

Fruits & vegetables

KEY COMPONENTS OF
HEALTHY DIETS



Advocacy Brief



gain
Global Alliance for
Improved Nutrition

Key facts

- Vegetables and fruits are essential to a healthy diet, providing a good source of fibre, vitamins and minerals, which help prevent deficiencies and/or maintaining good health.

- Low fruit and vegetable consumption has been linked to poor health and a range of non-communicable diseases (NCDs) such as coronary heart disease, strokes, type 2 diabetes, and some forms of cancerⁱ.

- In some countries, vegetables are often grouped with fruits. However, they tend to have lower sugar levels than fruits, and are easily incorporated into main meals. Fruits, in contrast, are often seen as snacks.

- In 2017, a diet low in vegetables was a risk factor contributing to around 1.6% of deaths in sub-Saharan Africa, 2% of deaths in the Middle East and North Africa, 2.4% of deaths in North America, 2.8% of deaths in East Asia and the Pacific as well as Europe and Central Asia, and around 3% of deaths in the region of South Asia and the Latin America and Caribbean regionⁱⁱ.

Fruits & Vegetables Composition

Fibre

Many vegetables and fruits are rich in fibre.

Micronutrients

That the body can convert as a source of Vitamin A.

Vegetables and fruits contain a range of vitamins and minerals required in trace amounts for the healthy functioning of the body.

Vitamin A - found in green, yellow and red vegetables and fruits; vital for healthy vision and well functioning immune system.

Vitamin C - found in a variety of vegetables and fruits, can help our bodies absorb more iron from plant-based foods.

Calcium - dark leafy green vegetables can be a good source of calcium; essential for normal growth and development.

Iron - a variety of dark green vegetables contain non-haem iron. A key mineral for growth and development, in particular for women and girls.

Beneficial non-nutrient components:

Including plant sterols, flavonoids and other bioactives (antioxidant and anti-inflammatory properties)

Sources: ⁱⁱⁱ

This brief focuses primarily on vegetables, but fruits are also discussed.

