with more proficient sublimation during the drying stages. Slow freezing is frequently liked to take into consideration bigger gem development, while fast freezing might be essential for delicate organic materials to forestall cell wall damage.
- II. **Essential Drying (Sublimation):-** In this stage, the tension is essentially diminished (making a vacuum), and intensity is applied to permit the frozen water to sublimate straightforwardly into fume. This interaction eliminates around 95% of the water content. The vacuum speeds up sublimation by bringing down the limit of the ice, and a cool condenser gathers the fume, keeping it from reemerging the product.
- III. **Optional Drying (Desorption):-** The last stage includes eliminating any leftover bound water atoms that were not disposed of during essential drying. The temperature is raised marginally to break the connections between

water and the material. This step commonly brings about a last dampness content of around 1-4%, guaranteeing long-haul soundness and a timeframe of realistic usability of the freeze-dried item.

## 10. Utilizing Food Scraps as Animal Feed:-

Utilizing food scraps as animal feed presents an opportunity to tackle two pressing issues simultaneously: food waste and climate-smart agriculture. Sometimes several scraps are found in food which could be simply thrown into landfills but instead, they are donated to animals for their benefit. Such a concept is based on the reuse of waste, but the agricultural practice and the environment also get numerous benefits from it.

If farmers feed their animals at the barn with discarded food, they can reduce the high prices related to purchasing commercial feed. It has even more of an impact when we are talking about small-scale farmers or those having work on a budget. As well food waste is a good source of energy, which can mostly enough supply animal needs. For example, beet and carrot tops, which are normally discarded, can provide vitamins and minerals, while leftover grains and bread will offer you carbohydrates and proteins.

Besides the economic benefits, the use of animal feed with lots of food scraps proves to be environmentally responsible. Alternatively, when organic waste decomposes in landfills and gases such as methane are produced there are harmful greenhouse gases. But by doing this way then the food system will be closed. It brings waste particles to life by transforming them into a valuable resource and this way, it results in reduced environmental footprints both at food production as well as at the disposal of waste. In addition, providing animals with food scraps enhances the facility of having a more mixed diet. Similarly to humans who need different types of foods for well-being, animals get the best offering when they eat different items. The addition of food waste may also contribute to the overall nutritional density of the traditional feed provided in farms and, potentially, to more robust live stocks and better outcomes.

## 11. Types of Food Waste for Animal Feeds :-

A wide assortment of homegrown creatures accept their sustenance from an assortment of food scraps and side-effects of the food business. The complete edible supplements (TDN) demonstrates the aggregate sum of a dinner or diet's fat, protein, and sugars that are absorbable. Energy that can be processed is straightforwardly connected to TDN. The TDN is valuable for steers cow eats less that are predominantly forage based. TDN esteems every now and again misjudge the value of giving amass in contrast with search. Change and handling of food squanders forestalls squander rotteness as well as assists with rationing deserted food assets and change them into monetarily suitable merchandise . Creature takes care of gotten from food squander (FW) can be arranged into a few kinds in view of their source and dietary structure.

Food wastes	Constituent	Animals that consume it
Potato waste	Crude protein (cp)7.6% Ether extract (EE) 7.0% Crude fibre (cf) 4.0%	Excellent source of energy for cattle feed, 10% to 20% as feed pellets; also used for pigs and goats
Banana root bulbs	CP:12.0%, Total digestible nutrients (TDN): 50.0%	Adult cattle can be for 20–25 kg per day after cleaning and for pig feeding
Appel waste	CP: 12.0%, TDN: 60.0%	30% of this trash can completely replace corn in the feed of poultry and cattle after being chopped, ground, and dried
Rice husk	CF: 39.0–42.0%, EE: 0.8–1.2%, CP: 2.9–3.6%	Cows, horses, and buffaloes
Tea waste	TDN: 58%, CP: 17.94%, Tannic acid: 1.9%	10–15% mixed with a tasty component are fed to cattle
Mango seed kernel	TDN: 55.0%, Protein 6%	20 to 40% for growing calves and buffaloes, 10% for milch cattle, 50% for ruminants, and also as fish feed

