



Repurposing food waste into nutritious foods

- Food waste generates 8-10% of global greenhouse gas emissions and costs the global economy nearly a trillion US dollars annually¹
- The food system's environmental footprint is expected to increase by 50–92% by 2050, threatening the achievement of global environmental goals²
- Three billion people worldwide are unable to afford the safe, nutritious foods that comprise a healthy diet³

BUSINESS MODEL FEATURES FOR REACHING LOWER-INCOME CONSUMERS WITH NUTRITIOUS FOODS

The **GAIN Business Model Research Project** aims to identify promising business models to reach lower-income consumers with nutritious foods. This brief summarises the results of a rapid review undertaken to build evidence on this topic.



Serving lower-income consumers: the business and nutrition opportunity

Lower-income consumers represent a large market, estimated at 4 billion people worldwide. Many low-income consumers' diets are lacking in food diversity and quality. There is a business opportunity for private companies to help improve this by providing safe, nutritious foods that meet customers' needs at an affordable price – as long as they do so in ways that are profitable and financially sustainable for the company.

Repurposing food waste and byproducts can offer a way to address both these challenges at once, contributing to SDG 2's aim of ending hunger and all forms of malnutrition and SDG 12's target of halving food waste.



Food wastes and byproducts are often available free or cheaply, and many are rich in nutrients – but they are seen as waste, not valorisable ways to make new nutritious food products. With the right business model in place, companies and those that support them, like enterprise support organisations (ESOs), may have opportunities for leveraging these undervalued materials to create value for customers, for the environment, and for themselves. This brief, based on a working paper by GAIN and Agramondis, showcases examples of byproducts ripe for this type of repurposing and innovation.

HIGH-POTENTIAL EXAMPLES

Fruit peels and scraps

By weight, 10-35% of a fruit is the peel and other typically discarded parts – resulting in millions of tonnes of waste each year. Fruit peels and scraps are rich in fibre and micronutrients like vitamins A and C (depending on the fruit). Instead of being discarded, they could be used in jam, infused water, smoothies, vinegar, syrups, chips, sorbet, zest for baking and cooking, salsa, tea, broth, and chutney. Once processed into flours, the uses are even broader: in breads, crackers, snack bars, biscuits, or porridges. Banana, orange, and mango are among the fruits with high potential for repurposing of peels and scraps.

Press cakes

Press cakes are the residues left over from pressing legumes, nuts, or seeds into oils or plant-based milks, like soymilk and sunflower oil. They tend to be rich in protein and fibre and sometimes contain minerals or vitamins (like calcium in soybean press cake and B vitamins in sunflower press cakes). While often used in animal feed, they can also be used to make meat replacements, in snacks, and ground into flours for use in baked goods.

¹ UNEP. Food Waste Index Report 2021.

² Springmann et al. 2018. Options for keeping the food system within environmental limits. Nature

³ FAO et al. 2020. The State of Food Security and Nutrition in the World 2020.



Cocoa bean pulp and cocoa pod husk

About 65 million MT of cocoa pods are harvested every year – but usually only the inner part of the cocoa bean, the nibs, are made into chocolate. This leaves behind the pulp that surrounds the beans as well as the husk of the bean. Both have potential uses: cocoa bean pulp can be processed into juice and used as a sweetener, while cocoa pod husk can be used to make drinks and chocolate-like products or powdered and used as a high-fibre additive to other foods.

Brewers' spent grain

Brewers' spent grain is a major (alcohol-free) byproduct of the beer-brewing industry, consisting of the residual grains (e.g., barley, wheat, or maize) left over after the fermentable sugars are extracted. It is high in protein and fibre, with some minerals such as calcium and magnesium, depending on the grain. Once dried, it can be ground and incorporated into baked goods to add protein, fibre, and minerals.



Cashew apples

A cashew apple is a fleshy, light red or yellow pear-shaped fruit, about the size of an apple, that develops from the cashew flower. For every unit volume of cashew nuts produced, there are about 10 units of cashew apples. Cashew apples are very high in vitamin C (their juice contains about six times more than orange juice), with large amounts of fibre – but they are also high in sugars. Cashew apples usually go to waste but can be used to make juice, vinegars, jam, chutney, dried snacks, and in baked goods.

Whey

Whey is a high-protein liquid produced as a byproduct of cheese production: for each kilogram of cheese, about nine litres of liquid whey are produced. Whey water can be used to make dairy-like drinks or dried to produce a protein-rich powder that also contains numerous minerals and B vitamins. This powder can be used to enrich many different types of products, such as yoghurts.



Eggshell

Discarded every time an egg is eaten and thus ubiquitous around the world, eggshells are a rich source of calcium. They can be cleaned and ground into a powder that can boost the calcium content of many dishes, like baked goods, with little change in taste or texture.

CROSS-CUTTING CONSIDERATIONS

Successfully transforming a byproduct into a safe, nutritious, and commercially viable food product requires several other steps. In particular, the byproducts need to be collected and aggregated to enable industrial processing. Since they are often widely disbursed at homes and food service locations, this creates a logistical challenge, and could make the costs of such operations infeasible – even if the cost for the waste ingredient itself is at or near zero. Finding the right way to market the products is also a challenge. While a focus on the environmental benefit might be a motivator for some, other shoppers are likely to be turned off by the idea of eating repurposed waste. Finally, using byproducts can raise certain food safety concerns – such as pesticide residues on fruit peels or bacteria in eggshells – that need to be carefully managed.

To Learn More:

Akindele et al. 2025. From Trash to Table: Opportunities for repurposing waste products into nutritious foods. GAIN Working Paper #46. <https://doi.org/10.36072/wp.46>

Nordhagen & Demmler. 2023. How do food companies try to reach lower-income consumers, and do they succeed? Insights from a systematic review. Global Food Security.

UNEP. Food Waste Index Report 2021. Nairobi: United Nations Environment Programme (UNEP)

While we hope this offered useful advice, users should always consider their company's circumstances when adopting new approaches – and make sure that they are used as part of a broader viable business model. The information featured here comes from a rapid, global review and will require additional local validation in each context.