Contributing to the SDGs

Contributing to the SDGs



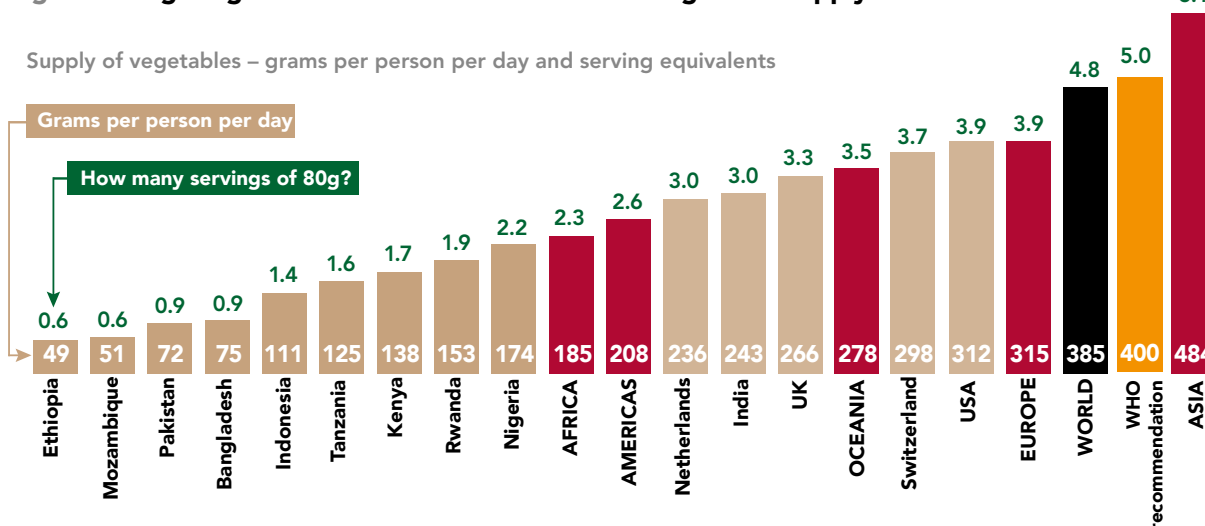
Introduction

Vegetable supply around the world

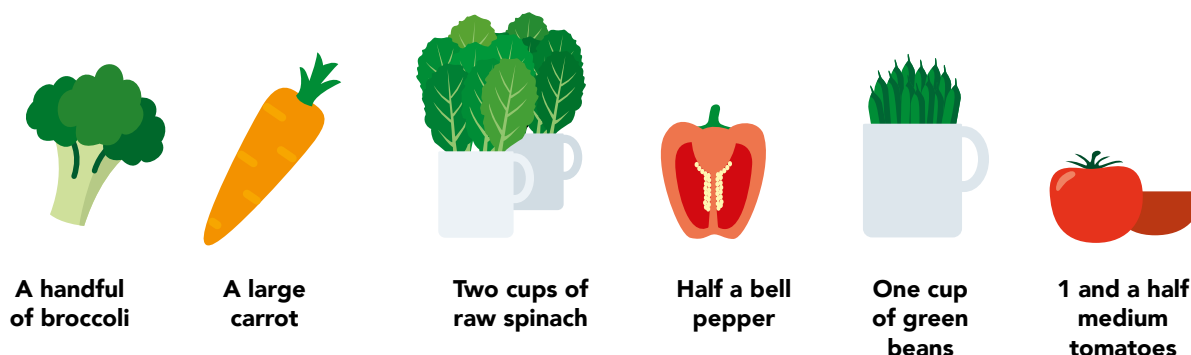
Fruits and vegetables are recommended across all dietary guidelines. Moreover, guidelines are increasingly emphasising that vegetables and fruits should make up a larger share of people’s meals than starchy staples. In Argentina, Austria, Benin, Ecuador, Finland, Jamaica and Qatar, for example, recent dietary guideline visuals^{iv} show larger fractions devoted to vegetables and fruits than to starchy staples like cereals, potatoes, bread, and the like. This contrasts with more traditional dietary guidelines which tend to emphasise staples.

Despite the nutrition credentials of vegetables, they remain relatively scarce and expensive in many low-income settings, including across many of the countries where GAIN’s main offices are based. Globally, average vegetable supply is around 385 grams per person per day. National variation is large though. In countries with GAIN offices, it ranges from just 49g per person per day in Ethiopia to 312g per person per day in the United States of America – or around half of an 80g serving to almost 4 servings (Figure 1). **The World Health Organization (WHO) recommends consuming at least 400g of fruits or vegetables per person per day**^{xvi}.

Figure 1: Large regional and national differences in vegetable supply^v



What is a serving of vegetables like?



Our vision: more available, accessible, and desirable vegetables

GAIN works on **supply** and **demand**, as well as on changing **incentives, rules and regulations** to encourage **production** and **consumption** of nutritious and safe foods. We seek to understand and tackle barriers faced by small enterprises working to boost availability, affordability, desirability, and convenience of **nutritious foods like vegetables**, especially for people on low-incomes.

GAIN case studies

Supply chain work for more nutritious, affordable vegetables

More work is needed to boost availability of vegetables – through increasing production, through incorporating more vegetables into processed products, and also by driving down loss and waste – particularly common with fresh vegetables which are often fragile.

Small- and medium-sized enterprises (SMEs) produce and sell a large fraction of the vegetables available in low-income markets. A recent analysis^{vi} found SMEs to be important at each stage of fruit and vegetable value chains across Africa, from production and processing (including storage, wholesaling, and logistics) to retail. Over 85 percent of fruits and vegetables, by volume, are produced by micro, small and medium farms, while in general, for less processed fruits and vegetables, a higher share ends up being sold through traditional retail outlets like small shops, groceries, street food vendors and hawkers – most of which are SMEs.