Coconut meal	TDN: 70.0–75.0%, CF: 10.0%, CP: 25.0–30.0%	Dairy cows can benefit from a highly helpful protein supplement that boosts milk fat content; also used for goat.
Coffee husk	CP: 7.0–8.0%, Ca: 0.51%, P: 0.25%	Cattle
Tomato waste	TDN: 55.0%, CP: 15.0%	For adult cows up to 50%, and for milch cows and poultry up to 16%
Soybean meal	TDN: 75.0–84.0%, CP: 45.0–55.0%, Rich in Ca and P	Livestock animal and cattle
Beet molasses	TDN: 65.0–75.0%, CP: 6.0–10.0%	Cows and buffaloes

(Table 3. Types of FWs/by-products and their uses as animal feed.)

- **Brewer's Grains :-** The buildup from lager creation, BWG is regularly high in dampness (70-80%) and is fundamentally utilized in dairy and hamburger steers eats less carbs. Taking care of levels for the most part range from 20 to 40 lb/cow/day, contingent upon dampness content.
- **Corn Side-effects :-** This side-effect from corn handling contains a blend of corn grain, gluten feast, and starch. It very well may be taken care of wet or dry, with taking care of cutoff points around 8-15 lb/cow/day for dry CGF and 15-25 lb/cow/day for wet CGF.
- **Distillers' Grains :-** This feed is delivered during ethanol creation and is wealthy in fermentable Fiber and protein, making it reasonable for dairy steers. It can further develop energy accessibility without expanding starch consumption, subsequently decreasing the gamble of rumen acidosis.
- **Handled Food Squander :-**
  - a. **Pig Feed:** Pigs can devour an assortment of food squander, including natural products, vegetables, and grains, after legitimate handling to wipe out microbes. This feed can give fundamental supplements like proteins and fats.
  - b. **Poultry Feed:** Like pig, poultry can profit from handled food waste, for example, products of the soil, which supplement their conventional feed sources with extra supplements.
  - c. **Dairy cattle Feed:** Grain-based food squander like bread can be reused into steers feed, gave it contains no creature determined items to stay away from wellbeing risks.
- **Hydroponics Feeds:-** Food waste can likewise be changed over into fish feed pellets, giving fundamental supplements while diminishing dependence on wild fish stocks generally utilized in fish feast creation.
- **Pet Food :-** Particular sorts of food waste can be securely remembered for pet food definitions, offering a reasonable supplement profile when handled accurately. Nonetheless, harmful food sources, for example, onions or chocolate should be kept away from.

## 12. Safety Policies:-

Food waste that isn't true to form treated could contain microorganisms that cause ailments. Around a similar time, the Brought together Domain government limited Food waste used in animal dealing with, and the following year, the European Affiliation gave near rules.

The prohibition does not apply to food waste that does not have any meat, fish, or other animal components in them. These wastes, though, pertain strictly to some manufacturing by-products, and it is the portion of EU food waste that is insignificant. We believe that heat-treated waste feeds shouldn't be under the ban for the reason that appropriate heat treatments can effectively make deactivated potentially dangerous bacteria along with viruses in waste feeds safe for animals. Some heat treatments consist of heating the feed material for more than 30 min at temperatures higher than 70 o C, just to make sure that the produced feed is safe. Additionally, heat treatment would help to alleviate the problems arising after waste generation. Unfortunately, this is offset by current EU restrictions that do not allow food waste to be used as animal feed.

### 13. Results:-

In the various kinds of diet tests directed, how much food squander utilized in the eating routine (substitution rate) went from 10% to 100 percent. Reactions as far as creature weight gain and additionally feed use effectiveness shift concerning creature species, physiological stage, taking care of time for testing, sort of feed waste, and substitution rate. Some studies have shown that there is no difference between a replacement diet and a no-replacement diet. In contrast, some other studies showed that replacement diets led to weight loss in chickens and pigs.

