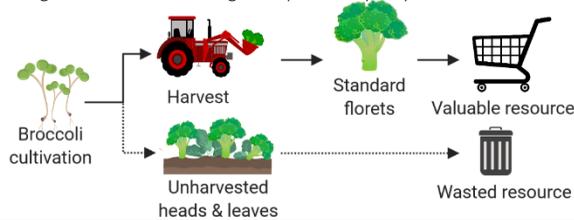




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BROCCOLI PRODUCTION

The broccoli plant in its entirety has an impressive nutritional profile, as it is packed with fiber, vitamins, antioxidants, etc. Even though the majority of the aboveground broccoli parts are edible, only 25% is harvested since primarily standard-size florets and some of the adjacent stems are considered valuable. The remaining unharvested parts are left in the field, leading to a substantial wastage of a potentially very valuable food resource.



RESOURCE RECOVERY

For many years it has been estimated that roughly one-third (1.3 billion tons) of the food produced globally is lost or wasted. However, in 2021 research showed that the global wastage of food is closer to 2.5 billion tons every year - of which roughly 1.2 billion tons origin from “on-farm losses”. Arguably, a considerable amount of food resources are not fully utilized and ultimately produced in vain, causing not only severe economic losses for farmers but also considerable environmental impact. Recovering these resources could infer important benefits compared to conventional production, and is also considered essential to maintain future food security, reduce the environmental burden related to food systems, enable a transition towards a circular food chain and support sustainable development. Owing to the increasing global population and urbanization, there's an urgent need to recover available resources to produce nutritious food items and functional ingredients.

PLANT POWER

Juice, chutney, smoothies, and flour are examples of products often produced via plant side-stream recovery. Consumers are often aware of the environmental and health benefits attributed to a plant-based diet, and many also see a high value in reduced waste and locally produced food. This awareness will likely infer an increased demand for nutritiously packed foods, preferably recovered locally.

Created by Louise Bartek
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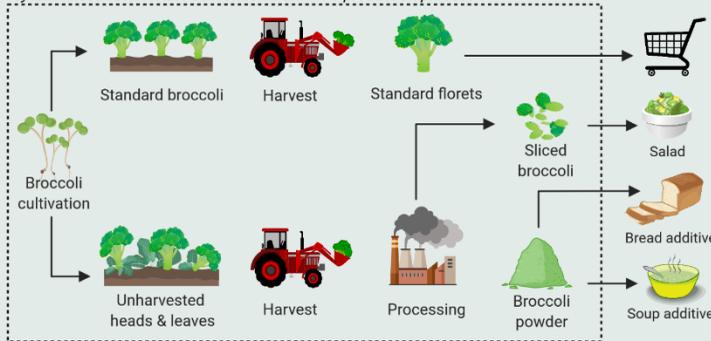
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FOOD FROM WASTE

System illustration for the conventional and new production process



Fruit and vegetables have a **high potential** to be recovered and used as **valuable side streams**, however, the environmental benefits are still unknown. This study aimed to assess the environmental impact of different products produced from unharvested broccoli parts, alongside identifying **potential benefits** of shifting to a **multi-output** broccoli production system. This was done by modeling a conventional system, alongside three alternative systems: **broccoli slices** used in salads, and **broccoli powder** used as an additive in bread and soups. Consequential and attributional life cycle assessments were conducted, based on scenarios for cultivation and production in southern **Sweden**.

Life cycle assessment (LCA) is a systematic method to gain a holistic quantification of the total **environmental impact** during a product's life cycle. The goal was to evaluate if **increased utilisation** of broccoli side streams could reduce environmental impact and contribute to more **sustainable food systems** in comparison to the current production.

ENVIRONMENTAL IMPACT

The results indicate that there are indeed potentially considerable environmental impact savings with broccoli side stream recovery. Sliced broccoli resulted in the lowest environmental impact as a stand-alone product, while broccoli powder used as a soup additive showed the lowest impact if an optimized new production substituted the conventional process.

Table 1. Environmental impact per 1 kg of collected broccoli parts

	ALCA			CLCA	
	Bread Additive	Soup Additive	Sliced Broccoli	New Production	Optimised Production
Climate change kg CO ₂ eq.	6.8×10^{-2}	-4.5×10^{-1}	-3.5×10^{-1}	-1.70×10^{-1}	-1.0×10^0

VALUE IN WASTE

Utilizing available by-products and side streams from the food supply chain could provide a profitable business opportunity for farmers and producers, alongside enabling a maintained stable supply of high-quality ingredients. Locally produced broccoli by-products in baked goods and soups also align with the increased consumer demand for plant-based food with added functional ingredients. If economic barriers and limiting consumer attitudes can be overcome, this nutritious broccoli resource could replace production of other resource-demanding products, while also enabling a higher yield per production area, improved efficiency and circularity within the food supply chain.

WHAT'S NEXT?

Want to learn more about food waste, LCA, resource recovery or our other projects? Then we invite you to follow our research on:

blogg/matsvinn.se

blogg.slu.se/foodsystem