But SMEs face significant challenges, including financial and capacity barriers to scaling up production, processing or distribution. Our work on supply chains for nutritious foods assesses value chains, identifies enterprises to support, and provides grants and technical assistance to help businesses produce and process nutritious and safe foods to market at affordable prices.

Since 2012, GAIN's flagship Marketplace for Nutritious Foods programme has offered networking opportunities, business planning support, and access to financial grants and investments to local companies looking to turn their innovative and nutrition-enhancing concepts into sustainable products. The ultimate goal of the Marketplace for Nutritious Foods is to create local markets full of diverse, nutritious and affordable foods. The programme has supported around a dozen businesses involved in vegetable and fruit supply¹ in Eastern and Southern Africa with technical assistance and/or grants. One of these, called African Farms and Markets (AFMA), is briefly profiled in below.

African Farms and Markets – supplying nutritious affordable vegetables



AFMA began in Nairobi, Kenya in 2008, buying and selling traditional African vegetables, as well as selling farm inputs, fertiliser, seeds and crop protection. They buy vegetables rich in nutrients like iron and vitamins A and E (including amaranth, African nightshade, cow peas, eggplant, kale, cabbage, and lettuce) from around 200 rural farmers and sell to small outlets or direct to resource-constrained consumers in Nairobi and Kiambu.

The main markets include Githogoro slums, Githurai 44, Mathare North and Thindigua. The adjacent image shows consumers buying from an AFMA seller in Githogoro slums.

With technical assistance and a grant from GAIN over 2019- 2020, AFMA is establishing a pack house for the vegetables, as well as building two collection centres, purchasing packaging, bagging and crating equipment, and procuring equipment for cooking demonstrations and marketing purposes. This will improve its penetration into informal markets while reducing loss and waste in the vegetable value chain, helping to keep prices reasonable for target consumers.

¹ Leafy and root vegetables, as well as fruits. GAIN also works with companies in the orange fleshed sweet potato (OFSP) supply chain (OFSP, although a tuber, is classified as a vegetable, and is high in vitamin A.)

Our **Postharvest Loss Alliance for Nutrition** (PLAN) initiative also works with SMEs to reduce food loss. PLAN in Nigeria and Ethiopia focusses on horticulture crops. One example of an SME supported through PLAN in Nigeria (Kennie-O Cold Chain Logistics) is profiled in below.

Kennie-O Cold Chain Logistics – cold transport for fresher vegetables



Established in 2014, Kennie-O Cold Chain Logistics (KCCL) provides dedicated and reliable cold chain solutions for the Nigerian food industry. This helps considerably to reduce food loss between farm and market.

With help from GAIN’s PLAN programme, in 2019, KCCL purchased and installed refrigeration in a large truck. This refrigerated truck is used primarily to provide a logistics service for fruit and vegetable farmers, transporting their goods to the market. It follows two main routes – Kaduna to Lagos, and Abuja to Lagos, taking between 60 and 90 trips annually.

A recent GAIN-commissioned modelling exercise demonstrated that grants like the one KCCL used to refrigerate the truck represent a viable economic investment for similar small enterprises.

GAIN also co-convenes the Scaling Up Nutrition (SUN) Business Network (SBN) with the World Food Programme. The SBN is a critical part of the SUN Movement, aiming to engage and mobilise business at a global and national level to act, invest and innovate responsibly to boost supply of nutritious and safe food. A recent conservative count of the number of SBN companies operating in the vegetable supply chain across five SUN countries – Bangladesh, Mozambique, Nigeria, Pakistan, and Tanzania – came to 144 members. Table 1 describes half a dozen examples of businesses in Nigeria.

