



## CHAPTER 7

# Supporting local food processing but moderating the consumption of ultra-processed food

Processed food and ultra-processed food (UPF) present both opportunities and challenges for food system transformation (**BOX 7.1**). Generally, as people become more urban and incomes rise, processed foods make up a growing share of diets. This evolution has some positive effects: food processing can contribute to better food safety and higher food quality. But it can also have negative effects: because more processed foods are convenient and are often less expensive, people are tempted to consume them in excess. Such overconsumption – especially of UPF – drives up health risks, increasing the incidence of overweight and obesity.

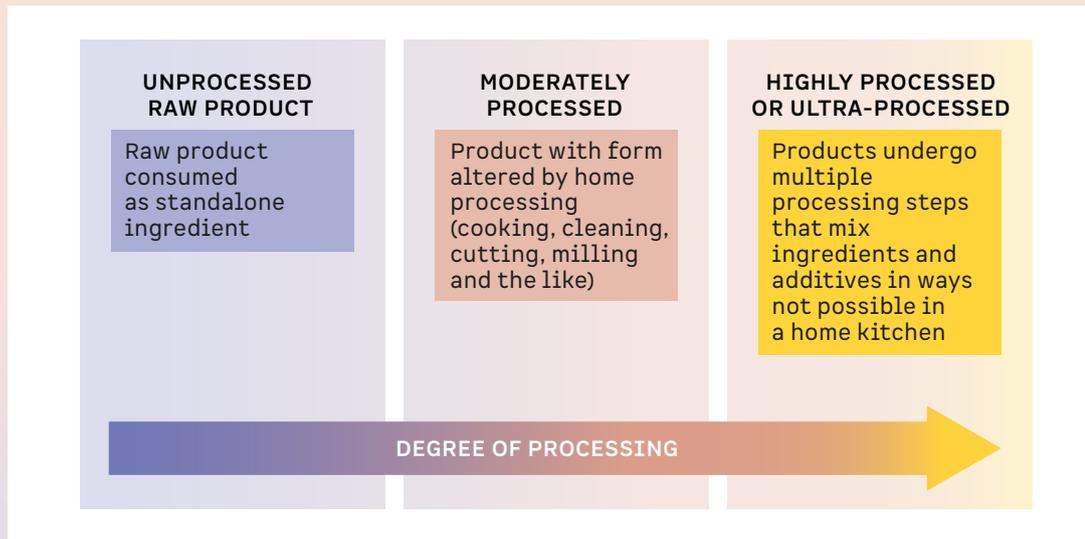
Efforts are thus needed to increase the production of processed foods, but also to manage and moderate UPF consumption. Attaining this balance depends on complex dynamics and interactions among various stakeholders in food processing, food services, and retail and consumer organizations. Policy incentives and product innovations are needed, accompanied by market regulation to create new opportunities for local entrepreneurship – and also to support balanced diets.

This chapter looks at ways to create opportunities to realize the potential for production and consumption of processed foods and UPF as part of food system transformations. How can the small-scale business potential in food processing be mobilized to improve rural and peri-urban livelihoods? What must be done to safeguard food safety and dietary quality in largely informal food markets as food processing and food services become more important? How can responsibilities for moderating the intake of processed foods be reinforced? What policy instruments are available to support responsible food processing through a conducive food environment?

### BOX 7.1 FOOD PROCESSING AND ULTRA-PROCESSED FOOD

Food processing includes all the techniques and methods – chemical and physical – that producers use to transform agricultural products into edible

foods. Such processes range from grinding grain for flour to the industrial methods that create convenience foods (van Boekel et al., 2010).



Processing provides important opportunities to preserve foods, to convert inedible raw materials into food and to convert difficult-to-prepare foods into nutritious and convenient forms (Haddad et al., 2018). However, a higher proportion of UPF in diets is often associated with excessive intakes of sugar, fats and salt, with negative effects on diet quality and health (Monteiro et al., 2019).

Processed foods and food-away-from-home services are becoming increasingly important in food systems, both for employment and

income creation and as part of household consumption expenditures. Generally, food system transformations lead to higher rates of production and consumption of processed foods, including UPF. As this shift brings both benefits and risks, it confronts policymakers with heightened trade-offs among various desired outcomes: food systems face the challenge of balancing livelihood and business opportunities, food safety, healthy diets and sustainable market integration.

*Note:* The commonly used NOVA classification, which defines foods by processing intensity, defines UPF as industrial formulations, which, besides salt, sugar, oils and fats, include substances not used in culinary preparations, particularly additives to imitate sensory qualities of minimally processed foods and their culinary preparations (Monteiro et al., 2019).

The chapter develops four key messages:

1. **Food processing provides opportunities for (youth) employment, female entrepreneurship and value added generation, and needs to be supported with training programmes and investment facilities.** Local food processing becomes increasingly important to absorb labour and create value added. It creates employment and income opportunities for women and youth, both in self-employment and in wage labour. Training programmes and investment facilities will further harness the potential of food processing for entrepreneurship in rural livelihoods, and trade policies and market regulation can reinforce the competitiveness of

- local small and medium-sized enterprises (SMEs) that are producers of moderately processed foods.
2. **Moderating consumers' intake of processed foods and UPF – preventing excessive consumption – is the way to counteract overweight and obesity risks.** Consumers increasingly prefer processed foods because they are more convenient, reduce food safety risk and prolong shelf life. But low prices easily lead to excessive consumption of convenience food with low nutritional content, especially by poorer households. With larger quantities and higher intensity, processed foods and UPF can become harmful. Public investments are thus needed in behavioural change communication (CHAPTER 1) and market incentives to moderate consumption: governments should enforce market transparency to enable balanced consumer choices.
  3. **The food industry carries substantial responsibilities to steer UPF intake by taking charge of healthier food products and sustainable processes and practices.** The private sector is in charge of most food processing, as well as of most distribution of processed foods to their various consumer constituencies through markets and food services. Quality upgrading can be supported by investments in desired product properties (including fortification), enabling responsible product innovation strategies and supporting processes for convening private and public cooperation on transparency in food markets.
  4. **Public policies and regulation can moderate UPF intake and reduce overweight and obesity risks through a conducive food environment.** Food processing offers opportunities to improve diet quality – yet the high energy, sugar, fat and salt in processed foods and UPF are associated with rising obesity in low- and middle-income countries, contributing to the triple burden of malnutrition (CHAPTER 1). To create appropriate food environments, public policies are needed that engage stakeholders in sharing responsibility for moderating UPF consumption – especially in the most vulnerable groups – and that accelerate partnerships for reducing overweight and obesity risks. To this end, economic, legal and institutional conditions must support public-private cooperation based on a mix of private-sector food innovation and public-sector food governance.

## Opportunities for youth employment, female entrepreneurship and value added generation

Food processing offers significant opportunities for developing local entrepreneurship, creating employment and generating value added in rural and peri-urban areas (**BOX 7.1**). Whereas some processed foods used to be imported, direct investments and local sourcing for food processing are increasing in response to growing urban and rural market demand. Optimizing

this potential requires low barriers to entry and supportive financial services, favourable market conditions and professional training of the labour force.

Local food processing encompasses both moderately processed foods and UPF, and it includes a wide range of activities – from self-employed street vendors and small-scale businesses to larger domestic and international food companies. Local processing ranges from milling, hand-pounding and fermentation to the more sophisticated production of frozen and canned food. Many small-scale processing activities take place in rural areas close to primary production (drying, fermentation), but industrial processing requires a larger scale and higher investments and is usually located closer to urban areas (**BOX 7.2**).

### **Creating inclusive business and employment opportunities in food processing**

The overall trend of employment in food processing varies by country income: it is fairly low in most low-income countries, rising in middle-income countries and falling in high-income countries. While food and beverage manufacturing accounts for just 3-5 per cent of food system employment across low-income eastern and southern African countries, this share increases to 25 per cent in middle-income Brazil, and it declines to 14 per cent in the high-income United States, as more employment shifts towards food services (Christiaensen, 2020). Informal SMEs dominate in all low- and middle- income countries, especially in producing moderately processed foods.

