Planet Friendly Home-Grown School Feeding

What does it mean?

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List of abbreviations

CFS	Committee on Food Security
EU	European Union
GHGs	Greenhouse gases
GPS	Global positioning system
HGSF	Home-Grown School Feeding (Program)
HLPE	High Level Panel of Experts
IPM	Integrated pest management
IRB	Institutional Review Board
ISFM	Integrated soil fertility management
KII	Key informant interviews
LMIC	Low- and Middle-Income Countries
NGO	Non-governmental organization
WFP	World Food Programme
WHO	World Health Organization

Executive summary

School meals present a unique opportunity to tackle the various food system challenges, including the depletion and pollution of natural resources, habitat and biodiversity loss, deforestation, ocean acidification, and climate change, while delivering multiple social and economic benefits towards sustainable food systems for healthy diets (WHO 2022; Pastorino et al. 2023).

Through evaluation of the current school meal supply chain in Sub-Saharan Africa, this study identifies practices in food production, transport, processing, and storage which may influence the impact of school feeding programs on planetary health. The study initially focuses on three main products supplied to schools by the World Food Program (WFP) - maize, beans and dark green leafy vegetables - and proposes to focus on general agronomic, food processing and handling practices. This is a consequence of the lack of crop-specific information on greenhouse gas emissions for the Sub-Saharan region but is based on several individual studies that can be generalized to provide qualitative information on which practices are more planet hostile and which are planet friendly. The results of this study may be interesting for school feeding programs in general, but especially for home-grown school feeding programs (HGSF), which promote shorter, sustainable value chains and a fairer economy for smallholder farmers, fisher folk and disadvantaged groups, particularly women and youth. Despite these advantages, the approach is challenged by the lack of evaluation tools and metrics that can be used to quantify the level of "planet friendliness" in the different regions HGSF is applied.

The assessment undertaken has resulted in an evaluation tool for all of WFP's farmer-directed procurement processes linked to school feeding. The tool, currently in draft form and yet to be tested, provides information about indicators to be included in food procurement policies and processes for the provision of greener school meals in low- and middle-income countries (LMICs). The tool is intended to simplify the evaluation of current procurement processes and guide future decision making around school procurement to ensure planetary health considerations are widely adopted to bolster systemic resilience.

Furthermore, the study identifies HGSF as a potential method to enhance local sourcing from smallholder farmers, bolstering sustainable local agriculture and strengthening local food systems (Pastorino et al. 2023). However, to support agricultural transformation towards environmentally friendly practices and food handling, it is crucial to have in place effective multi-level communication systems and supportive procurement policies. Some case studies highlight the economic benefits that HGSF can bring to local communities, but they also point out challenges in obtaining reliable information on actual food production processes, as sourcing and procurement often occurs at a range of nodes of the supply chain and not directly from farms.

The proposed tool, originating from the analysis of key informant interviews and a literature review, outlines 21 indicators along with potential measures and practices that are categorized as planet hostile, moderately planet friendly, and planet friendly. This tool can serve multiple purposes: as a checklist, a scoring template for refining tenders, a monitoring and evaluation tool, or a foundation for co-creating policies for any school feeding program at the school, local, or national level. It represents a first step towards the development of a tool that can analyse the entire school meal value chain and use sustainability ratings to identify areas for improvement. The tool requires testing and further refinement through an iterative, participatory process to identify context-specific opportunities for ensuring school feeding programs become more "planet friendly".

Introduction

As the world grapples with finding ways to mitigate high-prevalent malnutrition and its effects, other urgent intersecting factors should not be ignored. Challenges range from environmental degradation, pollution of natural resources, biodiversity loss and climate change driven by a combination of factors including the need to feed a rapidly growing human population. Assessing the current trends in food production, transport and storage systems that underpin our food system supports the development of evidence-informed guidelines that protect the interests of efficient, equitable, and sustainable use of resources, and aid in better management of food systems for the future.

Public food procurement has in recent years been seen as a key game changer for food systems transformation with the ability to influence both food consumption and food production patterns and to deliver multiple social, economic, and environmental benefits towards sustainable food systems for healthy diets (WHO 2022). Working with school feeding and public procurement programs to revisit and re-orient their policies and processes is seen by the Conference of the parties of the UNFCCC as a strategic way forward towards more sustainable agriculture, resilient food systems and climate action (UN Climate Change, COP28 UAE 2023). The concept of integrating food into climate adaptation plans is further embedded in the recommendations stemming from the recently launched CFS-HLPE report on "Strengthening urban and peri-urban food systems to achieve food security and nutrition" (HLPE 2024).

Public organizations are responsible for a considerable share of food procurement in any national economy, purchasing a significant portion of the food consumed daily (Jones 2021). Due to its pivotal role in public spending, procurement can act as a lever for implementing an economy-wide approach to climate change by aligning purchasing decisions with sustainability and climate objectives, engaging with suppliers to foster positive change, and encouraging innovation and transparency throughout the supply chain. Using a life cycle assessment to measure public procurement processes, contextualized programming has the potential to build a resilient and sustainable food system supported by the four sustainability pillars: social, environmental, health, and economic factors (WFP 2022b).

In 2019, WFP introduced a new policy and framework on local and regional food procurement, which established principles and parameters for procurement decision-making that acknowledged the importance of all actors in the food supply chain, including of smallholder farmers. The policy enhanced food purchases from local smallholder farmers with an aim to enhancing local development (WFP 2019). Since the policy was launched, WFP has steadily increased the share of food procurement that it carries out locally, including for its school feeding programs.

Smallholders are strongly represented in home-grown school feeding (HGSF) initiatives, for example, which connect school feeding programmes to local food production from smallholders (Box 1). When effectively designed, the key principles of HGSF include local food procurement, smallholder engagement, the serving of nutrient-rich and diverse foods, and regularity in meal provision, leading to increased farmer incomes and improved livelihoods. Emerging data from various geographies strongly suggest that HGSF has the potential to support nutrition-sensitive agriculture and agrobiodiversity and to address environmental degradation, climate change, malnutrition, and economic inequality (Singh and Conway 2021).

Box 1.

Home Grown School Feeding (HGSF) is defined as a school feeding model that provides safe, diverse, and nutritious food, sourced locally from smallholders to children in schools (FAO and WFP 2018). HGSF programs present a distinctive opportunity to address planetary health considerations within food systems.

Community and government led changes, including policies favouring the integration of agrobiodiversity and climate smart foods into school meal programmes, can effectively catalyse planet friendly agricultural practices and food sovereignty (WFP 2023). Documentation further suggests that the promotion of nutrient rich, locally adapted and diverse menus, clean energy for cooking, reducing food waste, promoting food systems education as well as promoting ecologically sustainable agricultural practices can contribute to school meals becoming more planet friendly (WFP 2023). In turn, a focus on making school meals more planet friendly would contribute to building sustainable food systems that are economically viable, providing broad-based benefits to society and having positive or neutral impact for the environment (FAO, Alliance of Bioversity International and CIAT, and Editora da UFRGS

2021). However, existing tools and measures are complex, time consuming and costly and can therefore only be used to a limited extent in a day-to-day basis.

Box 2

Planet friendly school meals are healthy school diets that have the least impact on environmental boundaries based on how the foods are grown, packaged, processed, preserved and transported to and prepared in the schools. Agricultural practices, transport systems, processing mechanisms, and storage methods thus all play a vital role in the environmental and climatic impact of school feeding programmes.

The aim of this study was to provide WFP, governments and schools procuring food for school meals with a tool to quickly assess and analyse the impact of food sourcing decisions on various dimensions of planetary health. The result is an evaluation tool for school meal value chains which provides information about measures to be included in food procurement decision making for providing planet friendly school meals in low- and middle-income countries (Box 2).

The work presented here include the key findings. Detailed background information and additional literature references are available in a separate document, the Annex. Additional evaluation criteria, qualitative indicators and a tracking progress checklist are presented in Annex 1; Annex 2 presents scientific background information for the proposed rating of the different practices; Annex 3 provides the literature references for the section on agricultural practices presented in the evaluation tool; Annex 4 presents background information on aspects relating to environmental impact along the value chain and Annex 5 on environmental impact of storage systems. Key findings of the KII are summarized in Annex 6.

SINGI with African nightshades at school. Photograph by: Annie Sanderson

Methodology

The research design, methodology and approach for this work was based on qualitative methods and approaches, including secondary data collection via a literature review, and key informant semi-structured interviews. These were both supported by the WFP global office. The regional focus for this work was on Sub-Saharan Africa.

The **literature review** focused on identifying practices withing the current procurement system that impact sustainability and provided insights and perspectives into the WFP-led acquisition of foodstuffs. Key documentation was provided by the WFP global and country offices. Additionally, a computerized search was undertaken using Google searching for appropriate keyword combinations in English including *home-grown school feeding*; *school meals*; *public* or *institutional food procurement*; *food procurement and climate change*; *agrobiodiversity*; *climate smart foods*; *planetary health*; *environmental impact*; *food processing*; *transport systems*; *food storage*; and *greenhouse gas emissions and public procurement systems*. Approximately 200 documents/reports/peer-reviewed papers published between 2009 and 2024 were fully analysed; 50% of these were peer-reviewed papers focusing on agronomic practices related to maize, bean and green leafy vegetable production and climate impacts published between 2011 and 2024.

Key informant interviews

To clearly understand the status and approaches used in school meal procurement to mitigate the environmental impact of the food supply chain, its activities, and associated value chain players, a round of stakeholder consultations was conducted from May 9th to June 16th, 2024. These consultations involved key informant, semi-structured virtual interviews with 10 different expert groups from various national and international institutions, including three schools, the Japan International Cooperation Agency (JICA), WFP, and the Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT). Key informants were comprised of:

1. Supply chain officers
2. Supply chain sustainability officers
3. Smallholder market access officers
4. School meals, social protection, and meal planning officers
5. Regional school feeding advisors
6. Nutrition data analysts
7. Homegrown school feeding procurement experts
8. Food systems and nutrition analysts
9. Food fortification and nutritious foods development officers
10. School officials, including the principal and teachers

The initial list of key stakeholders to be included was provided by WFP headquarters and was subsequently expanded using suggestions from the key informants. The virtual interviews were recorded following verbal consent from the participants. The semi-structured interviews sought to address information gaps around the impacts of school feeding programs, including HGSF, brought to light by the systematic literature review. They also aimed at identifying success stories on planet friendly considerations in past or ongoing school feeding and HGSF implementation efforts; good practices, and lessons learned, as well as revealing institutional/governance, operational, technical, and financial challenges.

Key assessment questions were developed by the evaluation team and guided the interviews. Transcribed raw data underwent processing, cleaning, and organization. Based on the identified key criteria, the transcripts were labelled by thematic coding and the development of an objective-specific framework for ease of presentation. This was done using MAXQDA version 24 (MAXQDA 2024). The quotes contained in the report have been annotated where necessary and supplemented by inserting information in [...] to provide contextual information and (...) to indicate sections that have been omitted to facilitate reading and understanding. In addition, case studies from past and ongoing school meal programs were identified and summarized to provide in-depth information about the diversity of settings under which school meal programs are operating.

At the start of the study, the focus was on three main foods –maize, beans, and green leafy vegetables–commonly procured in the countries where WFP operates. However, during the project, it became clear that a range of indicators relevant to planetary health apply to all foods. Consequently, the emphasis shifted from identifying differences between these specific foods to developing general criteria applicable to the procurement process for any food. Additionally, interviews underscored the need for a flexible tool capable of addressing various operational demands and predicting and mitigating the environmental impacts of both development and emergency operations. This tool would be adaptable for making daily decisions regarding WFP's local food procurement in its entirety.