### 14. Purpose of the Study:-

The study will help in identifying strategies for efficient waste management for big and small food service facilities. This will help to reduce contribution to already overflowing landfills and in turn, help reduce harmful methane emissions. Understanding current food waste disposal trends will help guide facilities to the appropriate food waste handling strategy. This study will also help to educate consumers and businesses on the importance of food waste prevention and give data on accepted procedures to diminish food squander. Finally, through a cost comparison of each of the food waste handling methods, this study will determine an environmentally and Monetarily reasonable ways to deal with food squander the board. This will provide definitive guidance on proper food waste handling which ultimately leads to lesser food waste generation.

Importance of Repurposing Food Scrapes

### 15. Conclusion:-

A lot of food waste is thrown into garbage cans by humans every day. Since it is a diverse source of nutrients, improper disposal of food waste and its processing can be harmful to the environment. These include, but are not limited to, air pollution (CO<sub>2</sub> emissions), eutrophication, and acidification, as well as others. Full utilization of food waste and safe animal feeding is an efficient action toward a potentially less stressed environment. A good example of a management policy is that food remains are used primarily to feed animals rather than feeding humans directly. However, healthy production of livestock anywhere in the world requires technically approved production methods and officially approved quality feed production. Various technologies have been invented that are used to convert food waste into various types of dry and liquid fodder that are destined for animals. Replacing food waste with commercially produced fodder as animal feed not only reduces the cost of livestock production but will also contribute to the growth of our local economy. Converting leftover food into animal fertilizers is another step in an emerging circle community aimed at safe development. “Unfortunately however, certification and quality control teams for both types of wasted foods must be very aware of the entity involved, including identifying different manifestations of the food before it is transformed into feed and after the process is complete. Furthermore, industry reports from associations, for example, the Food and Farming Association of the Gathering Nations, show the financial and ecological benefits of reusing wasted food in animal feed, reducing landfill-related natural impacts, and managing Emphasizes its potential to link rural practices. Research in the field of sustainable agribusiness has examined imaginative approaches to reusing wasted food as animal feed, combining both nature conservation and asset productivity.

### References

1. Ishangulyyev, R.; Kim, S.; Lee, S.H. Understanding food loss and waste—Why losing and wasting food? *Foods* 2019, 8, 297.
2. Li, M.; Jia, N.; Lenzen, M.; Malik, A.; Wei, L.; Jin, Y.; Raubenheimer, D. Global food miles account for nearly 20% of total food-systems emissions. *Nat. Food* 2022, 3, 445–453.
3. Hoang, A.T.; Varbanov, P.S.; Nižetić, S.; Sirohi, R.; Pandey, A.; Luque, R.; Ng, K.H. Perspective review on Municipal Solid Waste-to-energy route characteristics, management strategy, and role in circular economy. *J. Clean. Prod.* 2022, 359, 131897.
4. Elechi, J.O.G.; Nwiyi, I.U.; Adamu, C.S. Global food system transformation for resilience. In *Food Systems Resilience*; Intech open: London, UK, 2022
5. Abeliotis, K.; Lasaridi, K. Food Waste Prevention: Reduction, Reuse, and Recycling. *Resources* 2022, 12.

