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Economic Livestock Production Through Food Waste Feeding

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Food waste is a substance basically linked to food security. Globally, an estimated 1.3 billion tons of food for humans is lost and wasted each year (Gustavsson *et al*., 2011). For achieving global food security, reducing food loss and waste (FLW) essentially has to play a key role. It is estimated that by using less than a quarter of the food wasted, the approximate global population of 1 billion hungry people could be freed from malnutrition (Lim *et al*.2017). To sustainably meet the growing food demand amid climate change and dwindling resources, enhancing the utilization of food produced and cutting down waste is a necessity (Foley *et al.*, 2011). Food waste occurs at every stage of the food system from farm to fork (Xue *et al.*, 2017). Historically, feeding food waste and food production residuals to livestock animals has long been practiced in many parts of the world (Westendorf, 2000). However, the age-old practice lost its popularity with the advent of intensive animal feeding operations, which now operate with precision feeding using feed grains such as maize and soybeans for maximum productivity (Banhazi *et al.*, 2012). Utilizing food loss and waste in animal diets addresses waste management, food security, resource and environmental challenges. Livestock as “up-cyclers” play a critical role in the solution to reducing food loss and waste, with the potential to convert inedible foods into high-quality protein in the form of meat, eggs, and milk, while addressing waste management, food security, resource and environmental challenges (Dou *et al.*, 2018). Food waste arises from food processors, restaurants, households, and food markets. Some food waste can go directly to livestock farms as feed, whereas others require secondary processing where they are separated from waste, subject to further processing. Streams that are suitable as feed are used on livestock farms, those designated as unsuitable may be directed toward composting or bio digestion. Plants that produce bioethanol and vegetable oils produce

distillers' grains and oilseed meals, which can be used directly by livestock as an important source of energy and protein. A number of feed sources resulting from the regional processing of crops are often substituted for a portion of the cereal grain in animal diets, many of which have been characterized by Lardy *et al.* (2015). Milling of wheat to flour produces bran and germ or a mixture of by-products that can be offered to livestock as wheat middlings. Similarly, the hulls of primary crops such as oats, soybeans, and sunflowers may be removed during processing and are frequently used as a fiber source in ruminant diets. Processing by-products of fruits and vegetables including potatoes are also available for utilization in livestock diets. Any effort to divert food that does not meet quality standards for humans or is recovered prior to disposal in landfills must ensure that animal, human, and environmental health is uncompromised. Some of these agro-industrial residues from cereals, husks and peels of crops, peels and pulps of fruits, vegetable wastes, and bagasse are usually used in their raw state to produce many agro-based bioproducts including animal feed.

An increase in industrialization and globalization, coupled with population growth, has contributed immensely to the upsurge in agricultural and industrial activities around the world (Aruna *et al.*,2017. As a result of this upsurge, large quantities of agro-industrial food wastes are generated annually from domestic and commercial farms, as well as food processing industries (Sadh *et al*.,2018). These agro-industrial wastes represent one-third of the world's agricultural produce, which is equivalent to 1.3 billion tons of food produced for human consumption, and with an economic loss of € 800 bn, according to the United Nations Environment Programme (2021).

Animal feeds produced from chemical and mechanical processes include (i) Selection of feed ingredients for formulation of compound feed (i.e., various feed ingredients are mixed in proper ratio and additives to form diet according to the requirements of the animal), (ii) a green and dry fodder (hays, pasture, straw and silage) or (ii) a mixture of raw agro-industrial wastes/ by products. Animal feed provides nutritional requirements for animals for specific purposes. However, the presence of anti-nutritional factors (ANFs), such as hydrogen cyanide, caffeine, oxalates, phytates, tannins, polyphenols, and saponins, hinders nutrient availability and digestibility within foods, feeds, and agro-industrial wastes. Therefore, to reduce ANFs present in feed/fodder and to enhance nutritional quality as well as digestibility certain chemical/ mechanical treatment should be done before providing to the animal for optimum utilization.

According to Nath *et al.* (2023) Food Waste can be classified as follows: (i) Agro Food Wastes-that comes from farmers, (ii) Industrial Food Wastes-generated by wholesalers, (iii) Market Food Wastes-fresh and uncooked food made by secondary distributors, (iv) Hotel and restaurant Food

Wastes-additionally generated by secondary distributors in the form of cooked products, and (v) Domestic Food Wastes-generated by customers. Food Waste is divided into three types based on its physical state: Solid Food Wastes, Semisolid Food Wastes, and Liquid Food Wastes.

Benefits of Reducing Food Waste

- Reduction in cost on labour through more efficient handling, preparation, and storage of food that is generally used.
- Cost savings when purchasing only as much food as needed, and avoiding additional costs of disposal.
- Reduced methane emissions from landfills and a lower carbon footprint.
- Better management of energy and resources, preventing pollution involved in the growing, manufacturing, transporting, and selling of food.
- Community benefits by providing donated, untouched, and safe food that would otherwise be thrown out.
- Better utilization of resources involved in food production.
- Increased availability of food

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