The study adhered to the Institutional Review Board (IRB) of the Alliance of Bioversity and CIAT (2024-IRB39). The study also aligned with the norms and standards for evaluation as guided by the United Nations Evaluation Group (UNEG).

Sustainable Agri school land. Photograph by: Teresa Borelli

Results

Procurement systems

WFP's involvement and support in school meal programs vary by country and sometimes within country. Depending on where WFP has the lead and/or offers technical support in the development of procurement policies and guidelines, WFP is directly or indirectly engaged in food procurement from smallholders for school meals. This is done by designing and implementing school feeding programs aligned with national priorities that may not include planet friendly procurement aspects. In some countries, the transition of school meal program management from WFP-led to government-led is at an advanced stage such as in Benin.

In WFP-led school feeding programmes, WFP emphasizes food safety and quality through joint assessments with suppliers. The organisation works closely with governments and other partners to enhance program effectiveness and sustainability. Additionally, vendor management committees at WFP oversee procurement processes. WFP further uses several models for school meal programs based on local contexts (Figure 1). Under this modality, WFP maintains rosters of approved vendors for procurement.

> *However, for Benin, I can inform you that for now it is WFP that is leading the school meal program, but it is planned to be transferred to the government by the end of this year. The policy [procurement policy] is ready, but it has not yet been implemented, which is to be handed over [and does not include planet friendly aspects].*
>
> *Food Fortification and Nutritious Foods Development Expert*

Once school-feeding programs are well-established, a transition strategy is put in place and program implementation and management are handed over from WFP to governments. WFP then works with governments to increase the coverage, quality and sustainability of nationally owned programmes for example by aligning with national development plans (Bundy et al. 2009). The local procurement policy aims to support the regional agricultural economy but does not automatically include aspects of planetary health.

The Rwandan Government has for example successfully taken over the HGSF program under the lead of the government including procurement from fortification processors. Nevertheless, challenges include data scarcity and ensuring food safety standards are met when procuring locally. Further, the program does not include planet friendly procurement aspects.

> *And Rwanda is a good case [program has been handed over to the government], you know because it is a national program. Now if I remember correctly, the government has already invested, and taken over at least 3.8 million children under the HGSF program.*
>
> *Homegrown School Feeding Procurement Expert*

Increased budget allocations for school feeding programs in countries like Burundi have the potential to contribute to climate impact mitigation by incorporating sustainability criteria into the procurement process to promote sustainable food production. By focusing on sustainable approaches for meal preparation and procurement, region-specific challenges can be effectively addressed. Experts recommend that WFP consistently integrate sustainability criteria into its procurement processes while maintaining a focus on the community and humanitarian context. This approach will support sustainable changes in the school meals value chain, making it more planet friendly.

The pathways for school meal procurement vary based on the country programs in place. Maize is often purchased in bulk, while beans are acquired through mixed purchasing schemes depending on the program's resources. Green leafy vegetables, however, are usually bought locally or produced and contributed by the school community, resulting in a more diverse and less systematic value chain. Due to their high perishability and limited cool storage

and transport capacities, vegetables may be purchased daily to prevent food loss and waste. However, local sourcing may be insufficient due to the schools' limited financial resources and procurement systems that do not provide the funds needed to buy directly from local farmers. Any procurement evaluation tool for planet friendly school meal programs must therefore be flexible and adaptable to various steps in the procurement system and applicable to all decision-makers within the HGSF value chain. Figure 1 provides an overview of the different school feeding operating models, illustrating that there is no straightforward option for incorporating planet friendly aspects in the school meal value chain. Procurement decisions are made at different levels of authority with varying budget allocations.

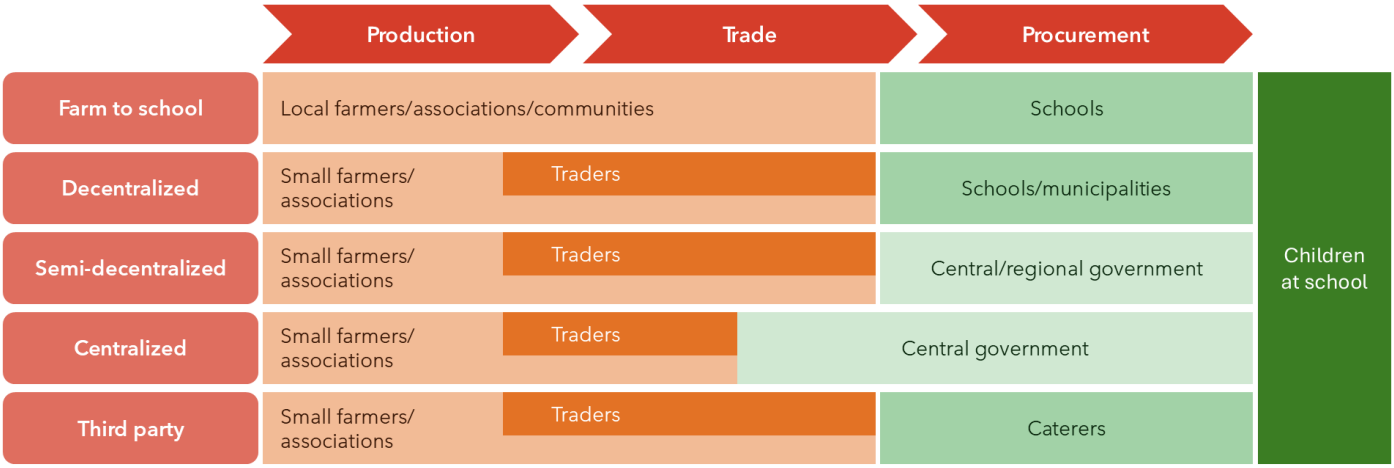


Figure 1: *Overview of the different combinations of centralized, decentralized and third-party operating school feeding models (FAO and WFP 2018, page 18)*

There is extensive knowledge and experience highlighting the challenges schools encounter in maintaining a sustainable school meal program. These challenges begin with budget constraints and the quantity of food required to meet children's nutritional needs, as well as the logistics and capacities needed by the various actors and institutions involved in these programs. Three case studies were chosen to illustrate the well-known complexities of implementing school feeding on the ground and to identify opportunities where planet friendly aspects can be easily integrated.

School lunch meal (Ugali, a maize based staple and leafy vegetables). Photograph by: Yasuyuki Morimoto

Case Study 1: Decentralized system

In this system, funds and authority for food purchases are transferred to the schools. Alternatively, or in addition, schools have adopted parent-supplied school meals, or cultivating food for the school canteen directly on school land. Typically, during non-emergency periods, schools depend on parents to provide food, they engage in self-sufficiency initiatives, procuring locally. Clear communication with parents about the required food items is essential in this system.

Parent-supported HGSF in Kitui County, Kenya

In Kitui, Kenya, a school initiated a parent-supplied school meal program when the government-led school feeding program proved insufficient and irregular. Since February 2024, without government support, the school sought approval from parents and the school management committee to implement parent-supplied meals. This system has the potential to involve local smallholder farmers and suppliers and is suitable for smaller-scale purchases, such as for one or two schools at a time. In this school-parent led program, food procurement depends on parents' resources and willingness to produce in a planet friendly manner.

Food items and their quantity are determined with the involvement of the headteacher, teachers, and other school stakeholders such as the management committee. Foods chosen are based on what is readily available, typically maize and beans. In some instances, schools accept other legumes, such as pigeon peas. Factors such as nutrient content (e.g., iron-rich beans) or farming methods (e.g., organic) are currently not considered. The main concern is ensuring enough food is provided to keep the children well fed. The frequency of food contributions by parents varies and can be weekly, monthly and termly. While most of the food provided comes from the parents' own production, some is purchased from local markets. Families may sometimes sell foods such as sorghum, millets or cassava to buy more maize and beans. By informing parents in advance about the required quantities needed and their "planet friendliness", farmers could be incentivised to rethink their production practices. Currently, the quality of food is checked upon delivery and products with pest infestation or poor quality are rejected. However, the production system is not "visible" and only attested by the contributing farmers. Food storage facilities are available and could be made planet friendly. Currently, however, there is no eco-friendly production standard for schools, so food quantity and safety are the main indicators used.

Common mixed dish (maize, beans and green leafy vegetable). Photograph by: Yasuyuki Morimoto

Case Study 2: Hybrid system

In farmers, third party or hybrid systems, authority and funds for food purchases are transferred to intermediate entities e.g., NGOs, catering companies, and central kitchens. This system increases the chances of involving local smallholder farmers/suppliers while maintaining some level of central oversight. However, it requires that the intermediate entities operate with policy regulations that support the inclusion of planetary health considerations and protect and/or provide space and opportunities for farmers to produce in an environmentally friendly manner.

Meghalaya, Northeast India

The Pradhan Mantri Poshan Shakti Nirman (PM POSHAN) or national school meals program in India aims to provide free cooked meals to all school children. However, the program has trouble effectively changing the lives of its beneficiaries in the country's most remote areas. In Meghalaya, a hilly state in the Northeastern region of India, where the Khasi indigenous community are over 1 million strong, schools receive inadequate funds from PM POSHAN to provide nutritious and balanced meals. Starting in June 2023, the Northeast Society for Agroecology Support (NESFAS) started testing the feasibility of setting up a local procurement model that includes a community fund raising plan to sustain the program beyond this pilot. Local procurement guidelines were developed by NESFAS, mandating that, except for rice, oil and sugar, all other food items required for the school meals program are sourced from local smallholders and farmers groups with preference given to groups with members from marginalized communities. The initiative, which ended in May 2024, was feeding 411 children in 10 schools across seven villages in the Khasi and Garo Hills regions of Meghalaya. Thanks to direct purchasing from local farmers, all children were guaranteed a warm, nutritionally adequate meal (5 food groups) with minimum food waste throughout the week. In kind contributions from parents, who provide seasonal wild vegetables, and produce from school gardens, also complemented the menu with traditional, nutrient rich food plants, that are also climate resilient, such as local millets, local bean varieties and green leafy vegetables. Initial results from the pilot show increased school attendance and renewed appreciation for heritage crops by students. Simultaneously, local farmers have benefitted from a reliable and stable market for their produce.

How the food is produced and how the production complies with the tenets of planet friendly school meals would need to be evaluated.

More information:

https://nesfas.in/community-led-school-meals-initiative-celebrated-at-mini-festival-mark-bittmann-applauds-indigenous-peoples-food-systems/

https://nesfas.in/community-led-school-meals-initiative-celebrated-at-mini-festival-mark-bittmann-applauds-indigenous-peoples-food-systems/

https://theshillongtimes.com/20/04/03/school-meals-fest-raises-hopes-for-indigenous-food-systems/

Koubri, Burkina Faso - Resilient local foods in school meals curb biodiversity loss and increases cultural identity

As part of its mandate, Association Watinoma (an Italian-Burkinabé non-profit organization that has been operating in Koubri, Burkina Faso) provides a daily balanced meal to all its students. Starting in 2023, within the EU-funded project SUSTLIVES, the Alliance of Bioversity International and CIAT has been working with Ecole Watinoma to improve the diversity of the school menu by including nutritious forgotten foods of the Sahel – such as moringa and Bambara groundnut. Local legumes such as Bambara groundnut thrive in nutrient-poor soils, are drought-tolerant, mostly resistant to pests and diseases and help replenish soil nutrients by fixing atmospheric nitrogen. As part of the work, these species are now grown in the school garden that directly serves the school canteen. Complementing the new menu are awareness raising activities on the benefits of these indigenous crops, including their role in diversifying diets. A 12-week course has been developed to encourage learning and intergenerational knowledge exchange around these species that also help to conserve and maintain cultural identity and culinary traditions alive.