6. Conrad, Z.; Blackstone, N.T. Identifying the links between consumer food waste, nutrition, and environmental sustainability: A narrative review. *Nutr. Rev.* 2021, 79, 301–314.
7. Brennan, A.; Browne, S. Food waste and nutrition quality in the context of public health: A scoping review. *Int. J. Environ. Res. Public Health* 2021, 18, 5379.
8. Schanes, K.; Dobernig, K.; Gözet, B. Food waste matters—A systematic review of household food waste practices and their policy implications. *J. Clean. Prod.* 2018, 182, 978–991.
9. Wu, G.; Bazer, F.W.; Cross, H.R. Land-based production of animal protein: Impacts, efficiency, and sustainability. *Ann. N. Y. Acad. Sci.* 2014, 1328, 18–28.
10. Esteban, J.; Ladero, M. Food waste as a source of value-added chemicals and materials: A biorefinery perspective. *Int. J. Food Sci. Technol.* 2018, 53, 1095–1108.
11. Miranda, C.D.; Cammack, J.A.; Tom Berlin, J.K. Life-history traits of the black soldier fly, *Hermetia illucens* (L.) (Diptera: Stratiomyidae), reared on three manure types. *Animals* 2019, 9, 281.
12. Edwards, F. Food Waste Activism in Australia. In *Food Resistance Movements: Journeying through Alternative Food Networks*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 29–48.
13. Castrica, M.; Rebucci, R.; Giromini, C.; Tretola, M.; Cattaneo, D.; Baldi, A. Total phenolic content and antioxidant capacity of agri-food waste and by-products. *Ital. J. Anim. Sci.* 2019, 18, 336–341.
14. Messner, R.; Johnson, H.; Richards, C. From surplus-to-waste: A study of systemic overproduction, surplus, and food waste in horticultural supply chains. *J. Clean. Prod.* 2021, 278, 123952.
15. Gonçalves, M.L.M.; Maximo, G.J. Circular Economy in the Food Chain: Production, Processing and Waste Management. *Circ. Econ. Sustain.* 2022, 1–19.
16. Liu, C.; Mao, C.; Bunditsakulchai, P.; Sasaki, S.; Hotta, Y. Food waste in Bangkok: Current situation, trends and key challenges. *Resour. Conserv. Recycle.* 2020, 157, 104779
17. Caldeira, C.; Barco, H.; De Laurentiis, V.; Sala, S. Review of Studies on Food Waste Accounting at Member State Level; Publications Office of the European Union: Luxembourg, 2019.
18. Rajeh, C.; Saoud, I.P.; Kharroubi, S.; Naalbandian, S.; Abiad, M.G. Food loss and food waste recovery as animal feed: A systematic review. *J. Mater. Cycles Waste Manag.* 2021, 23, 1–17.
19. Rohini, C.; Geetha, P.; Vijayalakshmi, R.; Mini, M.; Pasupathi, E. Global effects of food waste. *J. Pharmacogn. Phytochem.* 2020, 9, 690–699.
20. Truong, L.; Morash, D.; Liu, Y.; King, A. Food waste in animal feed with a focus on use for broilers. *Int. J. Recycl. Org. Waste Agric.* 2019, 8, 417–429.
21. Pinto, J.; Boavida-Dias, R.; Matos, H.A.; Azevedo, J. Analysis of the food loss and waste valorization of animal by-products from the retail sector. *Sustainability* 2022, 14, 2830.
22. Gadisa, B.; Taffa, G. Assessment of beef cattle production, slaughtering and marketing practice in Haramaya University, Ethiopia. *World* 2019, 3, 26–31.
23. Patsios, S.I.; Dedousi, A.; Sossidou, E.N.; Zdragas, A. Sustainable animal feed protein through the cultivation of *Yarrowia lipolytica* on agro-industrial wastes and by-products. *Sustainability* 2020, 12, 1398.
24. Wang, Y.; Levis, J.W.; Barlaz, M.A. Life-Cycle Assessment of a regulatory compliant US municipal solid waste landfill. *Environ. Sci. Technol.* 2021, 55, 13583–13592.
25. Erickson, M.C. Microbiological Associated Vegetables, with Nuts, Fruits, Issues and Grains. In *Food Microbiology: Fundamentals and Frontiers*; ASM Press: Washington, DC, USA, 2020; p. 179.
26. Bunditsakulchai, P.; Liu, C.J. Integrated strategies for household food waste reduction in Bangkok. *Sustainability* 2021, 13, 7651.
27. Bhatia, L.; Jha, H.; Sarkar, T.; Sarangi, P.K. Food Waste Utilization for Reducing Carbon Footprints towards Sustainable and Cleaner Environment: A Review. *Int. J. Environ. Res. Public Health* 2023, 20, 2318.
28. Afreen, M.; Ucak, I. Fish processing wastes used as a feed ingredient for animal feed and aquaculture feed. *J. Surv. Fish. Sci.* 2023, 6, 55–64.
29. Bulgakov, V.; Sevostianov, I.; Kaletnik, G.; Babyn, I.; Ivanovs, S.; Holovach, I.; Ihnatiev, Y. Theoretical studies of the vibration process of the dryer for waste of food. *Rural Sustain. Res.* 2020, 44, 32–45.
30. Song, D.B.; Lim, K.H.; Jung, D.H.; Yoon, J.H. Analysis of drying characteristics and cost of high-capacity vacuum-drying food waste disposal system using steam. *J. Biosyst. Eng.* 2020, 45, 126–132.