In sub-Saharan Africa, food processing today represents 30 per cent of total manufacturing sector employment, despite constituting no more than 5 per cent of food economy employment.<sup>7</sup> In Senegal, food processing is the largest manufacturing subsector, growing by 7.4 per cent a year between 2000 and 2010. In Niger and Nigeria, food processing accounts for nearly 50 per cent of all industrial activities, with many jobs in artisanal – and informal – SMEs. In Côte d’Ivoire, food processing has been found to be the second largest contributor to formal employment (14 per cent) and the largest contributor to formal-sector value added, while in 2012 food processing firms provided 18 per cent of agribusiness jobs even though they constituted just 4 per cent of all firms in the sector (Hebous and Tran, 2017).

Food processing offers significant employment and income opportunities to women in sub-Saharan Africa. Overall, 37 per cent of all female food economy workers are employed in off-farm segments, compared with 11 per cent of men. Women account for 83 per cent of total food manufacturing employment and 72 per cent of total food marketing employment (Allen et al., 2018). Informal employment in food processing tends to be low-skilled and labour-intensive, with low barriers to entry, so it provides inclusive opportunities. In rural areas,

<sup>7</sup> Across the region, off-farm activities account for 22 per cent of total food economy employment and 31 per cent of total non-farm employment. Within the off-farm portion of the food economy, food marketing activities – transport, logistics and retail – represent the largest share of employment, at 68 per cent, followed by food processing, at 22 per cent. This 22 per cent represents 4.4 per cent of the region’s food economy workforce (Allen, Heinrigs and Heo, 2018).

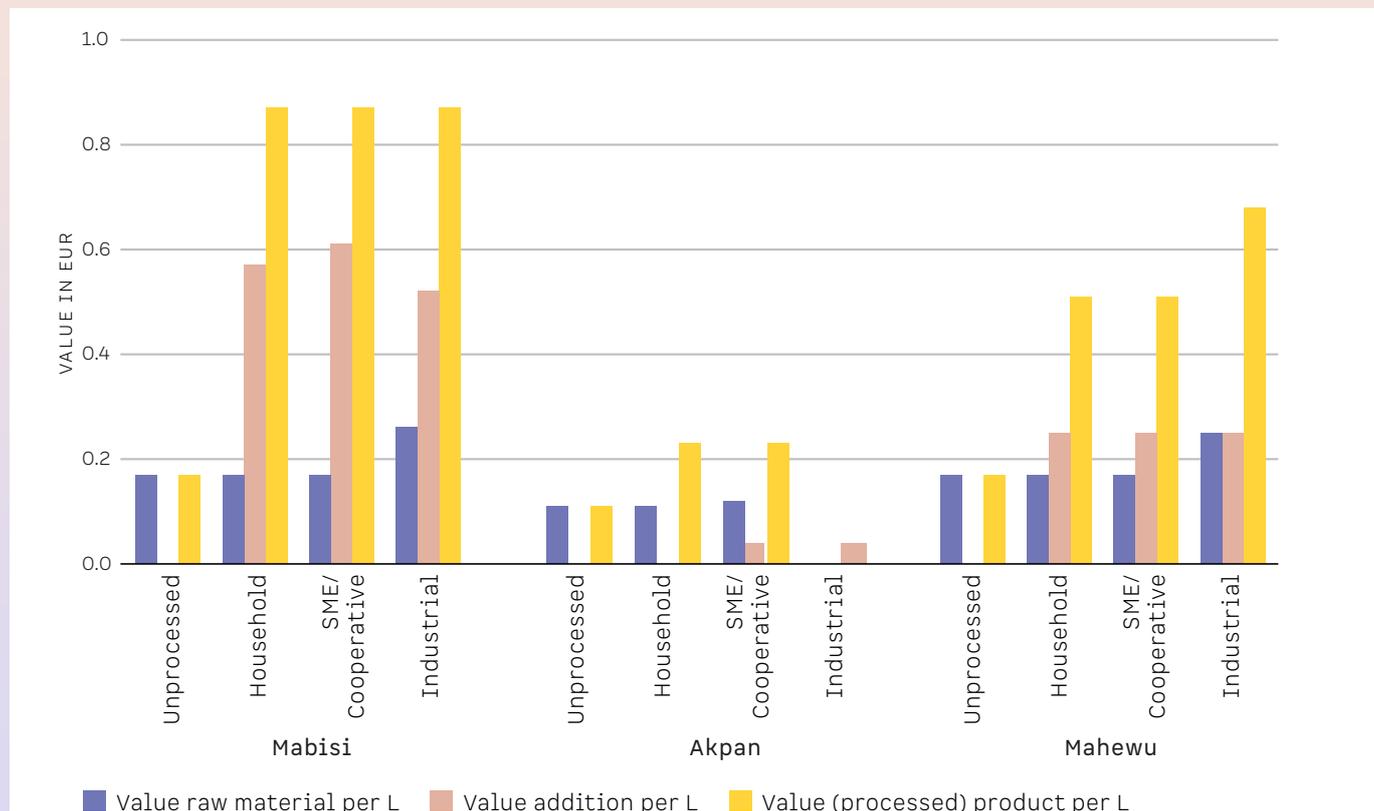
## BOX 7.2 FERMENTED FOODS FOR LIVELIHOODS AND HEALTH – ESPECIALLY IN AFRICA

In Africa especially, the agrifood sector holds great promise for bottom-up entrepreneurship. It can create jobs, generate innovations and enable the economic and social empowerment of women and youth. Many local and traditional foods are nutritious and attractive to many, yet have not reached a wider market because processing is small-scale and value chains are lacking. Among local foods, traditional fermented foods are of special interest.

Fermentation is an ancient processing technique that relies on microbial activity to transform raw

materials into attractive products with greater food safety, improved sensory attributes, increased nutritional value and health features and higher commercial value. Small-scale fermentation activities are an especially important economic opportunity for women: entry barriers and start-up costs are low, no specific assets are needed and production can be combined with domestic responsibilities. Still, traditional fermentation remains a neglected, small-scale, and underexploited practice in many countries – a missed opportunity for food security, nutrition and livelihoods.

### VALUE ADDED BY HOUSEHOLD, SMALL-SCALE AND INDUSTRIAL PROCESSING FOR THREE TRADITIONAL AFRICAN FERMENTED FOODS



Three examples of traditional fermented foods from Africa are *mabisi* (Zambia), *akpan* (Benin) and *mahewu* (Zimbabwe). These foods, which are either milk- or cereal-based, possess nutritional properties that make them highly valuable for guaranteeing food security. They also represent

Source: Matera et al., 2021.

tradition, cultural embeddedness and identity for their consumers – and an empowerment opportunity for their producers, who are mainly women. Traditional processing by households or by SMEs and cooperatives can be at least as profitable as industrial processing.

women are four times more likely than men to work in off-farm segments, while food processing and food services are almost exclusively women-led activities. More generally, many food processing activities, such as milling and brewing, are located outside primary cities, in small towns and more rural areas. Employment in food processing often maintains strong forward and backward linkages with other sectors. An initiative in India for inclusive and sustainable local fish processing is discussed in **BOX 7.3**.

Food-away-from-home activities – a category that includes street food, restaurants and other catering services – generate 10 per cent of off-farm food economy employment in sub-Saharan Africa, or 2 per cent of all food jobs. Women account for 88 per cent of the region's total food-away-from-home employment (Allen, Heinrigs and Heo, 2018). The share of food-away-from-home activities in employment is much higher in the region's urban areas, where food marketing and food-away-from-home jobs together account for 57 per cent of all food economy jobs.<sup>8</sup>

### **BOX 7.3 POST-TSUNAMI SUSTAINABLE LIVELIHOODS IN INDIA**

The fishing markets in India were devastated by the disastrous Indian Ocean tsunami in 2004. Hundreds of thousands of inhabitants in the coastal region of Tamil Nadu were displaced and left without work. Boats and equipment were destroyed, and the value chain was severely disrupted. Small-scale women processors were unable to obtain the capital to kick-start their businesses and optimize processing activities. Tamil Nadu is the fourth largest contributor to the fishing industry in India, so rehabilitating this market was an essential task for rural support in the aftermath of the tsunami.

