



Waste-to-Feed: Turning Agro-food By-products into Safe Animal Feed

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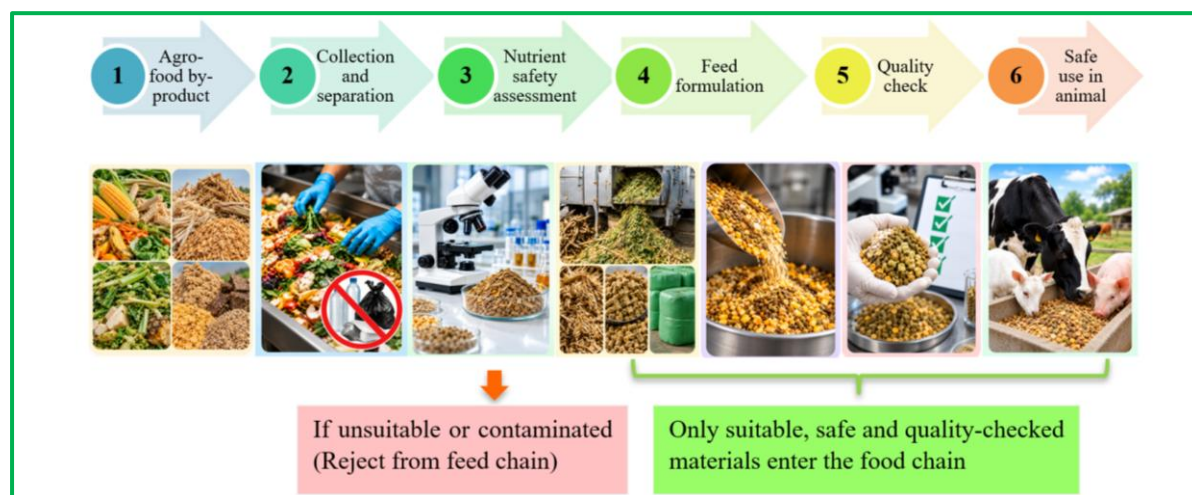
Large quantities of crop residues, food-processing by-products and surplus fruits and vegetables are generated every day. At the same time, feed is a major recurring cost in livestock and poultry production. Some of these materials still contain valuable nutrients and can be used as feed resources when they are properly selected, handled and processed. The opportunity is not simply to use waste as feed, but to recover useful nutrients safely and put them back into livestock production. This can help reduce avoidable waste, add to local feed resources and, where the supply and market are suitable, create opportunities for additional income and small rural enterprises.

Keywords: Circular bioeconomy, Feed safety, Resource recovery, Rural enterprise, Waste valorization

Livestock farming depends on a regular supply of feed, and the cost of feeding can strongly influence the returns from milk, meat and egg production. For many farmers, maintaining an adequate supply of feed throughout the year is also a challenge because the availability and price of conventional feed resources vary with season and location. At the same time, India generates large quantities of crop residues and by-products from milling, oilseed processing, fruit and vegetable markets, food-processing units and other agro-industries. A part of this material is already used as animal feed, but many other by-products are discarded, left to spoil or used without proper assessment of their feeding value. This represents both a resource loss and a missed opportunity. Some by-products contain useful amounts of energy, protein, fibre or minerals and can contribute to animal diets when their quality and safety are known. However, availability alone does not make a material suitable for feeding. The idea of waste-to-feed therefore needs to be understood differently. It is not about collecting whatever is discarded and feeding it to animals. It is about identifying suitable materials, keeping them separate from contaminants, assessing their nutritional and safety characteristics, applying appropriate processing where required, and incorporating them into a balanced ration. The approach can also create value beyond the farm gate: suitable materials may support local collection, processing, feed-ingredient supply and other small rural enterprises.

Which agro-food by-products can be considered for feed use?

Agro-food by-products are not a single group of materials. Their feeding value can differ widely, even when they come from the same type of crop or industry. Wheat bran is different from vegetable trimmings, and an oil cake is different from a crop residue. Therefore, the first step is to know what the material contains and whether it is suitable for the animal for which it is intended.



Practical pathway for converting suitable agro-food by product into a safe feed ingredient

Common materials that may be considered include cereal brans and broken grains, oil cakes and meals, selected fruit and vegetable by-products, suitable bakery and food-processing residues, brewer's grains and properly handled crop residues. Some can contribute energy or protein, while others mainly provide fibre or roughage. Their actual value depends on nutrient composition, moisture, digestibility, storage condition and possible contaminants.

For farmers, the important point is simple: do not select a by-product only because it is available or cheap. First ask where it came from, whether it has been kept clean, how quickly it spoils, what nutrients it supplies and whether it suits the animal's ration.