Table 1: Six examples of companies in Nigeria’s SUN Business Network working with vegetables

Company name	Brief description
Cee Perfect Global Supplies	A tomato farming company.
Kenni-O Cold Chain Logistics	A logistics company specialising in keeping fruits and vegetables fresh, helping to preserve nutrient quality.
So Fresh Neighbourhood Market	A pioneering healthy food chain, providing fresh, delicious, nutrient-rich healthy meals including a wide range of fresh salads, juices, sandwiches etc.
Soupah Kitchen Enterprise	A food processing company supporting local farmers by taking vegetables including tomatoes, peppers, onions, and garlic that would have otherwise wasted and producing ready-to-cook soups.
Veggie Victory	Nigeria’s first vegan restaurant. This company has also developed an easy-to-cook commercially produced meat substitute.
VIDSA Multiventures Ltd	Cultivators and processors of moringa – the leaves, roots and immature pods of which are consumed as vegetables.

SOURCE: vii



Another of GAIN's successful vegetable supply chain projects, recently concluded, was conducted under the Amsterdam Initiative against Malnutrition (AIM)^{viii} partnership. Vegetables for All (VfA) was implemented in four regions in the north-east of Tanzania, tackling not only supply and affordability, but also including strong demand components.

Another AIM partnership initiative, also including supply and demand components, was the Rural retail hubs project. Implemented in South Africa, it was based on the idea of creating central hubs to enable produce from local smallholder farmers to be collected in one location to supply local retail stores, thereby shortening the distance from farm to cold chain and helping to improve availability and affordability of locally-sourced fresh vegetables. SPAR International was the lead partner, supported by SPAR South Africa, Base of the Pyramid (BoP) Innovation Centre, Wageningen University Centre for Development Innovation and GAIN. The project included technical assistance to farmers on vegetable production, agricultural training, and improved access to finance. Two distribution hubs were established, and campaigns to boost consumer awareness about the nutritional benefits of vegetables also took place in three SPAR stores. In 2017, while almost 11% of women surveyed in the target area met the minimum dietary diversity score², this had risen to almost 21% by 2019, along with improvements in vegetable affordability^{ix}.

2 Figure 3 shows the typology of foods used in constructing dietary diversity scores. Vegetables are flagged in three of ten categories – orange vegetables, dark green leafy vegetables, and 'other' vegetables.

Vegetables for All

Vegetables for All, which ran from 2013 to 2019 was a public-private partnership of the Netherlands Enterprise Agency (RVO), Rijk Zwaan, Rabobank Foundation, the Global Alliance for Improved Nutrition (GAIN), Tanzania Horticultural Association (TAHA), Wageningen CDI, The World Vegetable Center (AVRDC) and ICCO Cooperation. It was implemented in four regions of northeast Tanzania: Arusha, Manyara, Kilimanjaro, and Tanga, aiming to stimulate both production and availability, as well as consumption of vegetables, by working along the vegetable value chain. In the 5 years of project implementation, achievements included:



- Increased availability of nutritious vegetables;
- Stronger and more sustainable vegetable supply chains;
- Improved access to vegetables for Base of the Pyramid (BoP) consumers;
- Increased consumption of vegetables by BoP consumers; and
- Increased income for farming families.

Table 2 enumerates some of the accomplishments.

Table 2: Vegetables for All in numbers

Company name	Brief description	Number
Vegetable farmers trained	On good agricultural practices (% female)	2,743 (41%)
	In good governance (% female)	2955 (45%)
	In financial literacy (% female)	2,464 (45%)
	On solar drying	530
Finance	Vegetable farmers in receipt of first loans in 2018 and 2019 (in how many farmer groups)	300 (14)
	Vegetable processors who received financial support to procure items such as solar dryers	4
Demonstrations, seedlings, and technology	Demonstration plots for training set up beside commercial vegetable production areas	97
	Plant nursery businesses established to sell vegetable seedlings	4
	Solar dryers constructed and distributed among farmer groups	9
Businesses who received business development + post-harvest loss management training	Vegetable processors	20
	Small-scale vegetable producers	3
Networking and knowledge sharing	Forums conducted in 2019	2
	Training of trainers sessions taken place	12
Awareness raising about vegetables	People reached through a radio campaign	4 million
	Cooking demonstrations organised	122
Targeted interactions with potential consumers	Adults	7,687
	School children	46,786