The Government of Tamil Nadu worked in collaboration with IFAD to bring support to small-scale fishers and midstream workers in the fishing industry after the tsunami. The processing industry largely employs women, a key demographic group in the region, so female processors became a target

*Source:* IFAD project completion reports and impact assessments.

group for intervention strategies. The project was to provide sustainable coastal community activity in the fishing sector by developing enterprises and resource management systems. Expected beneficiaries included 630,000 fishers, fishing sector wage labourers, women fish processors and vendors, and other marginalized groups in Tamil Nadu.

In addition to creating 200 artificial reefs and establishing insurance plans for 35,000 small craft for small-scale fishers, project services benefited nearly 110,000 people. A large proportion of beneficiaries were women (roughly 121,000 of the 151,000 project beneficiaries). Throughout the course of the project, 72 processing facilities were created or restored, satisfying the production needs of other industries as well, such as mango pulp production and millet processing.

<sup>8</sup> These activities are closely linked to the size of food markets, and the urban contribution to food marketing and food-away-from-home employment varies widely across countries. In Côte d'Ivoire, Ghana and Senegal, urban areas account for 66 per cent of all food marketing and food-away-from-home employment, compared with 52 per cent in Burkina Faso, Mali and Niger, more than 30 per cent in Abidjan, Cotonou and Lomé, and less than 10 per cent in Bamako, Conakry and Freetown (Bricas, Tchamda and Mouton, 2016). In India, by comparison, the food processing industry accounts for 32 per cent of the country's total food market and contributes almost 9 per cent of value added in manufacturing, while constituting 13 per cent of exports and nearly 6 per cent of industrial investment.

As youth join the labour force in sub-Saharan Africa, they predominantly enter non-agricultural sectors – especially in countries with higher education enrolment rates. Moreover, youth increasingly avoid agricultural sectors as they grow older. In Côte d’Ivoire, Ghana, Nigeria and Senegal, the share of all employment in the food system but outside agriculture is 31 per cent among those aged 15-19, rising to 67 per cent for those aged 30-34. For the same age cohorts in Burkina Faso, Mali and Niger, the employment share in the food system but outside agriculture increases from 17 per cent to 31 per cent (Christaensen, 2017).

This youth transition into non-agricultural activities is increasing in size and speed. Why? One answer is that youth are attaining higher levels of education and becoming more mobile (Christaensen, 2017). Another is that they lack access to productive agricultural resources and see little to aspire to in a life of agricultural activity. To promote employment potential and diversification, they need to be equipped with the necessary skills, and they need help from efforts to lower barriers to productive resources – barriers that are substantially higher for youth, and especially young women (Dolislager et al., 2020).

Because food processing and food services require initial investments in facilities and equipment, as well as funds to buy raw materials, local entrepreneurs in these areas can benefit from financial support (CHAPTER 6). The forms of such support may include:

- Quality upgrading of local home processing.
- Start-up grants through business incubators and accelerators.
- Long-term investment grants tailored to SMEs.

Also critical are public investments in infrastructure: stable energy supplies, safe water and road access are all preconditions for sustained business growth. These investments create opportunities to reinforce circular production, improve energy efficiency and reduce water use (CHAPTER 4).

### **Encouraging local sourcing through trade policies to boost competitiveness**

In general, local processing and manufacturing can substantially increase the added value of commodity exports – examples include coffee, tea, cocoa, cotton and seafood. And although just 10 per cent of processed food products are now traded globally, processed foods represent a growing share of global food sales.

The manufacturing of processed foods is highly concentrated (**BOX 7.4**). Over the next five years, annual imports of food processing equipment for meat and poultry slaughtering and seafood processing, along with bakery and beverage equipment, and cooling facilities for dairy and vegetables, are expected to grow by 6.9 per cent annually (Allen, Heinrigs and Heo, 2018).

**BOX 7.4 CONCENTRATION IN THE MANUFACTURING OF PROCESSED FOODS**

Globally, almost 50 per cent of the food manufacturing share is controlled by just 10 transnational food and beverage companies (TFBCs), and all of these TFBCs have UPF in their portfolios (Baker et al., 2020). Regional estimates are more difficult to retrieve, especially for UPF, but indications are that TFBCs dominate regionally as well. For example, in the Asian processed food manufacturing sector, the top five food and beverage corporations are TFBCs.

For TFBCs, the most profitable option is often to source and produce processed foods in a host country, especially when the host country has the

*Source:* van Damme et al., 2021

raw materials for production (Baker et al., 2020). In spite of this, exports of processed foods from high-income to low-income countries have grown in recent years – and this growth is expected to continue. For example, since 2014, exports from the United States in the category “Food Preps. & Miscellaneous Beverages” to Ghana have nearly tripled, rising from US\$2.62 million to US\$6.75 million. And while UPF products are not always well adapted to local preferences in low- and middle-income countries, a large share of the UPF market in countries with mostly traditional food systems is controlled by TFBCs.

To maintain and expand local sourcing for processed foods, local food processing needs a level playing field – a requirement that may entail constraints on multinational food companies. Such measures can combine trade policies (import tariffs, export support) with domestic market policies to enhance rural-urban linkages, including through direct sourcing contracts with smallholder farmers. In supporting local or regional procurement, trade policies can also encourage the establishment of local subsidiaries (**BOX 7.5**). In an example of trade policy to support local sourcing, in 2019 Nigeria acted to spur local dairy production by banning access to foreign currency for milk powder imports. Another policy stimulated local sorghum sourcing by large beer breweries.

Foreign direct investment (FDI) in food processing responds to outsourcing trends in manufacturing. Many global food companies – especially in drinks and dairy – have solid investments in developing countries based on proximity to consumer markets. In some cases, their initial establishment has been facilitated by free zones that offer favourable tax conditions. South-South FDI is also becoming important for leading firms in developing countries, especially as developing countries advance in regional blocs.

Finally, higher-income countries could substantially enhance local processing opportunities in low- and middle-income countries by further reducing tariff escalation for imports.

**BOX 7.5 COMMERCIALIZING SMALLHOLDER DAIRIES IN KENYA**

Food processing is a prime aspect of the milk value chain in Kenya. Since Kenya has a varied agricultural system, its processing industry is not reliant on imports from foreign countries for sustained business. As a result, improvements in market linkages between smallholder farmers and dairy producers and the milk processing industry can benefit both sectors if done properly. Projects focused on enhancing these market linkages and commercializing the activities of smallholder producers will benefit the livelihoods of all members.

The commercialization project sought to support rural smallholder farmers in various stages of the production cycle and producer activities. It was implemented to enhance the entire milk value chain through building the organizational and enterprise capacity of beneficiaries, providing technical support for business endeavours and providing market-driven commercialization strategies. Milk processing beneficiaries were also to receive additional support through technical skills

*Source:* IFAD project completion reports and impact assessments.

training and market-driven commercialization strategies. Introducing lower-cost technologies for manure processing would provide smallholder farmers with more suitable access to the processing industry through market linkages.

Project farmers showed a significant increase in the probability for receiving information on milk processing and quality control. The number of field days, extension visits and demonstrations for dairy value chain workers increased by 18 per cent, 14 per cent and 12 per cent, respectively. Dairy groups that were part of the project benefited from increased access to investment grants for milk processing plants, and eight milk cooling or processing facilities were established. Processing became more integrated into the value chain, and market linkages between numerous production and midstream activities within the dairy value chain were bolstered. The role of the private sector became more pronounced as well: two of the largest dairy processing firms offered marketing and technical support to project dairy groups.

**Supporting livelihood generation through education and labour force training**

Education and labour force training enable the engagement of youth in non-farm processing activities. While jobs in food services require little education, food processing demands greater technical and commercial capacities. On-the-job training facilities, professional education and workforce employment standards are useful for improving food quality, enhancing labour productivity and safeguarding decent employment conditions (including a living wage).

Training in food processing can open up opportunities for individuals who lack business experience, providing them with skills such as product costing and marketing. High returns can also be reaped from technical and professional training in resource use, novel product design, handling, food safety and hygiene, shelf life extension and waste management. Labour legislation and workforce training can help upgrade industrial quality and productivity.