Loss of biodiversity is an important indicator in the debate on planetary health. Agronomic practices, trade and procurement systems can either increase biodiversity loss or conserve and increase biodiversity as described in this case. Biodiversity should thus be included in the evaluation framework.

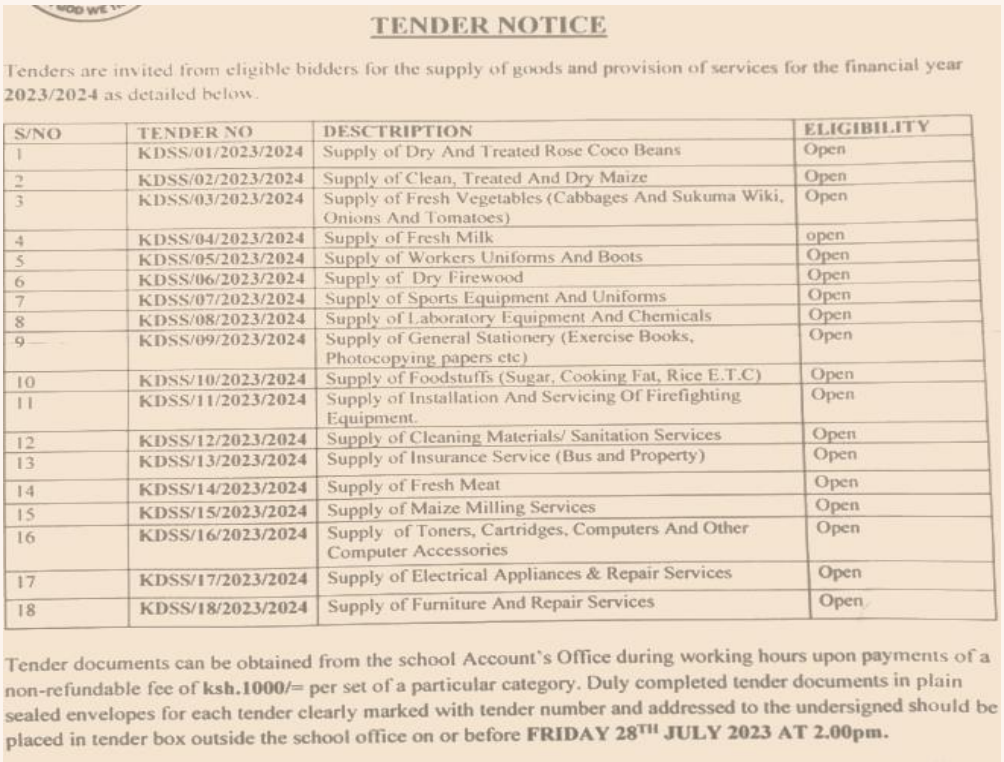
More information: https://alliancebioversityciat.org/stories/sowing-seeds-tomorrow-one-school-garden-time

Case Study 3: Centralized system

In centralized procurement systems food purchasing is managed and coordinated by a central authority or organization (e.g., government or WFP) rather than by individual schools or local entities. This system is ideal for bulk purchasing of cereals, like maize, but less workable for perishable vegetables. Bulk purchasing translates into cost efficiency and better bargaining power. Local smallholder farmers/suppliers may have difficulty accessing this centralized system and procurement officers may find it hard to establish how the food was produced and processed. For this to happen, planet friendly criteria should be included in the tender system and a monitoring system established that incorporates random sampling of suppliers along the food value chain to assess how the food was produced, processed and transported to the centralized storage facilities.

Government Supported School Feeding Program in Kitui County, Kenya

The central government in Kenya determines the amount of aid each county is allocated based on the total amount of donations received and the country's current financial situation. Subsequently, county governments allocate resources to schools, determining whether to distribute funds thinly across many schools or to concentrate funds on fewer schools and provide larger allocations. Food aid is primarily for emergency relief targeting areas or regions experiencing significant food security challenges. The availability of aid support is inconsistent. While support may be available one year, there is no guarantee that it will continue in the following year. For instance, in 2013, Kitui County received food aid for approximately 400 schools. However, in 2014, only 81 schools were supported (5% of the total public schools in Kitui county). When food assistance is distributed in-kind, schools simply wait for the predetermined supplies. Where support is provided in cash, schools publicly announce the specific food items required (such as maize, beans, salt, and cooking oil) and quantities needed, and then solicit suppliers (as shown in the tender notice). WFP-supported procurement activities are conducted in accordance with WFP guidelines that emphasize food quality, quantity, and delivery deadlines. Suppliers must consider several factors when sourcing foods, including colour, weight, shape of the foods, as well as insect damage. Suppliers typically deliver monthly. Additionally, they are usually required to meet the health standards set by the Kenyan Ministry of Health.



TENDER NOTICE

Tenders are invited from eligible bidders for the supply of goods and provision of services for the financial year **2023/2024** as detailed below.

S/NO	TENDER NO	DESCTRIPTION	ELIGIBILITY
1	KDSS/01/2023/2024	Supply of Dry And Treated Rose Coco Beans	Open
2	KDSS/02/2023/2024	Supply of Clean, Treated And Dry Maize	Open
3	KDSS/03/2023/2024	Supply of Fresh Vegetables (Cabbages And Sukuma Wiki, Onions And Tomatoes)	Open
4	KDSS/04/2023/2024	Supply of Fresh Milk	open
5	KDSS/05/2023/2024	Supply of Workers Uniforms And Boots	Open
6	KDSS/06/2023/2024	Supply of Dry Firewood	Open
7	KDSS/07/2023/2024	Supply of Sports Equipment And Uniforms	Open
8	KDSS/08/2023/2024	Supply of Laboratory Equipment And Chemicals	Open
9	KDSS/09/2023/2024	Supply of General Stationery (Exercise Books, Photocopying papers etc)	Open
10	KDSS/10/2023/2024	Supply of Foodstuffs (Sugar, Cooking Fat, Rice E.T.C)	Open
11	KDSS/11/2023/2024	Supply of Installation And Servicing Of Firefighting Equipment.	Open
12	KDSS/12/2023/2024	Supply of Cleaning Materials/ Sanitation Services	Open
13	KDSS/13/2023/2024	Supply of Insurance Service (Bus and Property)	Open
14	KDSS/14/2023/2024	Supply of Fresh Meat	Open
15	KDSS/15/2023/2024	Supply of Maize Milling Services	Open
16	KDSS/16/2023/2024	Supply of Toners, Cartridges, Computers And Other Computer Accessories	Open
17	KDSS/17/2023/2024	Supply of Electrical Appliances & Repair Services	Open
18	KDSS/18/2023/2024	Supply of Furniture And Repair Services	Open

Tender documents can be obtained from the school Account's Office during working hours upon payments of a non-refundable fee of **ksh.1000/=** per set of a particular category. Duly completed tender documents in plain sealed envelopes for each tender clearly marked with tender number and addressed to the undersigned should be placed in tender box outside the school office on or before **FRIDAY 28TH JULY 2023 AT 2.00pm.**

***Figure 2**: Public tender notice of a day secondary school. Various items are included in the list including food supplies (beans, vegetables, milk, fresh meat) and food processing services such as maize milling services*

Actors in the procurement systems

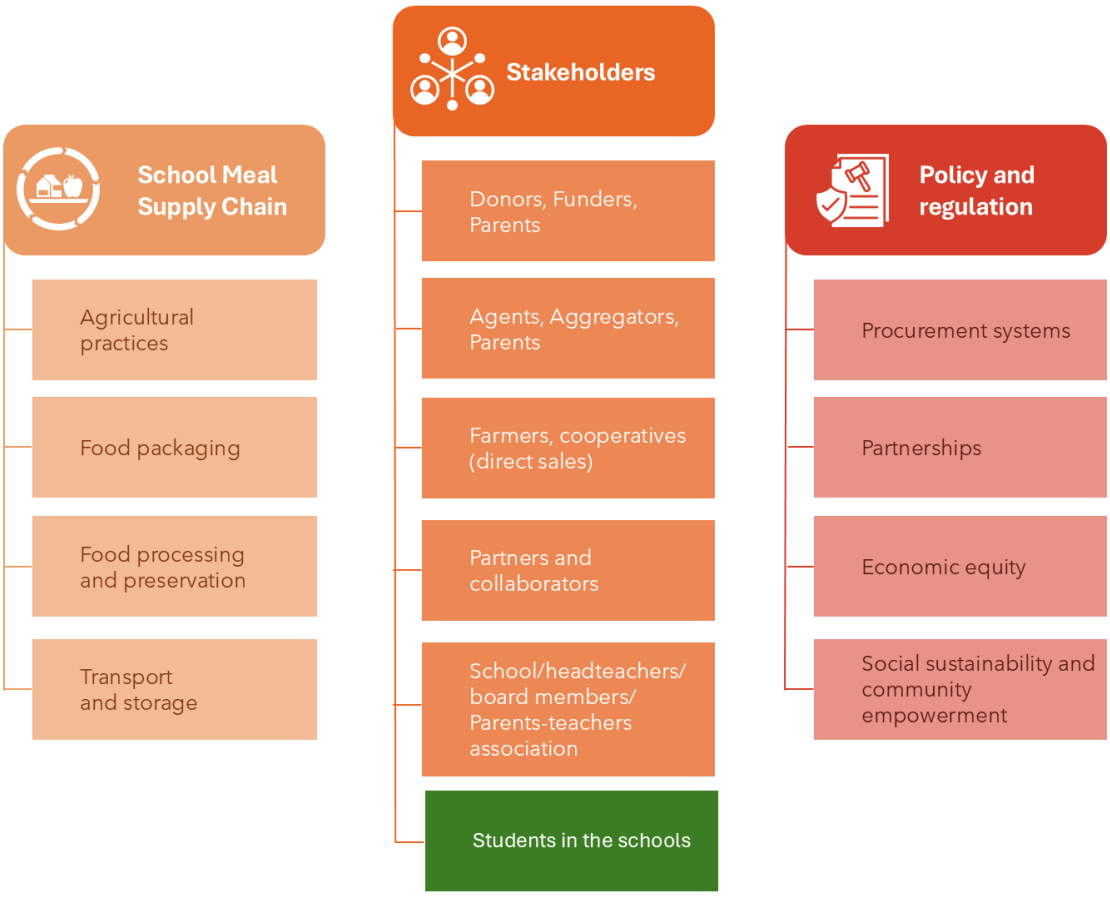


***Figure 3**: Stakeholders involved in the school meal supply chain. Ad hoc interventions along the school meal supply chain, the different actors and the policy environment have the potential to make school meals more planet friendly*

Differently from the linearity presented in Figure 1, school meals supply chains are complex, multifaceted and constituted by different players and procedures as for most public food procurement systems. Actors, including private sector suppliers, markets, producers, and vendors on the supply side, can be persuaded to adapt their procurement initiatives in pursuit of different outcomes linked to the three dimensions of sustainability (economic, environmental and social) (FAO, Alliance of Bioversity International and CIAT, and Editora da UFRGS 2021). Students, who are the school meals' main beneficiaries, can also act as decision makers in some settings, by accepting or rejecting what and how food is served. They may also be contributors either through their engagement in school gardens or by delivering foods contributed by their families. Ad hoc interventions along the school meal supply chain, the different actors and the policy environment have the potential to make school meals more planet friendly (Figure 3).