31. Filková, I.; Mujumdar, A.S. Industrial spray drying systems. In *Handbook of Industrial Drying*; CRC Press: Boca Raton, FL, USA, 2020; pp. 263–307
32. Despoudi, S.; Bucatariu, C.; Otles, S.; Kartal, C. Food waste management, valorization, and sustainability in the food industry. In *Food Waste Recovery*; Elsevier: Amsterdam, The Netherlands, 2021; pp. 3–19.
33. Betz, A.; Buchli, J.; Göbel, C.; Müller, C.J. Food waste in the Swiss food service industry—Magnitude and potential for reduction. *Waste Manag.* 2015, 35, 218–226.
34. RedCorn, R.; Fatemi, S.; Engelberth, A.S. Comparing end-use potential for industrial food-waste sources. *Engineering* 2018, 4, 371–380.
35. Goodman-Smith, F.; Miroso, M.; Skeaff, S.J. A mixed-methods study of retail food waste in New Zealand. *Food Policy* 2020, 92, 101845.
36. Abdel-Shafy, H.I.; Mansour, M.S.J.E.j.o.p. Solid waste issue: Sources, composition, disposal, recycling, and valorization. *Egypt. J. Pet.* 2018, 27, 1275–1290.
37. Hoka, A.I.; Gicheru, M.; Otieno, S. Effect of cow parity and calf characteristics on milk production and reproduction of Friesian dairy cows. *Exp. Anim.* 2019, 9.
38. Suri, S.; Singh, A.; Nema, P.K. Current applications of citrus fruit processing waste: A scientific outlook. *Appl. Food Res.* 2022, 2, 100050.
39. Ogana, G.; Abang, F.; Carew, S. Effect of Cocoa Husk Meal Based Diets on the Growth Performance and Nutrient Digestibility of Weaned Rabbits. *Am. Res. J. Humanit. Soc. Sci.* 2020, 3, 1–9
40. Ahmad, F.; Tauqir, N.; Faraz, A.; Asghar, I.; Wadood, F.; Tahir, M.; Mujahid, M. Performance of Lactating Sahiwal Cows Fed Corn Stovers Ensiled with Molasses, Urea and Lime Solution. *Iran. J. Appl. Anim. Sci.* 2021, 11, 59–66.
41. Hifizah, A. Horticultural Harvest Waste as an Alternative Feed with Anti-Methanogenic Properties for Ruminants: In Vitro Evaluation. Ph.D. Thesis, University of Western Australia, Perth, Australia, 2019.
42. Wang, H.; Xu, J.; Sheng, L. Study on the comprehensive utilization of city kitchen waste as a resource in China. *Energy* 2019.
43. Banožić, M.; Vladić, J.; Banjari, I.; Velić, D.; Aladić, K.; Jokić, S. Spray Drying as a Method of Choice for Obtaining High-Quality Products from Food Wastes—A Review. *Food Rev. Int.* 2021, 1–33.
44. Brancoli, P.; Bolton, K.; Eriksson, M. Environmental impacts of waste management and valorization pathways for surplus bread in Sweden. *Waste Manag.* 2020, 117, 136–145.
45. Janmaat, K.R.; Ban, S.D.; Boesch, C. Chimpanzees use long-term spatial memory to monitor large fruit trees and remember feeding experiences across seasons. *Anim. Behav.* 2013, 86, 1183–1205.
46. Difonzo, G.; Troilo, M.; Squeo, G.; Pasqualone, A.; Caponio, F. Functional compounds from olive pomace to obtain high-added value foods—A review. *J. Sci. Food Agric.* 2021, 101, 15–26.
47. Tropea, A.; Potorti, A.G.; Lo Turco, V.; Russo, E.; Vadalà, R.; Rando, R.; Di Bella, G. Aquafeed production from fermented fish waste and lemon peel. *Fermentation* 2021, 7, 272.
48. Qian, L.; Zhang, H. Controlled freezing and freeze drying: A versatile route for porous and micro-/nano-structured materials. *J. Chem. Technol. Biotechnol.* 2011, 86, 172–184.
49. Assegehegn, G.; Brito-de la Fuente, E.; Franco, J.M.; Gallegos, C. The importance of understanding the freezing step and its impact on freeze-drying process performance. *J. Pharm. Sci.* 2019, 108, 1378–1395.
50. Korolev, A.; Leisner, T.J.A.C. Review of experimental studies of secondary ice production. *Atmos. Chem. Phys.* 2020, 20, 11767–11797.
51. Khalida, A.; Arumugam, V.; Abdullah, L.C.; Abd, L. Dehydrated Food Waste for Composting: An Overview. *Sci. Technol* 2022, 30, 2933–2960.
52. Wheeler, R.R., Jr.; Hadley, N.M.; Dahl, R.W.; Williams, T.W.; Zavala, D.B., Jr.; Akse, J.R.; Fisher, J.W. Microwave enhanced freeze drying of solid waste. *SAE Trans.* 2007, 116, 510–537.
53. Nayak, A.; Bhushan, B.J. An overview of the recent trends in the waste valorization techniques for food wastes. *J. Environ. Manag.* 2019, 233, 352–370.
54. Karam, M.C.; Petit, J.; Zimmer, D.; Djantou, E.B.; Scher, J. Effects of drying and grinding in production of fruit and vegetable powders: A review. *J. Food Eng.* 2016, 188, 32–49.
55. Stanton, R.; Morrissey, C.A.; Clark, R.G.J. Analysis of trends and agricultural drivers of farmland bird declines in North America: A review. *Ecosyst. Environ.* 2018, 254, 244–254.