Training in food hygiene and safe food handling is critical, enabling handlers and vendors to control the spread of foodborne illnesses. Such training is affordable and can significantly change food safety knowledge and practices. But market incentives are also needed to encourage the full

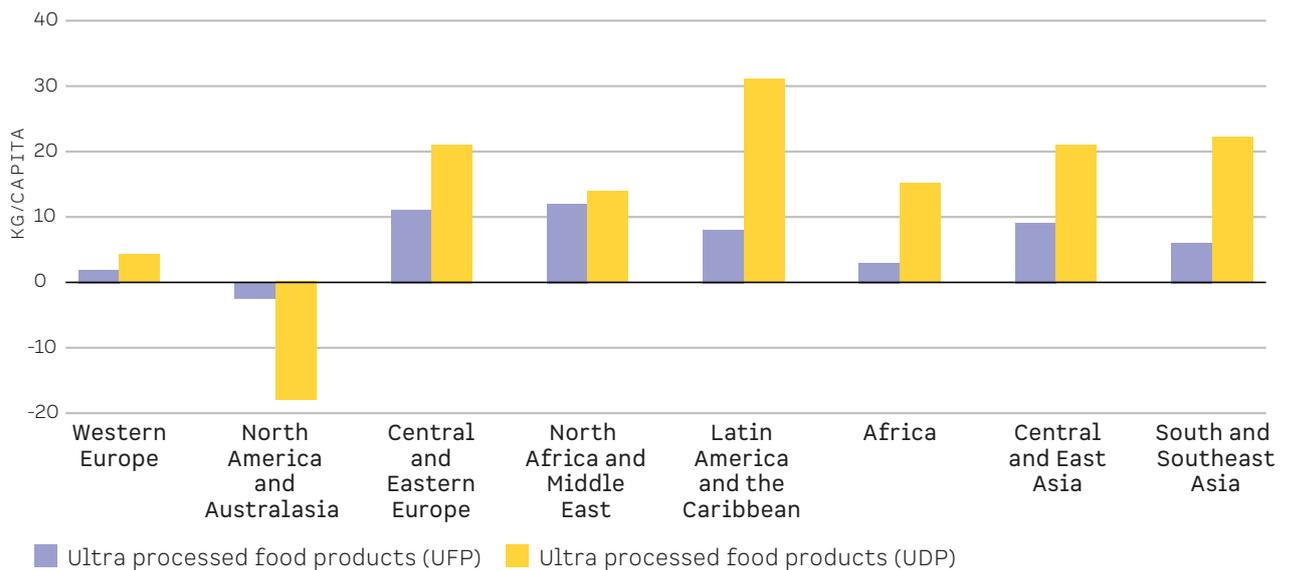
adoption of good hygiene practices – and their adoption will increase food prices (Choudhury et al., 2011).

Training in new processes – such as hazard analysis and critical control points and the labelling of quality assured food products – generally yields results. Far less successful are infrastructure investments, routine control and inspection systems, and organizational innovation. Legal enforcement tends to falter, as street vendors are harassed by authorities and forced to pay bribes. Moreover, actions to penalize street foods may reduce food access (Randolph, 2021).

## Improving nutritional content and moderating consumption

Consumer demand for processed foods and UPF is rising rapidly, thanks largely to their convenience, safety and extended shelf life. Yet the potential nutrition and health risks of UPF consumption make moderating their intake an urgent priority. Over the period 2002-2016, total per capita sales of both UPF and ultra-processed drinks rose substantially in low- and middle-income countries (**FIGURE 7.1**).

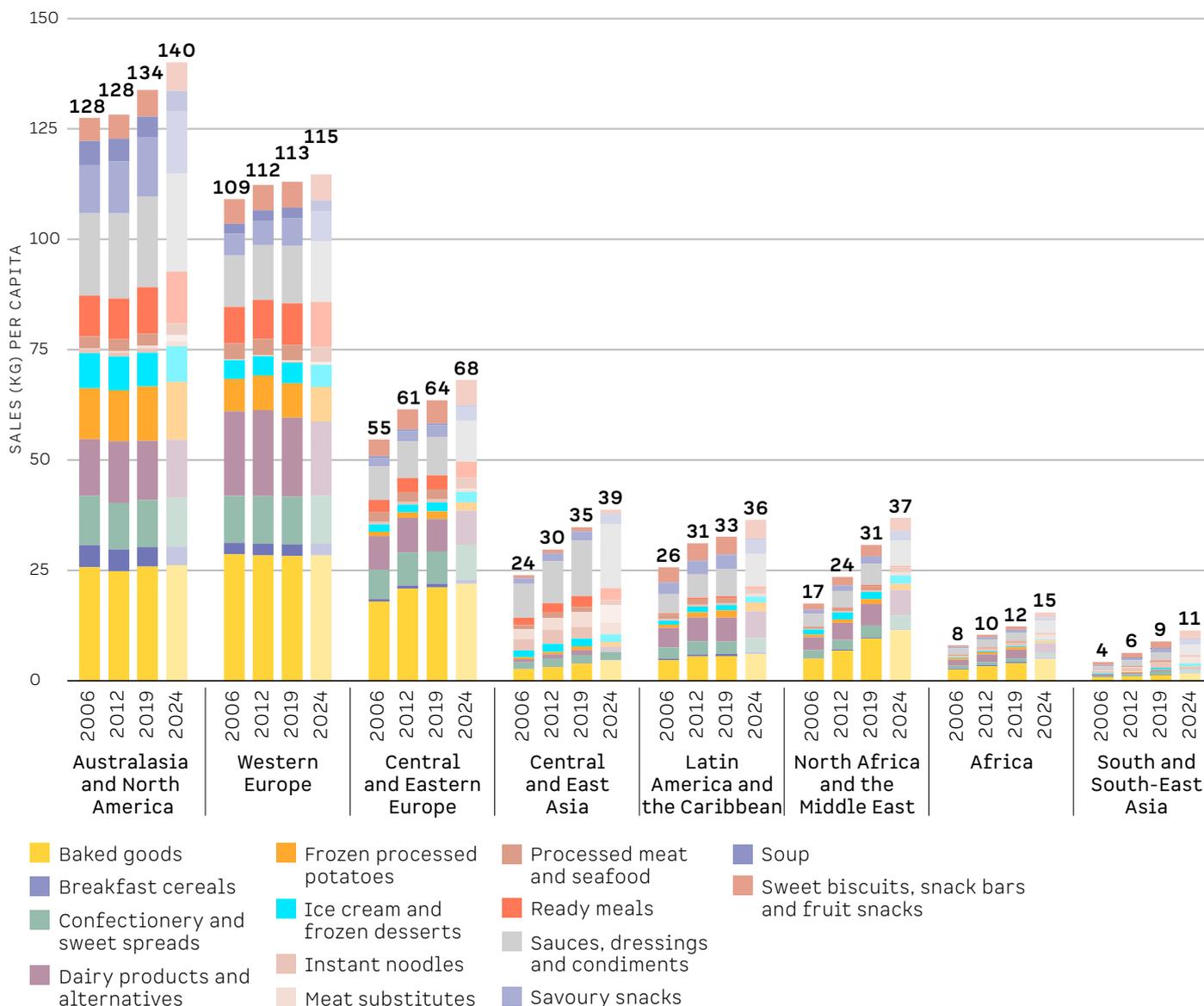
**FIGURE 7.1** CHANGE IN TOTAL VOLUME SALES PER CAPITA OF ULTRA-PROCESSED FOOD AND ULTRA-PROCESSED DRINKS, 2002-2016



Source: Global Panel on Agriculture and Food Systems for Nutrition, 2020.

In 2005, global sales of processed foods – including UPF – were already estimated to make up around three quarters of total annual food sales (Gehlhar and Regmi, 2005). In the 15 years since, the sale and consumption of ultra-processed food and drinks have risen in every area of the world: a trend that is projected to continue (**FIGURE 7.2**). Improved market connectivity and rising prosperity also lead to higher UPF consumption in marginal rural areas. Among the most important processed food products are pasta; bread; chicken and beef broth; canned food; salted, dried or oil-preserved fish and meat; and beer, soft drinks and wine.

**FIGURE 7.2 PER CAPITA ULTRA-PROCESSED FOOD SALES BY REGION, 2006-2019, WITH PROJECTIONS TO 2024**



Source: Baker et al., 2020.