> *"Students may go on strike if the school meal is not palatable"*
>
> *Headmaster in Busia, Kenya*

Current planet friendly considerations in WFP's food procurement system

In its quest to systematically integrate environmental considerations into the organization's work, WFP is guided by its Environmental Policy (2017), which emphasizes methods for identifying, avoiding, addressing, and managing environmental risks in WFP's interventions, while also acknowledging that WFP's food assistance activities can create environmental benefits. The policy, assists WFP in:

i) gradually improving the environmental sustainability of its activities and operations
ii) safeguarding the environment
iii) boosting resource efficiency and reducing its carbon footprint

iv) aligning its actions with international best practices and global standards for environmental sustainability, and
v) enhancing the capacity of partners to plan and execute environmentally sound activities for food security and nutrition.

In terms of the procurement of goods, services and food, WFP is guided by a goods and services procurement manual, which includes "guidance on sustainable procurement. WFP is increasingly incorporating environmental performance criteria and whole-of-life costing into the specifications of products and services and into tender evaluations" (WFP 2022a). For sustainable food procurement, the supply chain within WFP has developed indicators under the Environmental Plan of Action that address planetary health standards within the supply chain including shipping and aviation. WFP also enhances the capacity of local suppliers to improve the quality of food products offered to the organization, particularly through the smallholder market support program, and collaborates with partners and suppliers to minimize the environmental impact of the supply chain (WFP 2024b). At present, the WFP food procurement process involves the following steps: planning, sourcing, vendor registration and management, tendering, management and evaluation of quotations, procurement review and decisions, award and contracting, delivery and contract management. The organization's food procurement strategy takes into consideration

i) the state of the food markets,
ii) seasonality of crops (and purchasing of foods following their harvest seasons as far as it is possible),
iii) outcomes of market assessments- including availability of commodity, prices, location etc.

However, in the case of WFP, procurement processes tend to start from the market assessment and are characterized by a strong focus on availability of commodities sold at a fair price and delivered within a given timeframe. While sometimes market research may attempt to understand the environmental impact of local food production, transport, storage and consumption practices, these nodes in the supply chain seem not to be a major focus of WFP's current procurement procedures (WFP 2019). This results in a fragmented discussions and single solutions in which the different procurement sectors work with different tools and policy regulations to achieve planet friendly school feeding programs. Common agreement in the KII was that HGSF programs are somehow different to the "regular" school feeding programs; they have considerable potential to be planet friendly due to the inherent nature of HGSF programs. Also acknowledged was the notion that short value chains *per se* do not make a program planet friendly.

Undertaking a conclusive analysis of school meal procurement systems is a big challenge that has in turn forced WFP to selectively carry out an environmental impact analysis with a primary focus on food production. While streamlining supplier operations from WFP's side, the organization's adherence to environmental standards is mostly associated with the existence of a national framework that supports sustainability. Consequently, when no national laws and sustainability standards are in place, WFP will find it challenging to institute any supplier changes.

Further, WFP's choice of food suppliers in an emergency relief response setting is generally on a need's basis. To enable a rapid response, the approach generally focuses on production and processing capacity, food safety, quality system capacity, storage capacity, and logistics and less on the environmental impact of food procurement. This does not automatically exclude sustainability concerns, but it requires that sustainability aspects are included in the run up to emergency response procurement.

"(…) where we need to respond quickly to an emergency (…) we need to make sure that we can continue to deliver on that mandate and to provide the right assistance for emergencies when that occurs. So, we want to set up these types of operations and have the right guidance and steps in place so that when they are being set up in the future and emergencies are being responded to, that can be done from the beginning, more sustainably. (…) We just need to make sure that policies we put in place (…) make sure that we are not restricting the ability to make fast, effective decisions in response to emergencies purely based on sustainability, but at the same time, not throwing sustainability in the bin every time there is an emergency."

Sustainable Supply Chain Officer

While large-scale processors are considered big players in procurement, medium-scale capacity, and small-scale vendors are appreciated by WFP and especially targeted in HGSF programs. However, there is much work to be done in terms of food safety, quality implementation, and capacity strengthening to bring small-scale producers to par with the large-scale players. Most companies that WFP works with are international and therefore sustainability criteria for these companies may be incorporated in procurement tenders. WFP seeks to strike a balance in how the organization encourages a sustainable value chain while protecting local markets. Instead of setting up sustainability criteria to filter out non-compliant suppliers, local and regional procurement policies are developed that take care of supply chain sustainability. One example for this approach may be the school meal program in Ghana in which WFP provided financial and technical assistance to reduce CO_2 emissions in food value chains (WFP 2023; 2024a). Furthermore, WFP supports smallholder producers through buying their produce and enhancing their expertise in farming best practices. Like smallholder farmers, local vendors are not excluded from WFP tenders based on sustainability cut-off grounds except in certain circumstances when they are unwilling to comply or there is an existing international company that can do better.

"So, if I remember correctly, the one we have for the DRC maize meal is quite broad. It includes everything from production to land use (…) we have developed indicators and measures. Some are qualitative indicators. Some are indicators that are going to become better as we move forward as part of an exercise called Environmental Plan of Action, which is WFP's response to the UN environmental strategy."

Sustainable Supply Chain Officer

Current planet friendly considerations along the supply chain

WFP incorporates standards in its procurement system to address food safety and minimally on climate-friendly practices. These standards include microbial analysis of procured grains and focus on reducing solid waste and greenhouse gas emissions. Key indicators such as water footprint, greenhouse gas emissions (measured in kilograms of CO_2 equivalents per kilogram of food), and land use (measured in square meters) are of interest. Despite the potential to mitigate environmental impact, there is a lack of defined procurement methodologies for a planet friendly supply chain approach.

In 2022, a background paper was published highlighting progress and some of the potential bottlenecks faced by WFP on the implementation of the 2017 Environmental policy (WFP 2022a). Among these challenges was the requirement for clear targets for WFP's environmental footprint, in terms of emissions, waste generation, water consumption and biodiversity degradation. This gap will be addressed by WFP's Environmental plan of action (EPACT) for 2030, which, once published, will describe the organization's commitments to environmental sustainability management and set out targets for the reduction of WFP's environmental footprint by 2030.

Meanwhile, key informant interviews highlighted that WFP currently focuses mainly on the environmental pillar of sustainability, and specifically on reducing greenhouse gas emissions and ensuring no harmful solid waste is generated when food for school meal programs is produced or transported (Figure 4). This is based on the notion that these are the highest contributing factors to climate change and that efforts to curb their production may be easily integrated into WFP's school meal procurement programs to make them more planet friendly. Existing tools like the

"We use the cost of the diet tool (…) so sort of bridging between nutrition and economic access, (…) to compute the minimum cost of nutrient adequacy, affordability of these and full composition [with environmental impact] (…). (…) yes, the idea to move towards the environmental dimensions being part of the optimization. (…) Trying to minimize what is the potential harmful environmental impact [but to achieve a nutritious diet]."

Nutrition and Food quality service of WFP

cost-of-the-diet, which aims to improve the overall meal composition of school meals and addresses the nutrient needs of school children at affordable prices, have integrated environmental impact using the parameters *greenhouse gas emissions* and *water food print* for foods listed in the related database.

However, expanding the software to include other sustainability parameters, such as agronomic practices, could result in different greenhouse gas emission rates per food, while acknowledging the economic and social benefits to local producers who engage with HGSF. Local food production practices may be less efficient per ha of land but are associated with lower rates of greenhouse gas emissions due to the use of traditional farming practices and reduced transport times (Boone et al. 2016; Joseph et al. 2024). While transport logistics and packaging may have been included in the existing frameworks, more emphasis needs to be placed on the agronomic practices, on soil health, biodiversity loss and the water footprint of food production, which are important considerations for the different sustainability layers in food value chains (Joseph et al. 2024; Brempong et al. 2023).

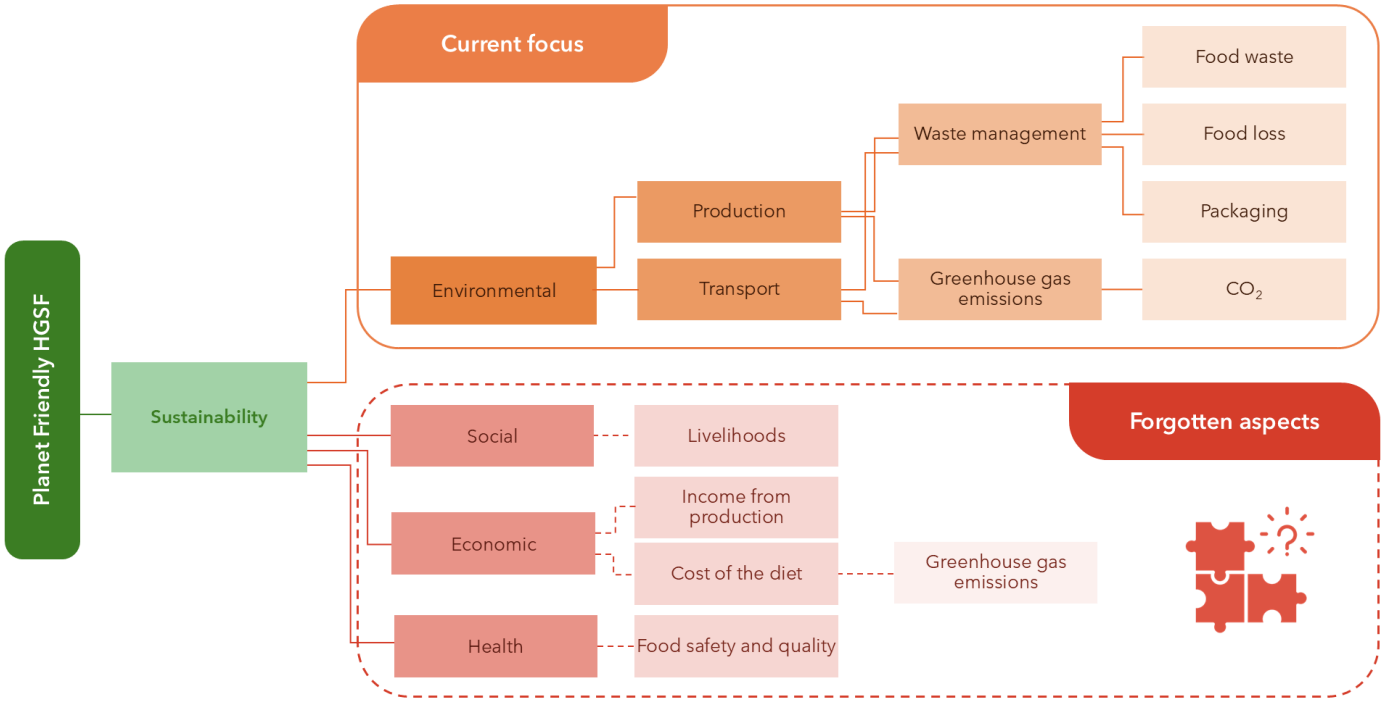


***Figure 4**: Planetary health considerations currently included in WFP's school procurement processes (compiled based on key informant interviews); closed line indicates existing debates and actions; dotted line indicates planet friendly aspects decoupled in WFP's internal strategic discussion around school procurement, based on information collected in June 2024*

Life cycle assessments reviewed in the literature indicated that shortening the school meal supply chain, such as through HGSF programs, significantly reduces GHG emissions (Brempong et al. 2023; Joseph et al. 2024). HGSF also cuts down on waste since shorter value chains typically involve less transport, minimal food handling, and reduced packaging. Although these benefits are recognized in the broader debate on planet friendly school meals, they are less emphasized, possibly because their impact on greenhouse gas emissions and waste is harder to quantify in a decentralized procurement system. Nonetheless, HGSF inherently supports social, economic, and health sustainability by fostering shorter, sustainable value chains and creating a fairer economy for smallholder farmers, fisherfolk, and disadvantaged groups.