56. Wilkinson, J.; Rinne, M.J.G.; Science, F. Highlights of progress in silage conservation and future perspectives. *Grass Forage Sci.* 2018, 73, 40–52.
57. MacLaren, C.; Storkey, J.; Menegat, A.; Metcalfe, H.; Dehnen-Schmutz, K. An ecological future for weed science to sustain crop production and the environment. A review. *Agron. Sustain. Dev.* 2020, 40, 24.
58. Henderson, N. Silage additives. *Anim. Feed. Sci. Technol.* 1993, 45, 35–56.
59. Wilkanowska, A.; Kokoszyński, D. Effect of diet and physical activity of farm animals on their health and reproductive performance. In *Handbook of Fertility*; Elsevier: Amsterdam, The Netherlands, 2015; pp. 159–171.
60. Shinde, A.; Mahanta, S.K. Nutrition of small ruminants on grazing lands in dry zones of India. *Range Manag. Agrofor.* 2020, 41, 1–14.
61. Iori, E.; Masotti, M.; Falasconi, L.; Risso, E.; Segrè, A.; Vittuari, M. Tell Me What You Waste and I'll Tell You Who You Are: An Eight-Country Comparison of Consumers' Food Waste Habits. *Sustainability* 2023, 15, 430.
62. Katajajuuri, J.-M.; Silvennoinen, K.; Hartikainen, H.; Heikkilä, L.; Reinikainen, A. Food waste in the Finnish food chain. *J. Clean. Prod.* 2014, 73, 322–329.
63. Giamouri, E.; Papadomichelakis, G.; Pappas, A.C.; Simitzis, P.E.; Galliou, F.; N.; Zentek, J.; Lasaridi, K.; Fegeros, K.; Manios, T. Meat Quality Traits as Affected by the Dietary Inclusion of Food Waste in Finishing Pigs. *Sustainability* 2022, 14, 6593.
64. Giamouri, E.; Pappas, A.C.; Papadomichelakis, G.; Simitzis, P.E.; Manios, T.; Zentek, J.; Lasaridi, K.; Tsiplakou, E.; Zervas, G. The Food for Feed Concept: Redefining the Use of Hotel Food Residues in Broiler Diets. *Sustainability* 2022, 14, 3659.
65. Hilborn, R.; Banobi, J.; Hall, S.J.; Pucylowski, T.; Walsworth, T.E. The environmental cost of animal source foods. *Front. Ecol. Environ.* 2018, 16, 329–335.
66. Banaeian, N.; Zangeneh, M. Study on energy efficiency in corn production of Iran. *Energy* 2011, 36, 5394–5402.
67. Padam, B.S.; Tin, H.S.; Chye, F.Y.; Abdullah, M.I. Banana by-products: An under-utilized renewable food biomass with great potential. *J. Food Sci. Technol.* 2014, 51, 3527–3545.
68. Manju Wadhwa, M.W.; Bakshi, M.P.; Makkar, H.P. Waste to worth: Fruit wastes and by-products as animal feed. *CABI Rev.* 2015, 2015, 1–26.
69. Kumar, S.; Sangwan, P.; Dhankhar, R.M.V.; Bidra, S. Utilization of rice husk and their ash: A review. *Res. J. Chem. Env. Sci* 2013, 1, 126–129.