Table 1. Common agro-food by-products and key considerations for feed use

Source	Examples	Possible feed role	Key consideration
Cereal processing	Wheat bran, rice bran, broken grains, maize by-products	Energy and/or fibre contribution	Check nutrient quality, moisture and storage condition
Oilseed processing	Oil cakes and meals	Protein contribution	Quality variation and anti-nutritional factors require attention
Fruits and vegetables	Fruit pulp, peels, trimmings, selected surplus produce	Energy and other nutrients, depending on composition	High moisture and rapid spoilage may limit storage
Bakery and food processing	Selected bread and cereal-based residues	Energy contribution	Must be free from mould, packaging and other contaminants
Brewery and agro-industries	Brewer's grains and selected processing residues	Protein and fibre contribution	Moisture, storage life and nutrient variation are important
Crop production	Suitable straw, stover and other plant residues	Roughage/fibre resource, particularly for ruminants	Digestibility and treatment requirements vary

Safety comes before savings

A by-product may look inexpensive, but cheap does not always mean safe or economical. Materials collected from markets, farms or processing units can become contaminated during harvesting, handling, transport or storage. Moulds and mycotoxins, chemical residues, harmful microorganisms and foreign materials such as plastic, glass or metal can make a feed material unsafe.

For farmers, the safest approach is to start checking the material at the source. Suitable by-products should be collected separately and kept away from mixed waste. They should be transported and stored under clean, dry conditions and protected from rain, moisture and other

sources of contamination. Materials that are mouldy, rotten, visibly contaminated or mixed with non-feed materials should be rejected.

Processing cannot solve every safety problem. Drying, heating or fermentation may help manage particular risks in suitable materials, but they should not be used as a way to rescue spoiled or contaminated feed. Mycotoxins, for example, may remain even after some common processing treatments.

Before introducing an unfamiliar by-product into the ration, its nutrient value, moisture and relevant safety parameters should be assessed. Where laboratory testing is needed, farmers can seek support from veterinary institutions, KVKs, feed laboratories or other appropriate technical services.

Processing adds value

Once a suitable by-product has passed the basic safety check, processing can make it easier to store, handle and use as a feed ingredient. The right method depends on the material and its characteristics.

Drying can reduce excess moisture and improve storage life. Grinding or chopping can improve uniformity and make mixing easier. Some suitable high-moisture materials can be preserved through ensiling, while fermentation or heat treatment may be useful for particular materials when carried out under suitable conditions. Processing cannot make an unsafe or contaminated material suitable for feeding. Good processing starts with a good raw material. The economics also matter. Processing should provide a clear benefit in terms of storage, handling, stability or feed use without adding more cost than the final product can justify. For small farmers, simple processing methods that can be managed locally may be more practical than sophisticated processing systems.



An Indian example: Krimanshi Technologies

A useful Indian example is Krimanshi Technologies Pvt. Ltd., Jodhpur, Rajasthan. The enterprise works with food, fruit and vegetable waste and agricultural residues and converts suitable materials into animal-feed ingredients and balanced compound feeds. The idea is straightforward: useful organic material that would otherwise be discarded can be collected, processed and put to productive use as feed.

Krimanshi began with a pilot project in Bikaner involving 30 farmers. In a 30-day trial conducted with Bahula Naturals and Urmul Seemant Samiti, 90% of the participating farmers reported an average increase of about 500 g in milk production per animal per day. About 83% also reported an increase in milk fat and SNF, while the average reported milk price increased by ₹6 per litre. These figures were based on farmers' observations after the pilot and therefore represent field-level experience rather than results from a controlled feeding trial.

The enterprise later expanded its work on converting food waste and agricultural residues into feed ingredients and balanced feeds. The ICAR-IVRI success story reports a

processing capacity of up to 40 tonnes of food waste per day, along with a network of distributors, retailers, FPOs and social enterprises.

Krimanshi also illustrates the role of institutional support in developing such enterprises. The company received ₹13 lakh through the RKVY-RAFTAAR ABI Scheme and mentorship under the IVRI Pashu Vigyan Incubator. Such support can help an emerging enterprise develop its product, test its approach and move from an initial idea towards commercial application. (Source: ICAR-IVRI, Krimanshi Success Story)



From waste collection to rural enterprise

The value of agricultural and food-based waste does not end when it is converted into feed. In many areas, these materials can also create opportunities for farmers, FPOs, self-help groups and rural youth.

Depending on local availability, opportunities may exist in collection, aggregation, storage, primary processing, feed-ingredient supply and market linkage. Not every activity requires large investments. In some situations, simple operations such as drying, storage or organized supply of suitable materials can add value and generate additional income.

However, success depends on more than the availability of raw materials. A sustainable enterprise requires a regular supply of suitable materials, quality control, efficient transport and access to reliable markets. Without these, even a technically suitable feed resource may not be economically viable.

For rural communities, the waste-to-feed approach offers an opportunity to convert underutilized materials into products that support livestock production while creating local economic activity.