Practices to be considered towards planet friendly school feeding programmes

Sustainable procurement practices that consider both social and environmental impacts along the food supply chain will enhance local markets driving economic equity while ensuring long term sustainability and healthy diets for school going children. Figure 5 presents an overview of the elements and stakeholders as well as the levels where decision making is taking place and where planet friendly procurement decisions may be implemented. The focus is on providing planet friendly school meals. Special actions may be taken in schools like a reduction of firewood consumption (Gelli and Ruel 2023) while actors in the procurement systems need to consider how food is produced, packaged, processed and potentially preserved, transported and stored prior to reaching the school. For optimal

evaluation, the school meal procurement system should consider both how the food is prepared at the school and the procurement process before the food reaches the school gate, as both aspects are crucial (Gelli and Ruel 2023).

In the HGSF approach, a variety of actors need to be involved to ensure that the food delivered to schools is planet friendly. This differs from the centralized procurement approach, where fewer people are involved in procurement, and larger retailers or aggregators are responsible for supplying food. HGSF requires strong tender processes, partnerships, and collaborations within a transparent policy framework that encompasses all sustainability aspects. Additionally, financial mechanisms are needed to cover the extra costs during the transition phase, as established networks may need to be reassessed and new networks created while the food value chain is transformed.

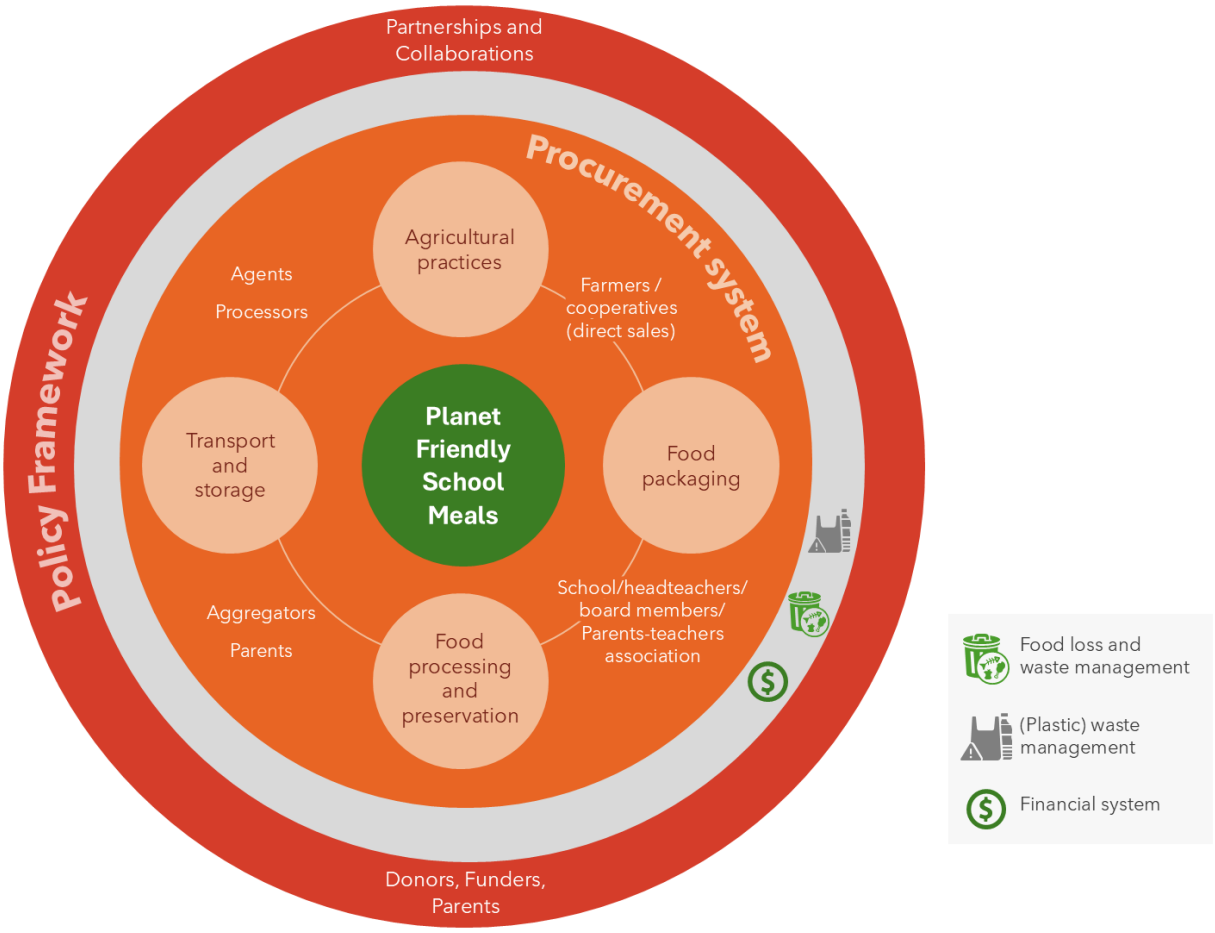


Figure 5: Overview of elements and stakeholders that need to be considered for evaluating school meals

Important elements of the procurement systems related to planet friendly school meals

To make informed decisions targeting planet friendly school meals, various steps in the food procurement value chain need to be examined by different stakeholders. Agricultural practices, food packaging, food processing and preservation as well as transport and storage all influence whether a school meal can be considered planet friendly.

Agricultural practices

The way food is produced can contribute significantly to environmental degradation. Especially, agronomic practices at farm level have enormous environmental implications and should be considered in an evaluation framework when procuring food. Activities such as tillage enhance soil erosion (Diop et al. 2022; Sithole, Magwaza, and Thibaud 2019), and deplete top fertile soil for crop growth. Chemical soil deterioration can result from the improper use of agrochemicals in agricultural production (Falconnier et al. 2023), leading to soil and water contamination and disrupting soil microbial communities and soil structure. Physical soil deterioration, characterized by compaction, crusting, and loss of soil structure, presents additional challenges for agricultural production. Compacted soils restrict root growth and water infiltration (Diop et al. 2022), compromising crop nutrient uptake and increasing chances of runoff and erosion. Runoff, collected in rivers and streams, may result in flooding far away from the actual precipita-

tion source areas resulting in economic losses and reduced agricultural productivity in the flood-affected areas (Saco et al. 2021). Loss of soil biodiversity due to land degradation reduces the natural resilience of agroecosystems, increasing vulnerability to pests, diseases, and environmental stresses.

While agriculture contributes to environmental degradation, this degradation also has negative implications for agriculture. Reduced biodiversity, land degradation, as well as climate change and variability imply low or poor agricultural productivity due to diminished ecosystem services. Owing to this complex agriculture-environment relationship, implementing planet friendly agronomic practices is imperative. Planet friendly agronomic practices enhance agricultural productivity while reducing environmental degradation and agricultural carbon (C) footprint. These include low-external input sustainable agriculture (LEISA), multiple cropping systems, and soil and water conservation technologies and approaches (Dubey et al. 2021). Food costs may be even reduced in systems which include underutilized plant-based foods at local level.

Planet-friendly agronomic practices serve as the foundation of sustainable agriculture. They encompass practices that reduce the environmental footprint of agriculture, enhance the efficient use of natural resources, and enhance the resilience to climate change and variability (Krall 2015; Piñeiro et al. 2021). Furthermore, sustainable agricultural production involves the implementation of sustainable land management (SLM) practices aimed at improving land productivity through restoration and increasing carbon sequestration for climate resilience (Tennigkeit, Okoli, and Brakhan 2023). These planet-friendly agronomic practices are important for climate change adaptation and mitigation. For instance, improved soil structure and water infiltration through reduced tillage and cover cropping decrease surface water runoff by promoting greater water infiltration, increasing water storage in subsurface layers and aquifers, and allowing for the gradual release of surface runoff from vegetated areas. This is particularly effective for flood control cases of heavy rainfall events (Saco et al. 2021; Antolini et al. 2020).

Case study 4: Cost effective nutritious school meals

Nutritious and varied school meals need not be expensive. A pilot study conducted in Kenya using WFP's School Meal Planner (SMP) PLUS software showed that introducing locally available, climate-resilient, nutrient-rich plant species as ingredients in the menu planner could improve the nutritional profile of school food servings at cost-effective prices. Carried out between 2020-2021, the study aimed to optimize the nutritional profile of daily menus provided to students in one school for the disadvantaged in Nairobi, Kenya. This was achieved by integrating indigenous plant-based foods in the menu planner to attain 30% of the recommended daily nutritional intakes for schoolchildren*. Three different optimizations were simulated using SMP PLUS. Results show that currently underutilized, local, nutrient rich crops can contribute to meeting 30% of the recommended daily nutrient needs of school-age children at affordable prices, with important savings for schools and school meal programs. The menu optimizations determined an important improvement of the current menus offered in the trial school, from a nutritional and cost-efficient perspective. Sometimes the integration of local foods in the school meal planner even exceeded the recommendations for some micronutrients.

*Kenya's national school feeding guidelines mandate that 30% of the total nutritional requirements for school-age children should come from school meals while the remaining percentage (70%) should be provided at home.

Agronomic practices and the human health nexus

Agronomic practices have not only far-reaching impacts on the environment but also directly and indirectly affect human health. Understanding these connections is crucial for developing sustainable agricultural systems that protect both ecological and human well-being. Healthy soil is the foundation of nutritious food. Agronomic practices that degrade soil quality, such as excessive use of chemical fertilizers and pesticides, soil erosion, and compaction, lead to reduced soil fertility and biodiversity loss. Degraded soils produce crops with lower nutrient content, affecting the nutritional quality of the food supply (Kihara et al. 2020). This can contribute to malnutrition and deficiencies in essential vitamins and minerals. In Sub-Saharan Africa, soil degradation and the low and improper application of fertilizer have increased micronutrient deficiencies in arable lands, particularly in zinc, boron, iron, molybdenum, and copper (Kihara et al. 2020). A review by Berkhout et al. (2019) highlighted strong connections between soil nutrient levels and child mortality, stunting, wasting, and underweight in the region. Enhanced soil health through

practices such as agronomic fortification (Kihara et al. 2020) coupled with environmental conservation measures will strengthen human health.

Agronomic practices may also result in water pollution, which in turn impacts human health. Improper irrigation practices, overuse of chemical inputs, and poor manure management can lead to water contamination. Runoff from agricultural fields often carries nitrates (Brender 2020) phosphates, pesticides (Horak, Horn, and Pieters 2021), and pathogens into water bodies, posing significant health risks. Contaminated drinking water can cause gastrointestinal illnesses, reproductive problems (Mukiibi et al. 2021), and neurobehavioral disorders (Fuhrimann et al. 2022). For instance, the presence of dichloro-diphenyl-trichloroethane (DDT), lindane and endosulfan in honey in levels exceeding the acute reference dose across Masindi District, Western Uganda, is linked to miscarriages, reduced implantation, menstrual irregularities, impaired semen quality, and prostate cancer (Mukiibi et al. 2021). In extreme cases, high nitrate levels in water can lead to methemoglobinemia, or 'blue baby syndrome,' which is potentially fatal for infants (Brender 2020).