While the transition to a modern food system typically results in an increase in intake of processed foods and UPF, consumption patterns vary regionally. These regional variations reflect differences in diets and culture, economic and social development (including education), degrees of urbanization, and market and governance structures. Per capita UPF sales are growing most rapidly in Africa, Asia and Latin America (see **FIGURE 7.2**). The fastest sales growth appears in frozen products, snacks and soft drinks, followed by baked goods, sauces and snacks. Total sales are highest in high-income countries (where they are levelling off).

Data on the share of total energy intake from UPF are available only for certain countries. In Brazil, Chile and Mexico, UPF delivers about 30 per cent of per capita daily energy intake. In the United Kingdom, this share rises to 50 per cent, and in the United States to 60 per cent (van Damme et al., 2021). The largest energy providers are baked goods, burgers, pizzas, sandwiches, frozen dishes, mass-produced packaged breads and sweetened milk-based products. In Asia, dried processed foods and carbonated soft drinks account for more than half of UPF sales (Baker and Friel, 2016).

The rise in processed food and UPF intake generally reflects increasing incomes and rapid urbanization: processed foods and sugary soft drinks are readily available at fairly low prices from corner shops, supermarkets, out-of-home food service providers and fast-food chains. A clear difference appears between rural and urban consumption of highly processed foods (**TABLE 7.1**). In Asian countries, including Indonesia, Nepal and Viet Nam, urban consumers spend 32-38 per cent of their total food budget on highly processed items, compared with 17-22 per cent for rural consumers. Similarly, a Chilean study found that UPF provided 29.3 per cent of the energy intake in urban areas but 23.7 per cent in rural areas (Cediel et al., 2018). In Kenya and Tanzania, average per capita daily energy intake from processed foods and meals consumed outside the home was 800 kcal in urban areas and 300 kcal in rural ones (Cockx et al., 2019).

**TABLE 7.1** SHARE OF HIGHLY PROCESSED FOODS IN TOTAL FOOD EXPENDITURE, 2010

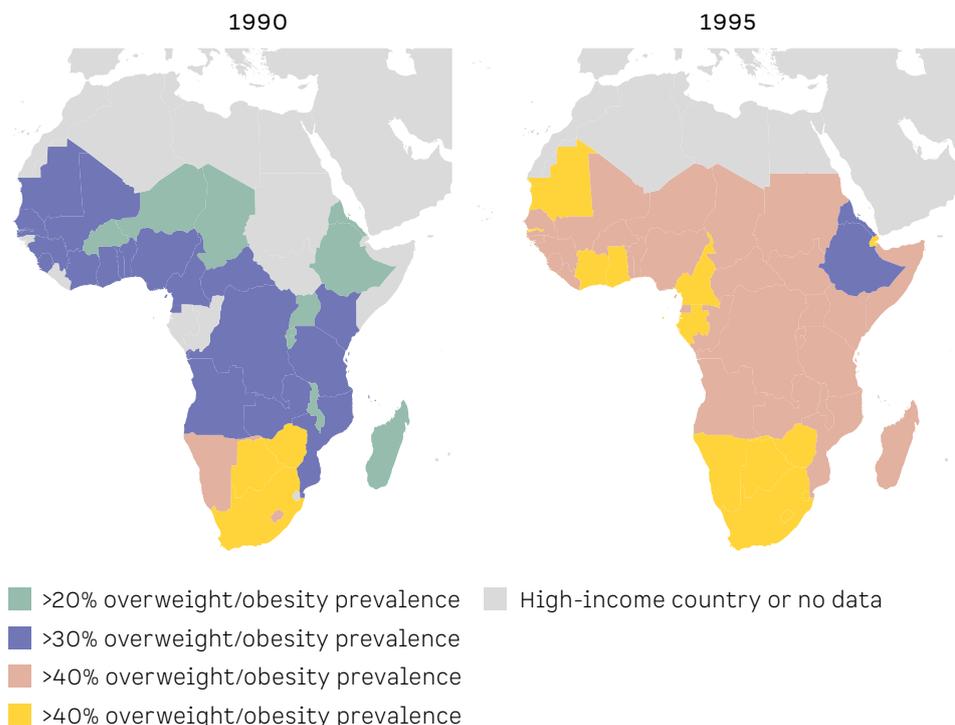
COUNTRY	SHARE OF HIGHLY PROCESSED FOODS AS A PERCENTAGE OF TOTAL FOOD EXPENDITURE IN VALUE TERMS (%)	
	RURAL	URBAN
Bangladesh	13.4	17.7
Indonesia	22.7	34.2
Nepal	17.0	36.7
Viet Nam	17.6	32.4

Source: Reardon and Timmer, 2014.

While the nutritional quality of processed foods varies widely, most UPF is energy-dense with lower diet quality due to high amounts of refined grains, added sugars and fat (Monteiro et al., 2019). If UPF is not nutritionally balanced, its consumption increases overweight and obesity rates (da Costa Louzada et al., 2015; Monteiro et al., 2019). The high energy density and low fibre content of much UPF tends to encourage overeating – yet it often lacks essential nutrients, causing a diffuse “hidden hunger”. As a result, even though the cheaper calories provided by UPF may benefit poor and undernourished people, they also contribute to the double burden of malnutrition (Traill, 2017). The prevalence of overweight and obesity in sub-Saharan Africa has increased rapidly since the 1990s (**FIGURE 7.3**).

From a consumer perspective, UPF can be attractive because of taste and convenience – and can save time, especially for women. In addition, a more diverse diet reduces the risk of inadequate nutrient intake: in rural African populations, introducing some UPF could improve the diversity and energy content of certain diets (Ferguson et al., 1993). Recently, research from sub-Saharan Africa has even indicated that the presence of UPF can mitigate underweight prevalence (Boysen et al., 2019). The possibility of fortifying food with appropriate micronutrients is one of the major advantages associated with industrial food processing.

**FIGURE 7.3** PREVALENCE OF OVERWEIGHT/OBESITY IN LOW- AND MIDDLE-INCOME SUB-SAHARAN AFRICAN COUNTRIES



Source: Reardon et al., 2021, based on 1990s and 2010s weight and height data from Demographic and Health Surveys.

For policy, the challenge is to do two things at once: mitigate the risk that increased UPF consumption will lead to unbalanced diets and raise poor people's overweight and obesity rates, and balance this risk against the wider advantages of processed foods. Attaining this balance requires attention to consumer education, food market transparency and outlet regulation, and food quality surveillance systems – all detailed below.

### **Enacting rules for convenience, ingredients and meal size to moderate UPF intake**

The rising intake of UPF reflects increasing purchases of foods in supermarkets and corner shops, along with an increase in away-from-home and fast-food consumption (Reardon et al., 2021). As a result of rising intake, diets are increasingly energy-dense and low in fibre. In addition, eating rates are generally higher for UPF than for unprocessed foods: energy intake from UPF is more than 50 per cent greater, explaining the link between ultra-processed diets and excess calorie intake leading to weight gain (Hall et al., 2019). Changing this behaviour requires strictly enforced rules to limit the purchase of UPF products, regulate the use of harmful ingredients and balance meals.

Policies to keep UPF consumption within reasonable boundaries can target convenience, meal content and meal size. For example:

- **Convenience.** Limit shelf space for UPF, and mandate responsible design of retail shops and supermarket outlets to influence convenience and choice (no sweets at cashiers and fresh fruits at shop entry).
- **Meal content.** Regulate the use of particular ingredients, including through authorization procedures for food additives, food enzymes and food flavourings.
- **Meal size.** Downsize meal and snack portions to reduce overeating risks.

The prospects for compliance with UPF regulations are generally good, given the importance of large-scale processors, the dominance of transnational food and beverage corporations (which control more than half of food manufacturing) and the international scale of fast-food chains.

Food fortification has proven feasible as a supplementary strategy for improving UPF nutritional quality. Because people eat staple foods daily, the easiest way to boost nutrition is to fortify such foods with iron, zinc, iodine, vitamin A and folic acid (Venkatesh Mannar and Hurrell, 2018). Food fortification is especially effective at reducing micronutrient deficiencies.