Source: *

Tackling papaya waste and snack innovation in Ethiopia

In 2021, GAIN embarked on leading a four-year public-private partnership to strengthen the papaya value chain in Ethiopia by repurposing leftover papaya into affordable and nutritious dried products including snacks in the form of flakes or powder, and snack bars that are also enriched with whey protein, vitamins, and minerals. Efforts are funded by the Danish International Development Agency (DANIDA) and the EU, as well as UNICEF. Partners include Addis Ababa University, the Confederation of Danish Industry, three Ethiopian food producers (Raya Horti Farms, Theday Agro Industry PLC, and Africa JUICE), agricultural engineering social enterprise Selam TRIAE, and Denmark-based Arla Foods Ingredients.

Papaya grows well in Ethiopia, where it is one of the most popular fruits. Unfortunately, a massive 30% of Ethiopia's papaya harvest is estimated to be lost to spoilage. This partnership aims to help fruit processors use leftover papaya to be incorporated into dried products, before it goes to waste.^{xvii}

Formulating a desirable, tasty papaya products based on processing of papaya and incorporating added protein and micronutrients is only part of the challenge. The team must also work with local manufacturers to enhance the supply chain and ensure they have the required technology and expertise to produce the snacks.

Innovation in manufacturing and product design is a key element of this project. The team is currently investigating processing methods including refractance window water drying, which works on the principle of heat transmittance from boiling water^{xviii}, and solar drying (Box A) as a low-cost and sustainable opportunities to reduce post-harvest loss of papaya and ensure a good supply is available for food processing. Researchers in Addis Ababa University are also involved in investigating how best to retain nutrients in papaya through the drying process. The team is planning for their delicious, nutritious, and affordable papaya products to launch in Ethiopian markets by 2023.



Papaya is a highly nutritious fruit, naturally rich in vitamins A, B, and C, and grown by more than 890,000 farmers in Ethiopia.

Box A: Solar drying and other innovations for improving food systems

Solar drying can be a highly environmentally sustainable and cost-efficient way to process and preserve nutritious foods like fruits and vegetables. It can remove up to 80% of moisture content from foods like these, preventing growth of microorganisms and thereby extending shelf life. Fruits and vegetables in their undried state are very prone to microorganism growth, which often drives significant post-harvest losses all through the supply chain, and can also impact food quality and safety.

Solar drying may be especially advantageous in areas like much of rural Ethiopia where distribution infrastructure and cold chains are limited, but where the thermal energy of the sun is often in abundance. Solar drying equipment varies in complexity and capacity, meaning both small-scale and industrial processors may acquire and operate it.

Solar processing is one innovation particularly relevant to fruits and vegetables like papaya that has been highlighted in the recently launched Innovative Food Systems Solutions portal, available at <https://ifssportal.nutritionconnect.org/>. Explore the portal for more innovative solutions like solar drying.^{xix}

An essential part of a healthy, diverse diet

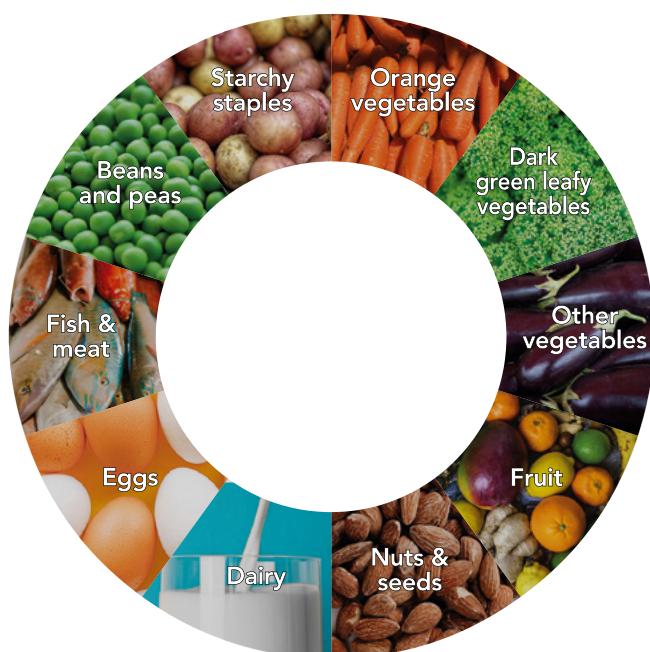
In promoting fruit and vegetable consumption, we have to go beyond boosting supply. As diets shift with increasing globalisation, urbanisation, and other trends, vegetables are unfortunately increasingly undervalued by too many consumers in too many settings. Given the integral role of vegetables in healthy diets, and considering GAIN's aim to promote more diverse, healthy diets, vegetables feature in many of GAIN's endeavors and programmes, even where they are not necessarily the focus. GAIN's workforce nutrition programme^{xi} is a case in point – aiming to improve the diets and nutrition of workers and farmers in low- and middle-income countries or communities, including garment workers in Bangladesh, and tea farmers in India, Kenya, and elsewhere.