Unsustainable agronomic practices degrade biodiversity, which maintains healthy ecosystems that support human health. Ecosystem services include pollination, pest control, and water purification. Habitat destruction through intensive soil disturbance and erosion, pesticide use, and monoculture farming disrupt these services. Loss of pollinators can lead to reduced crop yields and food variety, impacting dietary diversity and food security (van der Sluijs and Vaage 2016). Additionally, the decline in natural pest predators can increase the reliance on chemical pest control, further exacerbating environmental and health problems (Frison, Cherfas, and Hodgkin 2011; Larramendy and Soloneski 2019). Agricultural practices that contribute to greenhouse gas emissions exacerbate climate change, which has a range of health impacts. Climate change can lead to more frequent and severe weather events, such as heatwaves, floods, and droughts, directly threatening human health and safety. It can also alter the distribution of vector-borne diseases, such as malaria and dengue fever (Coates et al. 2020), and impact food and water security, leading to malnutrition and waterborne diseases such as diarrhoea (Dickerson, Cannon, and O'Neill 2022).

Integrating planet friendly agronomic practices is therefore essential for safeguarding human health. Practices such as crop rotation, reduced tillage, organic farming, proper manure management, and efficient use of water and fertilizers can mitigate the negative environmental impacts of agriculture. Enhancing soil health, protecting water quality, improving air quality, preserving biodiversity, and combating climate change, promote a healthier environment and, consequently, healthier communities.

Plastic in Agriculture and Food packaging

Plastics have become an integral part of modern agronomic practices and food packaging, offering benefits in terms of efficiency and productivity as well as food safety, but also posing significant environmental challenges. Plastics are widely used as mulch films (Dube and Okuthe 2024), greenhouse covers, irrigation pipes (Ragoobur, Huerta-Lwanga, and Somaroo 2021), pesticide containers, fertilizer bags, seedling trays, and wrapping to facilitate transport and packaging of processed foods. These often single-use plastic materials offer several benefits, including conserving soil moisture, controlling weeds, enhancing plant growth, and improving the overall management of soil and water resources. Plastics may be introduced into agricultural soil unintentionally, for instance, through plastic-contaminated compost and sewage sludge (UNEP 2021). The environmental impacts of plastics in agricultural soil and beyond the soil ecosystem are substantial.

Primarily, the persistence of plastic in the environment is of concern for soil and human health. Plastics often break down into smaller particles known as microplastics and nanoplastics (MNPs) (Dube and Okuthe 2024; UNEP 2021), which can remain in the soil for decades. This breakdown starts on the surface of the plastic soon after exposure to the environment (UNEP 2021) and is aggravated in Sub-Saharan Africa due to the harsh environmental conditions (Dube and Okuthe 2024). The MNPs can disrupt soil structure, affect soil organisms, and potentially enter the food chain, raising concerns about food safety and human health. Walker (2021) records that plastic contamination may impede progress in the implementation of the sustainable development goals (SDGs).

Recycling water containers for farming and domestic use. Photograph by: Yasuyuki Morimoto

While Africa is an emerging market for controlled-release fertilizers (Farmers Review Africa 2022), including polymer-coated NPK (Mordor Intelligence 2024) , it's crucial to consider the potential impact of plastic pollution. Polymer-coated fertilizers target production of cereals and grains, pulses and oilseeds, turf and ornamentals, and fruits and vegetables (Mordor Intelligence 2024). In addition, plasticizers like polyethylene and polyvinyl acetate are included in coating materials for urea fertilizer to enhance slow-release capacity, for improved NUE, and reduced leaching and evaporative losses of N (Beig et al. 2020). According to UNEP (2021) the plastic polymer encapsulation of controlled-release fertilizers can lead to soil contamination through microplastics. Farmers can use biodegradable options, including coating these fertilizers with biochar.

The accumulation of plastic debris in agricultural fields can hinder soil health and productivity. Over time, plastic residues can impede root development and water infiltration, leading to reduced soil fertility and crop yields. This necessitates regular removal and proper disposal or recycling of agricultural plastics, which can be costly and labour-intensive. Moreover, the production and disposal of plastics contributes to greenhouse gas emissions, exacer-

Drip line irrigation system made of plastic. Photograph by: Ambokili Farm

Polythene sheet for drying crops on the field. Photograph by: Ambokili Farm

bating climate change (Shen et al. 2020). The disposal of plastics through burning or landfilling can release toxic substances and further contribute to soil, water, and air pollution.

The use of plastics in agriculture requires significant investments in research for long-term sustainability. The Food and Agriculture Organization (FAO) is working on a Voluntary Code of Conduct on the sustainable use of plastics in agriculture (VCoC), which aims to strengthen policies and strategies in the agricultural chain (FAO 2023). Considering the current use, the implementation of plastic circular measures consisting of repair, recycle, and reuse underpin environmental conservation (Dube and Okuthe 2024). To further reduce plastic waste, biodegradable mulch films are currently being developed (Shah and Wu 2020); however, accessibility may be limited by financial constraints. Coupled with plastic circular measures, smallholder farmers should integrate other soil and water conservation measures such as crop residue retention and the use of live mulch during production.

Current estimates show that approximately 36% of all plastics produced are used in general packaging; out of this 85% end as waste (UNEP 2023). Despite countries setting goals to phase out harmful packaging, single use plastic in the food packaging sector remains a global challenge (Chakori et al. 2021). While the production of food packaging accounts for 5% of GHG compared to emissions from the entire food system, concerns are raised around environmental pollution negatively impacting soil, plant, livestock aquatic and subsequently human health (Sundqvist-Andberg and Åkerman 2022; Crippa et al. 2021; NEMA 2019). Different studies stress the ambiguity in the role of packaging in the food sector including hygiene myths around packaging to preserve food and reduce food loss and waste, but also around the packaging material and recycling system itself resulting in environmental challenges (Chakori et al. 2021; Sundqvist-Andberg and Åkerman 2022; Winton, Marazzi, and Loiselle 2022; Crippa et al. 2021).

Establishing standards for food packaging within HGSF programs and creating awareness of the existence of these standards will need to go a long way towards ensuring that the food products that are sourced for HGSF use low environmental impact packaging throughout the supply chain. Building knowledge and awareness of the most effective packing techniques and technologies as well as building capacity to implement these behaviours and technologies can be done by providing financial resources (e.g., subsidies) to actors along the HGSF supply chain (KII of WFP stakeholder).

Plastic use in a market, Kenya. Photograph by: Yasuyuki Morimoto

Clear guidelines are essential for proper disposal of packaging to reduce unnecessary waste, encourage recycling, and avoid overpacking and the use of chemicals. Procurement officers may struggle to establish measurable criteria for food product packaging, as these can be challenging to implement, especially since packaging typically occurs at the producer level. Packaging is necessary to prevent excessive waste and facilitate transport, but discussions and solutions are needed to minimize or eliminate packaging when handling larger volumes. Broader strategies may include avoiding packaging materials containing chemicals, PVC, or other undesirable substances. Technical specifications might ensure packaging consists of a single material, such as recycled cardboard or recyclable plastic, rather than complex composites (NDCs 2024).

Studies on greenhouse gas emissions showed that reusable systems outperform single use systems in the food takeaway sector. Whether this is valid for general food packaging if food need to be transported long distances in spaces without waste management compared to reusable packaging needs to be further investigated as this may result in increased food loss and waste (Bradbury et al. 2023; Joseph et al. 2024).

Food Processing and preservation

Box. 3

Food Loss is the decrease in quality or quantity of food resulting from decisions and actions of food supply chain actors, not including food retailers or consumers.

Post harvest food loss refers to the loss of food across the food supply chain from harvesting up until (but not including) the retail and consumption stages. Estimates around food loss vary widely; the FAO estimates that 13.8% of food produced globally is lost between the farm up to but excluding the retail stage (FAO, 2019).

Minimising global post-harvest food losses is important for climate change mitigation and adaptation as well as for related global development issues such as food insecurity and poverty (NDCs 2024; FAO 2019). Food losses occur during food processing as part of food preparation, but also during preservation to prevent food spoilage. Incorrect handling of food during transport and storage increases the risk of food loss and waste. Ideally, fresh and perishable products should therefore be processed and prepared quickly after harvest. HGSF programmes have an advantage here due to their short value chains. In regions with limited agricultural production, poor cold chains, and long distances between producers and schools, food processing and preservation become crucial to compensate for local production deficits. HGSF is also limited in drylands and urban areas with low agricultural productivity, where schools depend on food traded from more productive regions. Processing is necessary to prevent food spoilage before it reaches the school. Key processing methods include drying maize for milling and pre-cooking beans to reduce school cooking time, or drying beans carefully to avoid spoilage or germination during storage. Green leafy vegetables may also be dried to prevent waste and loss. Controlled drying technologies are important to reduce contamination risks, such as mycotoxins in maize, and to bridge seasonal gaps for perishable items like leafy vegetables. Similar side effects are associated with canning, bagging, sealing and smoking, preservation methods which all require energy and sustainable packaging solutions (Cramer et al. 2023). The specific processing method is product specific, and its efficiency related to the respective food processing plants, the volumes to be processed across the year as well as taste and thus cultural acceptability as outcome of the technology and recipe used.

Cold storage to prolong shelf life could bridge distances between production site and school, but also extend availability of perishable foods across agricultural seasons. However, to keep food from spoiling, cold storage requires greater energy usage with higher ambient temperatures. Depending on the duration of storage, temperature and preparation methods (like blanching, pre-cooking, and/or watering), nutrient losses occur just like any other preservation method. Ranging from bulk cold stores, multi-purpose cold stores, small cold stores, frozen food stores, walk-in stores, and controlled atmosphere, cold stores are designed for post-harvest handling by temperature reduction of fresh produce. This procedure is underpinned by the cooling design which reduces the respiratory rate, minimizes water loss, and therefore boosts the shelf stability of the raw produce through decelerating the rate of decay. In supermarkets, the refrigeration system is associated with the consumption of half of total energy used, signalling the high energy need in cold storage (Mylona et al. 2017). With the global electricity consumption through refrigeration estimated at 440 kWh/year/capita, fluorocarbons subscribe to 20% of GHG (Burek and Nutter 2020). Reducing emissions requires cutting down energy consumption and optimizing the efficiency of storage systems while using renewable energy. Given the generally underdeveloped electricity grid in Sub-Saharan Africa, mobile cold storage systems could offer a viable solution. These systems may reduce the need to address infrastructure gaps in cold chains, including food transportation, distribution, and storage at schools. (Solar Freeze 2024). In addition, this can include but is not limited to utilizing LED lighting, using closed display cabinets, and energy-saving anti-sweat heaters and defrosts (Mylona et al. 2017)

Most of the greenhouse gas emitted from value addition and processing are a result of the technology and energy source used: natural gas, coal, diesel, and firwood among other sources. In many regions these energy sources are used to produce electricity or cooking energy. (Shabir et al. 2023; NDCs 2024). To decrease fossil energy consumption, there is a need to expand the use of solar, water, and wind energy sources, with a focus on sustainably sourced firewood. Coupled with energy-efficient food processing systems, this approach could significantly minimize overall

energy consumption and reduce greenhouse gas emissions (WFP 2023). Pre-cooked beans processed in energy efficient processing plants may support energy saving in the schools who often rely on firewood as primary cooking energy (Case study 5).

Case study 5: Beans in school feeding programs

As part of the work supported by the Pan African Bean Research Alliance (PABRA), high-iron beans are being integrated in school menus and school gardens in several African countries such as Burundi, the Democratic Republic of Congo, Malawi, Tanzania, Rwanda, Uganda, and Zimbabwe. In Tanzania, for instance, schools are encouraged to cultivate these beans in their gardens, which double up as education props for scientific learning. These initiatives, which frequently began as pilot programs, are growing with assistance from different stakeholders and partners.