Not all vulnerable people can be reached through food fortification, however. And absorption is sometimes limited. Thus, food fortification must be accompanied with improved diets.

To reduce harmful ingredients and improve nutrient content in frozen, canned and packaged foods, it is generally necessary to reduce the amount of added salt, sugar and fats. Other promising strategies rely on innovative technologies, however. Examples include:

- Starch chemistry modification.
- Naturally derived non-caloric sweeteners.
- Fat-reducing food preparation processes.
- Novel water-soluble fibres (Weaver et al., 2014).
- Targeted biodelivery of antioxidants and other bioactive compounds through nanotechnology.

Unfortunately, many of these technologies are more available to transnational food and beverage companies than they are to local informal-sector enterprises.

Consumer education can help to moderate UPF intake in various socio-economic groups. Moderating UPF consumption is important to avoid the risks of overweight and diabetes. Both information access and social norms are critical for steering consumer behaviour (CHAPTER 1). Consumer education campaigns can guide food choices in desired directions and inform consumers about the health prospects and risks associated with different types of food products.

Over the last two decades, a growing number of countries have developed country-specific food-based dietary guidelines that embody national nutrition recommendations and express the principles of nutrition education in terms of food. A study of 83 guidelines showed that most recommend lowering the consumption of sugars and salt, which are present predominantly in processed foods (Haddad et al., 2016). In some countries, the guidelines explicitly recommend avoiding UPF that is high in fats, sugars and salt. While other guidelines are less explicit, many advocate consumption of whole, raw or unprocessed foods. The advice to limit highly processed foods was the fourth most common limitation message, after recommendations to limit salt, fat and sugar intake (Herforth et al., 2019).

As detailed in CHAPTER 1, nutrition education is key to strategies that target lifestyle behaviour (Baker et al., 2020). It improves dietary quality and awareness. In Trinidad and Tobago, school education interventions reduced intake levels for fried foods, soft drinks and snacks high in fat, sugar and salt (Francis, Nichols and Dalrymple, 2010). In Brazil, education interventions were especially effective in reducing soft drink consumption (James et al., 2004).

### **Ensuring that institutional procurement programmes use food quality surveillance to limit health risks from UPF intake**

Food quality norms in institutional procurement programmes can enforce the selective intake of UPF. Organized programmes for providing meals in schools, workplace canteens, hospitals and prisons need to obey strict rules

regarding food composition, diet quality and origin. In addition, responsible authorities should monitor and control the content of canned and processed food distributed under social safety net programmes (food or cash for work) targeted towards vulnerable households, women and children.

## The food industry can – and must – act in various ways to support responsible food processing

Both at the international level and at the national level, the food industry carries a substantial responsibility to guarantee that food manufacturing contributes to healthy and affordable products and balanced and sustainable diets. Investments in product, process and system innovations need to be aligned with dietary requirements and sustainable sourcing principles. The private sector's engagement in food processing, packaging, marketing and sales can be shaped in several ways:

- By investing in healthier, more convenient food and upgrading product properties.
- Through business innovation strategies at the enterprise or value chain level.
- With sector-wide initiatives to influence norms on consumption, develop common standards for more sustainable food manufacturing and reduce waste.

### **Improving product properties**

Food and beverage companies are working on technical innovations to make processed foods and UPF healthier and more sustainable. Indeed, food processing accounts for more than half of private spending on food- and agriculture-related research and development (R&D) (Fuglie, 2016). These private R&D expenditures influence the types of processed foods that will become available in the coming decades, as food is produced, processed and packaged in new ways to make it safer, healthier, more nutritious or more delicious.

As firms set priorities for R&D investments, they seek technical improvements that affect attractiveness, affordability, product safety and shelf life, as well as health, nutrition and sustainability. The potential for innovation depends on firm size (scale), gestation period and capital intensity. Multiple obstacles and uncertainties can reduce the number of product innovations that succeed, but the private sector appears responsive to changing consumer priorities.

Specific food processing innovation trajectories aim to develop or strengthen desired properties of processed foods and so improve food safety, nutritional quality and health. These trajectories are:

- Upgrading local seed systems and improving seed properties to enhance nutritional content and improve conservation potential.
- Promoting new products that advance the protein transition (insects, seaweed, microalgae, meat substitutes) while supporting the bioeconomy.
- Scaling biological control measures to combat aflatoxins and to reduce moisture in food storage.
- Exploiting opportunities for health risk reduction in food processing through hazard analysis and critical control points.
- Designing contract farming arrangements that prescribe product properties for processing (tomatoes for pasta sauce, potatoes for chips and French fries) or that regulate UPF ingredients.

To control overweight risk, the world must reduce oil, saturated fat, salt and sugar content in processed foods and beverages. Over 1961-2014, global palm oil production rose from less than 5 million to 50 million tons, around 70 per cent of it for food manufacturing. Beet sugar and sugar cane production also vastly increased, from 53 million to 177 million tons. High-fructose corn syrup constitutes almost 100 per cent of caloric sweeteners added to foods and beverages (Baker et al., 2020). Reducing these components in processed foods yields large health and environmental benefits.

Innovations for healthier and more sustainable diets are emerging in biotechnology, in functional foods and in nanotechnology (packaging), and will be put to use in food products. In addition, highly disruptive food innovations are expected in alternative proteins, food sensing, mobile services, insurance, blockchain, precision agriculture, microbiome technologies, gene editing, molecular biology and off-grid energy generation (WEF, 2018).

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### **Increasing resource efficiency, traceability and shelf life through business innovation strategies**

Food processing firms are also pursuing innovation opportunities to increase resource efficiency and traceability, especially through business process investments to improve shelf life and to add traceability for perishable food products. Major investments focus on better product handling (logistics, packaging and storage), on safeguarding procedures to enhance nutritional quality throughout the food chain, and on information management and data-sharing practices that are critical for inclusiveness (CHAPTER 4).

Large business investments – at both the enterprise and the value chain level – aim to prevent food waste, safeguard food safety and build competitive advantages in existing and new market segments. Some promising process innovation trajectories are:

- Improving the stability, safety and quality of locally processed foods (see **BOX 7.2**).
- Investing in process innovation, such as facilities for drying, freezing, cooling and heating.
- Improving logistics and biodegradable packaging to safeguard product quality during transport and storage.
- Promoting better supply chain integration using novel ICTs (blockchain) for chain transparency.
- Using digital facilities for fast information sharing (real-time sensors) and improving financial transactions.

### **Supporting precompetitive activities through sector-wide initiatives towards common standards**

Sector-wide initiatives to make processed food healthier, safer and more sustainable include product standard harmonization, common agreements on packaging and a global framework to reduce losses and align with global reporting standards. Broad business participation in these networks is critical to uphold their legitimacy and authority. Firms also increasingly self-regulate on norms relating to restricted advertising, and guarantees with regard to customer data management are also becoming more important.

Some important sector-wide initiatives in the food processing area are:

- Global reporting standards for responsible business management practices.
- A framework for sustainable packaging and waste reduction.
- A regulatory framework for big data management (privacy rules).
- Voluntary restrictions on marketing and advertising.
- Operating licences and tax regulation for international agribusinesses.

## Reducing health risks by establishing a conducive food environment

Public policies and regulation – developed and enforced through governance processes involving all stakeholders – can support a conducive food environment. Such an environment induces healthy consumption of processed and ultra-processed food by the most vulnerable consumer groups: poor households, ethnic minorities, pregnant women and adolescents, among others. Features of a conducive food environment for moderating UPF intake include:

- Taxes and levies on UPF.
- Public, private and voluntary systems of grades and standards.
- Market facilities for specific food delivery channels.
- Public-private interfaces that support stakeholder cooperation on moderating UPF intake.

### Using taxes and tariffs

Domestic levies and taxes support sustainable consumption of processed foods. Also promising are import tariffs levied on UPF (Boysen et al., 2019) to limit consumption and reduce obesity rates.

In sub-Saharan Africa, an increase of one percentage point in UPF tariffs is expected to reduce obesity prevalence by 0.18 per cent – though it is also likely to increase underweight prevalence by 0.05 per cent. In Mexico, a tax in force since 2014 has proved effective in reducing soft drink consumption. The years since then have seen households at the lowest socio-economic level reduce their purchases of taxed beverages by the biggest margins (Colchero et al., 2017).