One example comes from the tea plantations of Indonesia. Between 2013 and 2015, with funding from the Netherlands Embassy, GAIN partnered with Business Watch Indonesia and tea co-operatives in 14 districts of West- and Central Java to improve the food and nutrition of 32,000 tea farmer families, predominantly through targeting women – tea workers themselves, or the family members of tea workers. The programme aimed to

- a) enhance awareness of the importance of nutrition;
- b) increase the availability and affordability of nutritious foods for tea farmer households, including through the cultivation of home gardens growing fruits and vegetables; and
- c) establish a support system for improving nutrition in the target districts, through the establishment and training of nutrition ambassadors to support community dietary behaviour change.

The dietary diversity score was used as the main indicator of an adequate diet, with the minimum dietary diversity for a woman defined as at least 5 of 10 food groups (Figure 2) a day.

Figure 2: Ten food groups for measuring dietary diversity

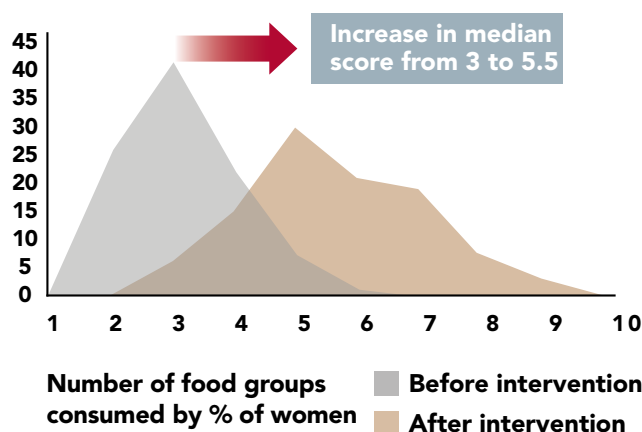


“Before the training I thought that healthy food was something expensive, but now I know that **healthy food is available everywhere around us.”**

Mrs. Romanah, 25 years

Many households reported an increase in cultivating vegetables and fruits, while dietary diversity among women increased (Figure 3). These positive effects of the programme encouraged the Government of Indonesia to adopt it as a national programme in the 32% of the nation's tea areas that it manages (smallholder farmers own 46% of Indonesia's tea plantations, while companies and estates manage 23%)^{xii}.

Figure 3: Self-reported improvements in dietary diversity, May 2014 to May 2015



Source: ^{xiii}

Fruits and vegetables as an important source of missing micronutrients for children

Recent research by GAIN and UNICEF called Comprehensive Nutrient Gap Assessment (CONGA) identified key nutrient gaps faced by young children aged 6-23 months in Eastern and Southern Africa, as well as South Asia. CONGA also highlighted the micronutrient-dense foods that are already relatively affordable in local contexts, though under-consumed, identifying good candidate foods to help plug particular nutrient gaps. Vegetables appeared as an important and affordable source of various micronutrients in all nine of the countries in which CONGA research was conducted. The findings (Table 3) point to a need to increase demand among families with young children, particularly those on low incomes, to include items like dark green leafy vegetables and orange- and yellow-coloured fruits and vegetables in children’s meals.