In Rwanda, a more advanced model sees processors supply processed bean products to schools, mostly in their pre-cooked form. This enhances nutritional availability, accessibility, and affordability while minimizing the environmental impact of cooking (using firewood).

Moreover, programs go beyond the school premises to incorporate household participation and community demonstrations, raising awareness and demand for high-iron beans. The goal is to improve nutritional outcomes by supplying vital minerals like iron and zinc, which are important for growth and development, especially in children.

To maintain a sustainable supply chain of iron-rich beans, efforts also involve working with private sector processors and national partners. Through this partnership, local communities and schools benefit from increased manufacturing efficiencies and value-added products. Overall, the projects show the nexus between nutrition and agriculture. They explore economic sustainability through private sector involvement and use schools as centers for community development and nutrition education.

Transport

While food production exerts considerable environmental pressure on our planet (Halpern et al. 2022), the way food is transported, especially perishable items, plays a critical role in determining whether it contributes to environmental degradation or supports planetary well-being. Half of the energy used in producing and delivering fruits and vegetables that travel long distances is linked to transportation (Wikoff, Rainbolt, and Wakeland 2012). Studies quantifying emissions across different stages of the food value chain have focused primarily on Europe and North America, with less attention given to Sub-Saharan Africa. In Sub-Saharan Africa, the rise in vehicle ownership is linked to factors such as the absence of formal public transport systems, weak regulations on vehicle imports, growing urbanization, and increasing per capita gross product (Mbandi et al. 2023). Mbandi et al. (2023) emphasize that in addition to the increasing number of vehicles, emissions from road transport are exacerbated by the high average age of the fleet, which is mainly composed of imported second-hand vehicles (accounting for ~90% of vehicles in SSA), poor fuel quality, poorly maintained roads, lack of vehicle emission regulations and inadequate implementation of vehicle inspection and maintenance programmes (Mbandi et al. 2023). The impact of the 'food miles' from farm to school depends not only on the distance travelled but also on factors such as the mode of transport, the age of the vehicle fleet, and the overall infrastructure. Estimates suggest that, for instance, transportation within Europe could have a greater impact on GHG than transatlantic shipping (Nijdam, Rood, and Westhoek 2012). Nijdam et al. (2012) argue that "the larger the volumes, the lower the additional impact" thus the actual mode may be less relevant than the total volume to be transported.

Global estimates attribute 11% of the carbon footprint of food to transport itself (Nijdam, Rood, and Westhoek 2012), with additional emissions depending on the refrigeration system and the product's needs to maintain quality (Tassou, De-Lille, and Ge 2009). Consumer behaviours and food choices are crucial in determining what is traded and the accepted travel distances. In planet-friendly HGSF programs, procurement officers, who control the budget and make purchasing decisions, act as consumers. The mode of food transportation depends on the product's shelf life, fuel cost, travel distance, and available infrastructure (Hammond et al. 2015). Due to the high interdependence between efficiency and speed, products with shorter shelf lives, such as meat, fresh seafood, and green leafy vegetables, often incur high transport costs and may require air transportation to minimize travel time over long distances.

Conversely, less perishable items like grains and beans can be transported by rail, ship, or road, where travel time is less critical. Collaborative findings indicate that the climate impact of the transport system is also influenced by intrinsic product factors, such as the moisture content observed in legume transportation (Tidåker et al. 2021).

WFP procures food products from both farmers and traders, necessitating training to create incentives and align practices based on life cycle assessment outcomes (Joseph et al. 2024). To cut road transportation emissions, truck drivers receive training in efficient driving techniques. WFP has also conceptualized a tracking system for its commodities to enhance supply chain traceability. Although not yet globally established, pilot phases in some country offices have shown promising results. Evaluating this system will enable WFP to quantify sustainability aspects of each trip, including distance covered, fuel used, and other factors. Additionally, GPS devices on vehicles and goods help mitigate data gaps in measuring transport emissions. However, this system does not account for agronomic practices used in primary food production. It is also unclear how well these concepts can be transferred and adopted by stakeholders once WFP is phasing out.

> *"So electric trucks are fantastic, but we need [the respective] infrastructure in the countries. So, we start with a pilot phase, we'll do a proof of concept, which is what we're working on right now. We'll see if it works, then we'll scale it up. The fastest solution is just to renew the fleet. You know, by buying newer trucks we will reduce our environmental impact just because they are more fuel efficient. We are doing efficient driving training for our drivers to consume less fuel. That will also reduce transport costs and reduce environmental impact."*
>
> *Supply Chain Sustainability Officer*

Storage

Although storage technologies contribute to reducing postharvest food losses and waste, they significantly impact greenhouse gas emissions when powered by fossil fuels. With warehousing becoming an important pillar in the food value chain, warehousing emissions are attributed to air conditioning, cooling, heating, and lighting (Fichtinger et al. 2015). These factors are influenced by stockholding levels, inventory management, and warehouse design among other convergent elements including the type of equipment, and warehouse output. There is little information available on whether transport or storage makes the greatest contribution to greenhouse gas emissions and at which stage of the value chain, e.g. the storage systems at farm or during transport or at school level, the opportunities for saving greenhouse gases are greatest. Land use is the most important GHG factor in the entire food value chain. However, refrigeration systems undoubtedly have a significant impact on the environment. Ranging from bulk cold stores, multi-purpose cold stores, small cold stores, frozen food stores, walk-in stores, and controlled atmosphere cold stores, these storage systems are designed for post-harvest handling of fresh produce by temperature reduction. This procedure is underpinned by the cooling design which minimizes water loss and boosts the shelf stability of the raw produce by slowing the rate of decay. Reducing emissions requires cutting down energy consumption, optimizing the efficiency of storage systems and switching to renewable energy sources. This can include but is not limited to utilizing LED lighting, using closed display cabinets, and energy-saving anti-sweat heaters and defrosts but also reflecting on the energy source for the storage (Mylona et al. 2017; NDCs 2024).

Evaluation tool for decision makers in school food procurement

The findings from key informant interviews (KII) and the literature review were used to develop a draft evaluation tool for school feeding programs, designed for use by procurement officers, headmasters, and other stakeholders involved in school meal procurement. This approach aims to balance nutritional and climate requirements for school meals. The tool currently includes 21 indicators across ten dimensions of sustainability, primarily focusing on the environmental aspect rather than the social, economic, and health dimensions (Table 1). The proposed indicators were identified as relevant from both the literature review and the KII. This list of indicators follows the food value chain and can serve as a basis for discussions on incorporating specific requirements into school food procurement policies, such as the use of foods grown using regenerative or organic farming, agroecology, and agroforestry. The tool also addresses how to further reduce emissions in storage, food preservation, and transport.

The indicators, related measures, and practices for evaluating school meal sourcing decisions may guide and help decision makers to monitor the procurement process. Practices are categorized into three types: a) planet hostile

(red column) indicating unsustainable practices with significant negative impacts, b) moderately sustainable practices with minor negative impacts, and c) planet friendly (green column) representing the most sustainable practices with significant positive environmental effects, including greenhouse gas emission reduction and broader sustainability benefits. Planet hostile practices are scored -1, moderately sustainable practices are considered neutral (0) with potential for improvement, and planet friendly practices are scored +1. The final score is the sum of the individual scores divided by the number of practices evaluated. Total scores can be used for comparing schools and regions over time. If food production or handling practices are not clearly "green" or "red," an amber column may be selected. This may also be chosen in case the production system is using both planet hostile and planet friendly across the farm. Not all indicators may be applicable to every food commodity; in such cases, they are marked "NA" for not applicable. The number of "NA" indicators should be reported alongside the total score for comparison purposes.

The planet friendly practices can be used to improve and evaluate tenders by selecting measurable indicators while scoring results can be used as an evaluation tool at the school level to identify areas for improvement in food procurement. Procurement officers can also use these indicators to translate them into practical policy norms, procurement rules, and contract guidelines for school meal provisioning at national, regional, and local levels.

The scoring schemes needs testing and evaluation by procurement officers and decision makers as same measures may have multiple functions and are thus applicable for different indicators. Does this mean they should be included several times and put extra weight into the overall score? Or if there is a "sustainable production practices" do I give it a green scoring if there is at least one of among "intercropping, rotation or agroforestry"?

Food certification could potentially reduce the complexity of the tool, as procurement officers could follow a clear guideline to buy "planet friendly food". However, there are no global standards and benchmarks for this term, and each label, each certification comes with its own bottlenecks. This is attributed "to a missing shared definition within the literature [and market and trade system], which can encompass and describe the multiple purposes of food certification" (Latino et al. 2022). Several food certificates to enhance food quality exist but they rely on the willingness to pay for the higher quality and the additional costs which come with the certification itself as it requires a certification, monitoring and evaluation system to ensure that the certificates are holding what is promised (Abate et al. 2021). Smallholders and farmers using neglected underutilised species may have, in the worst case, no access to these certification schemes and would thus be not eligible to sell their products to schools.

Finally, the tool may complement existing school certification schemes like the Green School Certification program. The Green School Certification Programme aims to ensure that public and private schools in the Middle East and North Africa achieve a real commitment to sustainability in six categories: Waste, Green Spaces, Energy and Water Efficiency, Health and Safety, and Sustainability Education and Innovation (Green Schools 2020). The environmentally friendly procurement of school meals may become an important new field of action.

Parent-Teacher meeting. Photograph by: Yasuyuki Morimoto

Table 1: *Tool for the qualitative evaluation of agronomic practices and the environmental sustainability of school meal programs*

Environmental dimension	Indicator	Evaluation criteria	Qualitative rating (-1, 0, +1)			Rating result and comments
Biodiversity	Species richness and abundance	Presence of diverse plant and animal species in and around crop fields	Monocropping	Intercropping independently	Multiple sustainable crop production practices i.e., intercropping, crop rotation and/or agroforestry	
	Habitat preservation	Maintenance or enhancement of natural habitats within the agricultural landscape	Deforestation, slash and burn agriculture [1]		Agroforestry, buffer strips, conservation tillage, integrated pest management (IPM), organic farming	
	Impact on pollinators	Presence of pollinator populations (insects and birds)	Absence of pollinators (insects and birds)	Presence of either insects or birds	Presence of pollinators (especially insects like bees, and birds)	
Soil conservation	Soil erosion control/ moisture conservation	Presence of soil and water conservation measures	Absence of soil conservation measure (s)	Implementation of one biological or vegetative conservation measure	Integration of both biological and mechanical measures	
		Type of tillage	Conventional tillage independently	Conventional tillage with soil conservation measure (s)	Conservation tillage	
Soil health	Soil organic matter and soil nutrients	Practices that enhance soil organic matter and nutrients	Monocropping		Integrated soil fertility management (ISFM) Biochar application	
					Organic farming	
			Indiscriminate application of inorganic fertilizers		Judicious application of fertilizers through 4R strategy (Right source, right	

[1] Slash and burn agriculture involves the cutting down and burning of forested area or woody vegetation to clear land for crop production (Serrani et al. 2022)