The feed still has to be balanced

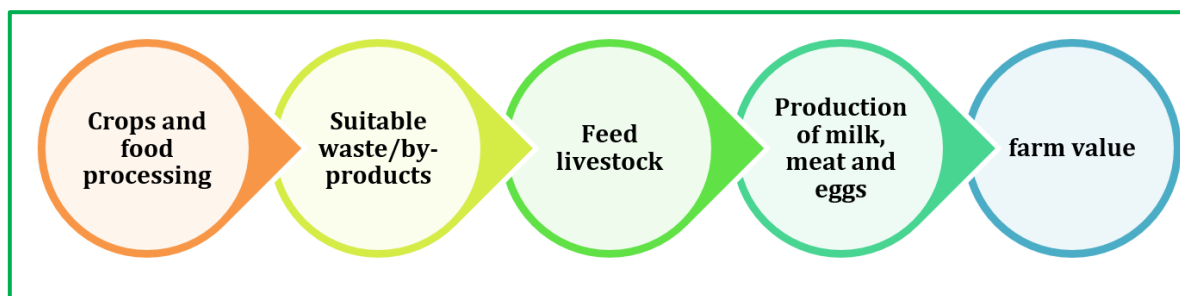
A suitable waste material or by-product is an ingredient, not automatically a complete feed. Its value depends on the nutrients it supplies and what is already present in the animal's ration. A material may provide useful energy, protein or fibre but still be short of other nutrients needed for production.

The amount that can be used also depends on the animal species, age, body weight, production stage and the rest of the ration. For example, a high-moisture material may appear cheap when purchased fresh, but it provides less dry matter per kilogram. Similarly, a fibrous crop residue may be useful as roughage for cattle or buffaloes but may not have the same feeding value for poultry.

Therefore, a new material should be introduced as part of the overall ration, rather than simply replacing another ingredient kilogram for kilogram. Its nutrient composition, moisture content, digestibility, appropriate inclusion level and effect on the cost of the complete ration should be considered.

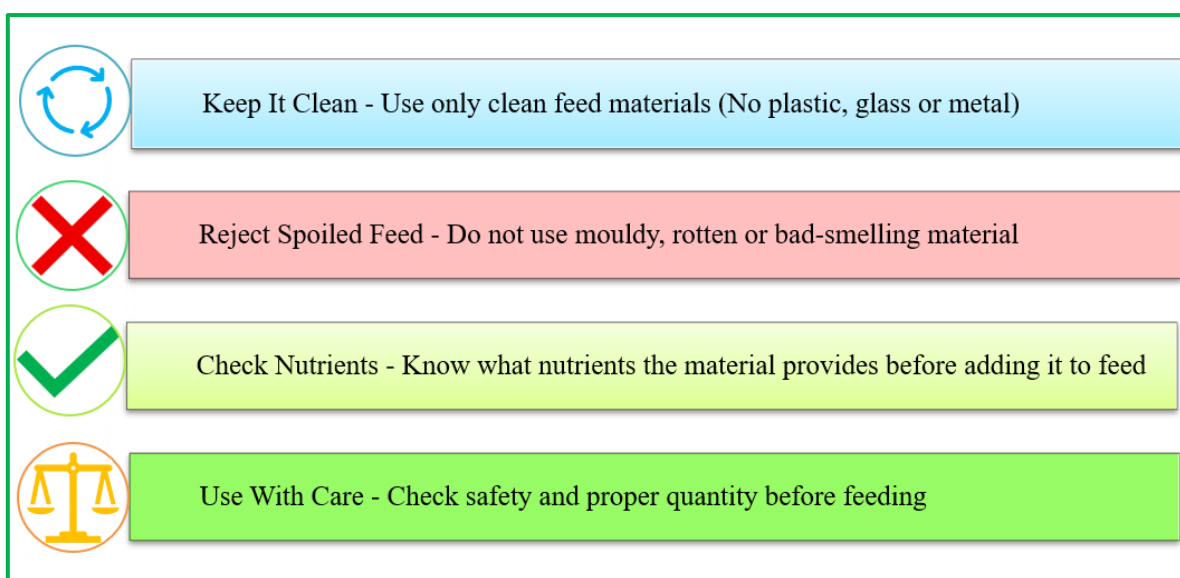
Connecting crops, markets and livestock

The waste-to-feed approach can connect crop production, food processing and livestock farming by directing suitable residues and food-processing by-products towards feed use. Livestock can then convert these feed resources into milk, meat and eggs, creating additional value for the farm. Where local supply and markets are well organized, this approach can also create opportunities for collection, processing and feed supply.



From Food Waste to Farm Value

Four GOLDEN RULES for farmers



The way forward

Turning agricultural and food wastes into feed requires more than simply finding a use for discarded materials. The focus should be on safe materials, suitable processing, balanced feeding and practical economics.

Better coordination among farmers, FPOs, food-processing units, feed manufacturers, veterinarians, KVKs, research institutions and entrepreneurs can help build reliable local supply chains. Training and simple testing facilities can also help farmers identify suitable materials and avoid unsafe ones.

With the right knowledge and support, materials that are currently underused can become useful feed resources and new rural business opportunities. The goal is not to feed every type of waste to animals, but to identify the right material, handle it safely and use it where it genuinely adds value.

Summary

Agricultural and food wastes, crop residues and processing by-products should not be viewed only as materials to be discarded. Some of them can become useful feed resources when they are properly selected, handled, processed and included in a balanced ration. Their use can help diversify feed resources, recover useful nutrients and, where local supply and markets permit, create opportunities for rural enterprises. The key is to move from “waste” to “safe and useful resource” through appropriate testing, processing and feeding practices.