Table 3: Comprehensive Nutrient Gap Assessment (CONGA) findings relating to vegetables

Country	Key micronutrients of concern among young children	Affordable vegetables for particular nutrients of concern
Bangladesh	Zinc, vitamin A, calcium, iron, iodine	Dark green leafy vegetables for iron, vitamin A, and calcium; Orange/yellow fruits and vegetables for vitamin A
Ethiopia	Iron, zinc, iodine, vitamin A, calcium	Ethiopian kale for iron, vitamin A, and calcium
India	Iron, vitamin A, zinc, vitamin B12, folate, calcium	Dark green leafy vegetables for iron, vitamin A, calcium, and folate; Orange/yellow fruits and vegetables for vitamin A
Mozambique	Iron, vitamin A	Orange-fleshed sweet potato for vitamin A
Pakistan	Vitamin A, iron, folate, vitamin B12, zinc, calcium, iodine, and vitamin D	Dark green leafy vegetables for calcium, iron, vitamin A, and folate
South Africa	Vitamin A, calcium	Carrots and mango for vitamin A
Tanzania	Iron, vitamin A, calcium	Spinach for iron, vitamin A, and calcium
Uganda	Iron, calcium	Amaranth greens for calcium and iron
Zambia	Iron, zinc, vitamin B ₁₂ , calcium, vitamin A and folate	Dark green leafy vegetables for iron, folate, calcium, and vitamin A

Source: ^{xiv}

Recommendations

It's clear that in many settings, especially but not exclusively in low- and middle-income countries, people stand to benefit from more fruits and vegetables in their diets.

2021 is the International Year of Fruits and Vegetables^{xv}. What sorts of things might be done to help boost vegetable and fruit supply and demand around the world? We've listed a few ideas:

Governments can make policies and regulations work for improved fruit and vegetable supply – for instance through funding schemes to develop and boost uptake of improved varieties, including of neglected or traditional vegetables. They can also contribute to multi-stakeholder efforts to reduce loss and waste of perishable fruits and vegetables along the supply chain.

On the demand side, governments, private-sector stakeholders, development partners, and consumer groups can work together to develop innovative demand-generation campaigns, encouraging people – particularly our younger generations – to desire vegetables as much as less healthy options.

Where governments procure food and meals, such as for schools, prisons, and canteens, they can ensure these include ample vegetables in line with national dietary guidelines, helping to stimulate supply and demand.

Governments, including municipal and other sub-national ones, should also be encouraged to set policies in place that boost selling, advertising and otherwise promoting vegetables and other healthy options, while discouraging sales and advertising of unhealthy options – especially to children – as part of wider schemes to improve food environments and reduce food 'deserts' and 'swamps'.

The private sector can also play a big role, by complying with government efforts to improve food environments, or by voluntarily improving offerings. Food manufacturers for example might incorporate a higher proportion of vegetables in processed food offerings, while all companies, particularly larger ones, can offer workplace nutrition programmes that include healthy offerings with plenty of vegetables. Larger companies can mentor smaller ones, for instance to improve the nutrition and business cases of their offerings. Small and medium enterprises can join networks like the SUN Business Network to amplify their voices and to better access available opportunities such as trainings in their communities of practice.

Individuals, consumer groups, and non-governmental organisations have a crucial role to play in amplifying voices and holding both government and private sector actors to account, particularly where commitments are made.

The supply challenges around fruits and vegetables, their lack of affordability, and the underexploited opportunities to boost fruit and vegetable demand are widespread and global. Programming to support these foods will remain firmly on GAIN's plate in the future, as part of our commitment to making healthy foods and healthy diets more available, accessible, and desirable.

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Contact

Global Alliance for Improved Nutrition (GAIN)

Rue de Varembe

1202 Geneva

Switzerland

T: +41 22 749 18 50

E: info@gainhealth.org

www.gainhealth.org