### Using public, private and voluntary systems of grades, labels and standards

Grades and standards shed light on the social and environmental effects of food production and product formulation. Information on product quality at the outlet level favours more balanced UPF consumption. Market transparency also helps consumers reduce UPF intake, especially from supermarket purchases and from out-of-home meals. For packaged UPF products and fast-food meals, both voluntary and obligatory product information and product labelling (positive and negative) can support healthier consumer choices. Some examples are:

Market transparency helps consumers reduce UPF intake, especially from supermarket purchases and from out-of-home meals.

- Marketing rules and food labelling for products posing health risks from excessive intake – in Chile, warning labels are obligatory for products that exceed a certain level of sugar, sodium, saturated fats or calories, and these products may not be advertised to those under the age of 14.
- Voluntary certification and labelling for the use of sustainable production methods, the payment of fair prices and the payment of a living wage – often used for tropical commodities.
- Public standards with industry guidance on reducing plastic packaging or reusing plastic.
- Obligatory nutrition scores on processed foods.
- Regulation of advertisements for particular foods (infant food) and those directed at specific consumer groups (adolescents, pregnant women).

Labelling and certification aim to reduce or optimize the intake of selected nutrients and to influence industry practices – for example, to reduce a product’s content of unhealthy compounds, such as salt and trans fats, or to add healthy components, such as protein and micronutrients (Shangguan et al., 2019). So far, labelling rules have had larger effects on product formulation by the food industry than on consumer choices. Even so, labelling and certification can help consumers make better choices – if the information is available and clear.

### **Using market facilities for specific food delivery channels to widen access to more balanced diets**

Ultra-processed food is delivered through a wide number of market channels, mainly supermarkets and corner shops, home delivery (courier services) and out-of-home consumption. Important market facilities to regulate both formal and informal food markets include entry permits, operating licences and sanitary controls. In addition, opportunities exist to upgrade food services and widen access to more balanced diets by training chefs and improving menus.

With increased use of the internet and mobile devices, app-based services that enable personalized nutrition and home delivery can support balanced diets.

With increased use of the internet and mobile devices, app-based services that enable personalized nutrition and home delivery can support balanced diets. For example, services can deliver information on product properties and promote access to higher-quality diets tailored to individual needs. Digital market spaces can also expand access to ingredients, and they can target various consumer categories with tailor-made offers.

### **Using public-private interfaces to support stakeholder cooperation for a collaborative food environment**

Given the high number and wide diversity in scale and degree of informality of businesses involved in food processing, a key principle for improving the food environment is to create conditions for compliance based on voluntary cooperation and countervailing power. To align stakeholders and to support collective action, four elements will be essential:

- Civic empowerment through consumer associations and interest groups.
- Engagement of interested outside actors (for example, health insurance companies).
- Learning platforms and value chain partnerships.
- Due diligence practices and self-regulation by the food industry.

It is increasingly clear that no single policy on UPF will achieve desired food system outcomes through universal application: one size does not fit all. To support responsible food processing and moderate UPF intake, consumer incentives must be combined with production facilities and market

restrictions. Policy negotiation must seek a supportive regulatory framework, along with pricing and taxation measures to enhance business innovation, and information provision requirements to nudge consumers towards more balanced dietary choices (WEF and McKinsey, 2020).

## Policy priorities for local food processing

Food processing offers important opportunities for off-farm employment and rural entrepreneurship, and it can contribute to safer, affordable and diversified diets. But it is equally important to protect households from UPF intake that exceeds healthy levels.

Policies to steer the production and consumption of processed foods and UPF need to combine local engagement in small-scale business, affordable technologies, and supportive price and non-price incentives. In the earlier stages, attention should focus mostly on business development and market entry facilities. In the later stages, taxation and legal regulation are required to safeguard an equitable and balanced food processing sector. The most advanced food systems need to embrace engagement in public-private partnerships and reliance on voluntary standards as leading governance principles.

Policies to support healthy, inclusive and sustainable food processing should focus on three objectives:

- Facilitate small-scale local food processing industries that provide new bottom-of-the-pyramid business and employment opportunities – especially for women and youth – and that increase access to a wider variety of food products.
- Support the moderate intake of processed foods and UPF through incentives for responsible business innovation processes and standard-setting facilities for the food environment – because producers are most likely to respond positively to a combination of enabling and constraining incentives.
- Promote effective public-private interfaces to support a conducive food environment, based on clear guidance and behavioural change communication, to encourage moderate UPF intake by disadvantaged groups and prevent excessive UPF intake, especially through global self-regulation by firms engaged in UPF supply and marketing.

# References

- Allen, T. and Heinrigs, P. 2016. Emerging Opportunities in the West African Food Economy. West African Papers 01, OECD Publishing, Paris (available at: <http://dx.doi.org/10.1787/5jlvfj4968jb-en>).
- Allen, T., Heinrigs, P. and Heo, I. 2018. Agriculture, Food and Jobs in West Africa. West African Papers 14, OECD Publishing, Paris.
- Baker, P. and Friel, S. 2016. Food Systems Transformations, Ultra-processed Food Markets and the Nutrition Transition in Asia. *Globalization and Health*, 12 (1): 80.
- Baker, P., Machado, P., Santos, T., Sievert, K., Backholer, K., Hadjikakou, M., Russell, C., Huse, O., Bell, C. and Scrinis, G. 2020. Ultra-processed Foods and the Nutrition Transition: Global, Regional and National Trends, Food Systems Transformations and Political Economy Drivers. *Obesity Reviews*, 21 (12): e13126. doi: 10.1111/obr.13126.
- Boysen, O., Boysen-Urban, K., Bradford, H. and Balié, J. 2019. Taxing Highly Processed Foods: What Could Be the Impacts on Obesity and Underweight in sub-Saharan Africa?" *World Development*, 119: 55-67.
- Bricas, N., Tchamda, C. and Mouton, F. 2016. L'Afrique à la conquête de son marché alimentaire intérieur. Enseignements de dix ans d'enquêtes auprès des ménages d'Afrique de l'Ouest, du Cameroun et du Tchad. Etudes de l'AFD, No. 12, Agence française de développement, Paris.
- Cappellesso, G. and Thomé, K.M. 2019. Technological Innovation in Food Supply Chains: Systematic Literature Review. *British Food Journal*, 121 (10): 2413-2428. <https://doi.org/10.1108/BFJ-03-2019-0160>.
- Cediel, G., Reyes, M., da Costa Louzada, M.L., Steele, E.M., Monteiro, C.A., Corvalán, C. and Uauy, R. 2018. Ultra-processed Foods and Added Sugars in the Chilean Diet (2010). *Public Health Nutrition*, 21 (1): 125-133.
- Choudhury, M., Mahanta, L.B., Sarmah Goswami, J. and Dutta Mazumder, M. 2011. Will Capacity Building Training Interventions Given to Street Food Vendors Give Us Safer Food? A Cross-sectional Study from India. *Food Control*, 22 (8): 1233-1239. (available at: <https://doi.org/10.1016/j.foodcont.2011.01.023>).
- Christiaensen, L. 2017. Agriculture in Africa: Telling Myths from Facts: A Synthesis. *Food Policy*, 67: 1-11. (available at: <https://doi.org/10.1016/j.foodpol.2017.02.002>).
- Christiaensen, L. 2020. *Agriculture, Jobs, and Value Chains in Africa*. Washington, D.C.: World Bank.
- Cockx, L., Colen, L., De Weerd, J. and Paloma, G.Y. 2019. Urbanization as a Driver of Changing Food Demand in Africa: Evidence from Rural-Urban Migration in Tanzania. EUR 28756 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-73182-2, doi:10.2760/515064, JRC107918.
- Colchero, M.A., Rivera-Dommarco, J., Popkin, B.M. and Ng, S.W. 2017. In Mexico, Evidence of Sustained Consumer Response Two Years after Implementing a Sugar-sweetened Beverage Tax. *Health Affairs*, 36 (3): 564-571.
- da Costa Louzada, M.L., Baraldi, L.G., Steele, E.M., Martins, A. P.B., Canella, D.S., Moubarac, J.-C., Levy, R.B., Cannon, G., Afshin, A. and Imamura, F. 2015. Consumption of Ultra-processed Foods and Obesity in Brazilian Adolescents and Adults. *Preventive Medicine*, 81: 9-15.
- Dolislager M., Reardon, T., Arslan, A., Fox, L., Liverpool-Tasie, S., Sauer, C. and Tschirley, D.L. 2020. Youth and Adult Agrifood System Employment in Developing Regions: Rural (Peri-urban to Hinterland) vs. Urban. *The Journal of Development Studies*, 57 (4): 571-593.
- Ferguson, E.L., Gibson, R.S., Opare-Obisaw, C., Osei-Opare, F., Lamba, C. and Ounpuu, S. 1993. Seasonal Food Consumption Patterns and Dietary Diversity of Rural Preschool Ghanaian and Malawian Children. *Ecology of Food and Nutrition*, 29 (3): 219-234.
- Francis, M., Nichols, S.S. and Dalrymple, N. 2010. The Effects of a School-based Intervention Programme on Dietary Intakes and Physical Activity among Primary-school Children in Trinidad and Tobago. *Public Health Nutrition*, 13 (5): 738-747.
- Fuglie, K. 2016. The Growing Role of the Private Sector in Agricultural Research and Development World-wide. *Global Food Security*, 10: 29-38. (available at: <http://dx.doi.org/10.1016/j.gfs.2016.07.005>).
- Gehlhar, M. and Regmi, A. (editors) (2005) Factors shaping global food markets. In *New Directions in Global Food Markets*. Agriculture Information Bulletin no. 794. Washington, D.C.: US Department of Agriculture.
- GLOPAN (Global Panel on Agriculture and Food Systems for Nutrition). 2020. *Future Food Systems: For People, Our Planet, and Prosperity*. London: GLOPAN.
- Grace, D., Dipeolu, M. and Alonso, S. 2019. Improving Food Safety in the Informal Sector: Nine Years Later. *Infection Ecology & Epidemiology*, 9 (1): 1579613 (available at: <https://doi.org/10.1080/20008686.2019.1579613>).
- Haddad, L.J., Hawkes, C., Achadi, E., Ahuja, A., Ag Bendeck, M., Bhatia, K., Bhutta, Z., Blossner, M., Borghi, E. and Eriksen K. 2018. *Global Nutrition Report 2018: Actions and Accountability to Advance Nutrition and Sustainable Development*.
- Haddad, L., Hawkes, C., Waage, J., Webb, P., Godfray, C. and Toulmin, C. (2016). Food systems and diets: Facing the challenges of the 21st century. London, UK: Global Panel on Agriculture and Food Systems for Nutrition. Advance Nutrition and Sustainable Development. Washington, D.C.: IFPRI.