70. Siva Sankari, M.; Vivekanandhan, S.; Misra, M.; Mohanty, A. Oil Cakes as Sustainable Agro-Industrial Feedstock for Biocarbon Materials. *ChemBioEng Rev.* 2022, 9, 21–41.
71. Bampidis, V.; Robinson, P. Citrus by-products as ruminant feeds: A review. *Anim. Feed Sci. Technol.* 2006, 128, 175–217.
72. Katileviciute, A.; Plakys, G.; Budreviciute, A.; Onder, K.; Damiani, S.; Kodzius, R. A sight to wheat bran: High value-added products. *Biomolecules* 2019, 9, 887.
73. Ubalua, A. Cassava wastes: Treatment options and value addition alternatives. *Afr. J. Biotechnol.* 2007, 6, 2065–2073.
74. Mazzafera, P. Degradation of caffeine by microorganisms and potential use of decaffeinated coffee husk and pulp in animal feeding. *Sci. Agric.* 2002, 59, 815–821.
75. Wilkinson, J.; Young, R. Strategies to reduce reliance on soya bean meal and palm kernel meal in livestock nutrition. *J. Appl. Anim. Nutr.* 2020, 8, 75–82.
76. Habeeb, A.; Gad, A.; El-Tarabany, A.; Mustafa, M.; Atta, M. Using of sugar beet pulp by-product in farm animals feeding. *Int. J. Sci. Res. Sci. Technol* 2017, 3, 107–120.
77. Mottet, A.; Tempio, G. Global poultry production: Current state and future outlook and challenges. *World's Poult. Sci. J.* 2017, 73, 245–256.
78. Van Huis, A.; Oonincx, D.G. The environmental sustainability of insects as food and feed. A review. *Agron. Sustain. Dev.* 2017, 37, 43.
79. van Hal, O. *Upcycling Biomass in a Circular Food System: The Role of Livestock and Fish*. Ph.D. Thesis, Wageningen University and Research, Wageningen, The Netherlands, 2020.

80. Iqbal, N.; Luqman, Z.; Jawad, H.; Aslam, S.; Farhab, M. Socio-economic impact of COVID-19 on livestock. In *Veterinary Pathobiology Public Health*; Unique Scientific Publishers: Faisalabad, Pakistan, 2021; p. 396.
81. Anthony, O.C. Implementation of Vision 20: 2020 agricultural policy and food production in Nigeria, 2007–2015. *Int. J. Res. Innov. Soc. Sci.* 2019, 3, 42–64.
82. Suplicy, F.M. A review of the multiple benefits of mussel farming. *Rev. Aquac.* 2020, 12, 204–223.
83. Ryen, E.G.; Babbitt, C.W.J. The role of US policy in advancing circular economy solutions for wasted food. *J. Clean. Prod.* 2022, 369, 133200.
84. Munesue, Y.; Masui, T. The impacts of Japanese food losses and food waste on global natural resources and greenhouse gas emissions. *J. Ind. Ecol.* 2019, 23, 196–1210