- Hall, K.D., Ayuketah, A., Brychta, R., Cai, H., Cassimatis, T., Chen, K.Y., Chung, S.T., Costa, E., Courville, A. and Darcey, V. 2019. Ultra-processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake. *Cell Metabolism*, 30 (1): 67-77.
- Hawkes, C. 2013. Promoting Healthy Diets through Nutrition Education and Changes in the Food Environment: An International Review of Actions and their Effectiveness. Nutrition Education and Consumer Awareness Group. Rome: FAO.
- Hebous, S. and Tran, T. 2017. *Trends and Prospects for Formal Job Creation in Côte d'Ivoire*. Washington, D.C.: World Bank.
- Herforth, A., Arimond, M., Álvarez-Sánchez, C., Coates, J., Christianson, K. and Muehlhoff, E. 2019. A Global Review of Food-Based Dietary Guidelines. *Advances in Nutrition*, 10 (4): 590-605.
- James, J., Thomas, P., Cavan, D. and Kerr, D. 2004. Preventing Childhood Obesity by Reducing Consumption of Carbonated Drinks: Cluster Randomised Controlled Trial. *BMJ*, 328 (7450): 1237.
- Materia, V.C., Linnemann, A., Smid, E. and Schoustra, S. 2021. Upscaling of traditional fermented foods to build value chains and to promote women entrepreneurship. Background paper for the *Rural Development Report 2021*. IFAD. Rome: Italy.
- Miranda, A. 2018. Public Food Procurement from Smallholder Farmers: Literature Review and Best Practices. Working Paper 176, International Policy Centre for Inclusive Growth (IPC-IG), Brasilia.
- Monteiro, C. A., Cannon, G., Lawrence, M., da Costa Louzada, M. L. and Machado, P. P. 2019. *Ultra-Processed Foods, Diet Quality, and Health Using the NOVA Classification System*. Rome: FAO.
- Randolph, D. 2021. Food Safety in Formal and Informal Markets and Food Systems Transformation. Background paper for the *Rural Development Report 2021*. IFAD. Rome: Italy.
- Rao, N. C. and Dasgupta, S. 2009. Nature of Employment in the Food Processing Sector. *Economic and Political Weekly*, 44 (17): 109-115.
- Reardon, T., Tschirley, D., Dolislager, M., Snyder, J., Hu, C. and White, S. 2014. Urbanization, Diet Change, and Transformation of Food Supply Chains in Asia. East Lansing, MI: Global Center for Food Systems Innovation (available at: [http://www.fao.org/fileadmin/templates/ags/docs/MUFN/DOCUMENTS/MUS\\_Reardon\\_2014.pdf](http://www.fao.org/fileadmin/templates/ags/docs/MUFN/DOCUMENTS/MUS_Reardon_2014.pdf)).
- Reardon, T., Tschirley, D., Saweda L., Liverpool-Tasie, O., Awokuse, T., Fanzo, J., Minten, B., Vos, R., Dolislager, M., Sauer, C., Dhar, R., Vargas, C., Lartey, A., Raza, A. and Popkin, B.M. 2021. The Processed Food Revolution in African Food systems and the Double Burden of Malnutrition. *Global Food Security*, 28: 100466 (available at: <https://doi.org/10.1016/j.gfs.2020.100466>).
- Reardon, T. and Timmer, C.P. 2014. Five inter-linked transformations in the Asian agrifood economy: Food security implications. *Global Food Security*. Volume 3, Issue 2, July 2014, pp. 108-117.
- Shangguan, S., Afshin, A., Shulkin, M., Ma, W., Marsden, D., Smith, J., Saheb-Kashaf, M., Shi, P., Micha, R. and Imamura, F. 2019. A Meta-analysis of Food Labeling Effects on Consumer Diet Behaviors and Industry Practices. *American Journal of Preventive Medicine*, 56 (2): 300-314.
- Traill, W.B. 2017. Transnational Corporations, Food Systems and their Impacts on Diets in Developing Countries. Trade Policy Technical Notes. Rome: FAO.
- van Boekel, M., Fogliano, V., Pellegrini, N., Stanton, C., Scholz, G., Lalljie, S., Somoza, V., Knorr, D., Jasti, P.R. and Eisenbrand, G. 2010. A Review on the Beneficial Aspects of Food Processing. *Molecular Nutrition & Food Research*, 54 (9): 1215-1247.
- van Damme, I., Fogliano, V. and Feskens, E. 2020. Role of Ultra-processed Foods and Food Systems Transformation: Implications for Supply Chains and Consumption Patterns. Background paper for the *Rural Development Report 2021*. IFAD. Rome: Italy.
- Venkatesh Mannar, M.G. and Hurrell, R.F. (eds.). 2018. *Food Fortification in a Globalized World*. London: Academic Press.
- Weaver, C.M., Dwyer, J., Fulgoni, V.L., King, J.C., Leveille, G.A., MacDonald, R.S., Ordovas, J. and Schnakenberg, D. 2014. Processed Foods: Contributions to Nutrition. *The American Journal of Clinical Nutrition*, 99 (6): 1525-1542 (available at: <https://doi.org/10.3945/ajcn.114.089284>).
- WEF (World Economic Forum). 2018. *Innovation with a Purpose: The Role of Technology Innovation in Accelerating Food Systems Transformation*. Geneva: World Economic Forum.
- WEF (World Economic Forum) and McKinsey. 2020. *Food Systems Initiative: Incentivizing Food Systems Transformation*. Geneva: World Economic Forum (in collaboration with McKinsey & Company).