Environmental dimension	Indicator	Evaluation criteria	Qualitative rating (-1, 0, +1)		Rating result and comments
				rate, right time, right location)	
				Intercrop-ping/agro-forestry with le-guminous crops/shrubs/ trees	
				Application of slow-release fer-tilizers or coa-ting fertilizers with biochar to enhance slow-release mecha-nism	
				Composting	
	Soil bio-diversity	Presence of earthworms	Absence of earth-worms	Presence of earthworms	
Water conservation	Irrigation efficiency	Efficient use of water re-sources for ir-rigation	Flood irrigation	Precision irriga-tion e.g., drip system	
			Excessive water application	Crop residue re-tention	
	Salinity manage-ment			Mulching	
	Soil and water con-servation practices	Water run-off	Inefficient irriga-tion systems	Biochar and ma-nure applica-tion	
		Minimization of water run-off and eva-poration		Ripping	
Water quality	Water pollution	Minimization of water run-off, nutrient leaching, and pesticide residues in water	Indiscriminate application of inorganic fertilizers	Integrated soil fertility manage-ment (ISFM)	
				Integrated pest management (IPM)	
				Buffer strips	

Environmental dimension	Indicator	Evaluation criteria	Qualitative rating (-1, 0, +1)			Rating result and comments
			Indiscriminate application of chemical pesticides		Application of slow-release fertilizers or coating fertilizers with biochar to enhance slow-release mechanism	
Greenhouse gas emissions [2]	Carbon footprint	Practices that reduce greenhouse gas emissions and enhance carbon sequestration	Indiscriminate application of nitrogen-based fertilizers	Conventional tillage with soil vegetative or mechanical conservation measure	Integrated soil fertility management (ISFM)	
	Carbon sequestration		Conventional tillage		Conservation tillage	
			Deforestation, slash and burn agriculture		Agroforestry	
Food processing	Type of energy used for processing	Energy source and energy expenditure for processing (e.g. milling or drying)	Thermal processing through open three-stone fires and traditional cookstoves	Thermal processing through improved biomass cookstoves	~Thermal processing with clean cooking devices[3]	
			Mechanised processing using fossil fuels or biofuels produced unsustainably	Mechanised processing using fossil fuels as backup solution to grid electricity or standalone power generation from renewable sources	Use of food varieties with a short preparation/ processing time	
					Mechanised processing using renewable energy	
	Level of processing	Energy consumption during processing and food prepa-	Products require long cooking time, e.g., dried beans		Pre-processed product which reduces cooking time at school (e.g., precooked beans)	

[2] Especially for this indicator: There are certainly other factors that could be mentioned here. The same measures could address different indicators and thus be listed multiple times, which would then give them additional weight. This requires further research and an assessment of which measure fits best where and which measure from the tool can actually be assessed by procurement officers.
[3] This includes devices that use electricity, gas, liquid fuels or pellets

Environmental dimension	Indicator	Evaluation criteria	Qualitative rating (-1, 0, +1)			Rating result and comments
	required at school[4]	ration at school			Blanched and dried vegetables that require less cooking time	
	Water usage	Amount of water used for processing	High water usage from unsustainable resources	Use of water saving tools	Use of water saving tools, and water recycling	
	Waste disposal	Amount of waste per tonne	Discharge of water-based waste products into water bodies	Centralized waste disposal	Waste recycling Use of biodegradable packing material Composting of food waste	
	Food Quality	Nutritional value	Highly processed foods with negative long term health impact (e.g., sweet cookies)	Processing to extend shelf life without additives	Minimally processed foods	
Storage	Type of energy used for cold storage	Energy source and energy expenditure for cold storage	Post harvest refrigeration in warehousing powered by fossil fuels and/or using inefficient storage solutions (e.g. appliances with low energy efficiency rating, sun exposed locations, frequent opening)	Post harvest warehousing powered by fossil fuels only as a backup alternative	Post harvest warehousing powered by renewable energy and/or use of efficient storage solutions and practices	
					Natural cooling options (e.g. evaporative cooling, natural ventilation, shading)	
			Refrigerated transport on vehicles that combust fossil fuels	Refrigerated transport on hybrid vehicles	Refrigerated transport on electric vehicles	

[4] The tool is limited to procurement decisions. However, procurement decisions influence the preparation of meals at school and possibly also the flavour of the meal. Pre-cooked meals can potentially be prepared more energy efficiently in food processing plants, but then need to be packaged. Examples are given here that require further assessment and calculation of energy consumption for meal preparation. A blanched and dried leafy vegetable requires energy during preparation and subsequent packaging to prevent rehydration and associated mould growth. However, the water footprint, labour and cooking time involved in the final preparation of the meal are lower. Which of these measures are more environmentally friendly would have to be investigated, for example, as part of a life cycle assessment for school meal programmes in arid regions compared to vegetable-growing areas.

Environmental dimension	Indicator	Evaluation criteria	Qualitative rating (-1, 0, +1)			Rating result and comments
			and/or are inefficient			
			End user refrigeration powered by fossil fuels and/or using inefficient equipment	End user refrigeration powered by fossil fuels only as a backup alternative	End user refrigeration powered by renewables and/or using efficient equipment	
Packaging	Level of plastic use between farm gate and school gate	Packaging with plastic elements	Packed in plastic bags/containers	Partially packed in plastic	Use of biodegradable packaging	
				Reduced packaging	Use of reusable packaging and /or existence of recycling infrastructure, systems and practices	
					No packaging	
Transport	Type of energy used for transport	CO2 emissions	Transport on vehicles that combust fossil fuels and/or are inefficient	Transport on hybrid vehicles	Transport on electric vehicles charged from renewable energy sources	
					Real-time traceability of procured foodstuffs	
			Relying on global transportation networks	Consideration of food mileage	Adoption of renewable energy sources	
					Reducing distance covered by trucks through local sourcing of foodstuffs	
	Transport distance	Km from production to use	Transported from a distance of more than XX km	Transported from a distance between XX and YY km	Transported from a distance less than XX km	

Colour codes: ***Red:*** *Least sustainable practice (s) or significant negative impact.* ***Orange:*** *Moderately sustainable practices or minor negative impact.* ***Green:*** *Most sustainable practices or significant positive impact.* ***Grey:*** *Qualitative classification is not feasible.*

Study limitations and opportunities

The results of this analysis provide an initial overview of the challenges and impacts associated with local school food procurement. However, further interactions and discussions are needed to enhance this picture. Some important study **limitations** to be considered are:

- This desk-based study was conducted through secondary data review and KII. Most of the collected information from the KII was qualitative. The semi-structured interviews covered a limited sample of stakeholders. Targeted WFP focal points, and suggested key informants identified during the semi-interviews represent a small sub-sample from the wide range of actors involved in the implementation of school feeding procurement programs, which might bias or at least potentially ignore other key experiences and testimonials.
- Interviewing a more diverse range of actors, including, students, parents, school committee members, directors, operators, and representatives of government entities related to the health, economy and environment sectors would have enriched the discussions and helped identify any undocumented impacts of local school food procurement programs. In addition, information collected from key informants remains largely unquantified.
- There are several general tools and databases for evaluating or supporting the assessment of the environmental impacts of agronomic practices. These tools include Cool Farm Tool, EX-ACT Tool, and AgBalance. Additionally, databases like FAOSTAT, CGSpace, and EDGAR provide valuable data. However, there is a lack of tools and databases specific to Sub-Saharan Africa and other tropical regions.
- Existing databases on GHG emissions exist but are mainly populated with data from the global North. Data from the tropical belt and Sub-Saharan Africa exist but are scattered across different publications and often with a focus on one crop or practice. A quantification of GHG emissions on specific food crops was therefore impossible.
- The limited timeframe for this study (3 months) prevented the identification and consultation of additional experts, potentially overlooking previous or ongoing successful initiatives by other entities. It also did not allow for piloted testing of the tool with any procurement officers or decision-makers.
- Among the respondents interviewed, there is a clear absence of a shared understanding and definition of "planet friendly." This lack of consensus leads to fragmented actions that must be interconnected and scrutinized, as individual solutions may inadvertently impact other dimensions of sustainability besides the environment.

Despite these limitations, the study also offers several **opportunities** which may be followed up:

- The proposed tool provides an overview of practices categorized as planet hostile versus planet friendly within the school food value chain. While not exhaustive, it serves as a starting point for initiating discussions on necessary changes to achieve a planet-friendly school feeding program.
- The tool can also inform the transformation of policies and regulations that set minimum requirements for claiming a school value chain as planet friendly.
- Additionally, the tool offers guidance for conceptualizing school gardens, particularly focusing on agronomic practices recommended for their planet-friendly attributes (refer to case study 4).
- In HGSF programs, different stakeholders face varying limitations and opportunities to act. This tool is adaptable, allowing step-by-step implementation based on existing resources and priorities.
- Until now, agronomic practices have not been detailed in the planet-friendly school feeding program discourse. This study expands intervention possibilities and underscores the need for innovations within the current system by comparing practices across dimensions–from detrimental practices to moderate and beneficial practices.
- Furthermore, the tool can easily incorporate aspects that support planetary health within school settings.
- The qualitative evaluation tool presented serves as a baseline for assessing the environmental impacts of agronomic practices in tropical regions, filling a gap where specific tools and databases for Sub-Saharan Africa and other tropical areas are lacking.

Recommendations

Apply, test and further develop the tool

The proposed evaluation tool represents an initial stage in the creation of a diagnostic tool aimed at evaluating the environmental impacts of school food procurement. It is advisable to advance its development through an iterative process involving stakeholders, promoting its adoption, and fostering continued sharing of experiences among program implementers and beneficiaries.

Tools can help to drive change

Agronomic practices play a crucial role in HGSF programs. However, there is a notable gap in assessing the environmental impacts of these practices at the level of primary food production within such programs. Existing studies on HGSF programs in Sub-Saharan Africa have predominantly focused on educational outcomes, food diversity, food security, and nutrition for schoolchildren and local communities, as well as the local agrifood economy (FAO, Alliance of Bioversity International and CIAT, and Editora da UFRGS 2021; Okolo-Obasi and Uduji 2022; Prifti and Grinspun 2021; Roothaert et al. 2021; Wineman et al. 2022). Agronomic practices within HGSF programs can contribute to issues like land degradation, water scarcity, pollution, biodiversity loss, and greenhouse gas emissions. These environmental concerns have significant implications for socio-economic and environmental sustainability but are often not adequately addressed in the planning, execution, and evaluation of these programs. The proposed evaluation tool could prove invaluable in guiding procurement actors within WFP and nationally managed school feeding programs to monitor and assess these activities effectively.

> *"In recent years, we've seen increased discussions around the contributions of school feeding, maybe to some of the environmental negative impacts that we are seeing predominantly in Africa most use firewood to prepare school meals. In Kenya, there are discussions on centralized steam kitchens where they can prepare 30,000 meals in each kitchen for redistribution, but it's like I said, that works in the urban area or the cities"*
>
> *Regional School Feeding Advisor*

Urban and rural solutions - just the same?

The current focus is on aligning sustainability with national procurement standards by incorporating environmental considerations in response to climate change. For example, in Kenya discussions revolve around centralized steam kitchens for urban school meal preparations, they typically overlook equivalent measures for rural areas. This oversight impacts decisions regarding food procurement and distribution methods. Therefore, the tool must be adapted to regional variations. For instance, solar panels and electric trucks may be deemed sustainable in one country due to their environmental benefits and local availability, whereas in another country, their implementation may pose challenges for WFP and other stakeholders due to differing regional contexts.

Multisectoral collaboration

In a recent Landscape Analysis conducted in West Africa by WFP, ECOWAS and the School Meals Coalition, it was highlighted that political commitment, sustainable funding mechanisms, multisectoral coordination, and community engagement are crucial for achieving sustained impacts on education, health, nutrition, and local economies, while also enhancing resilience to future challenges (WFP 2024a). However, interviews conducted in Kitui county, Kenya, as part of this study revealed that WFP determines the budget and region of intervention in consultation with central government officials, considering weather patterns and harvest forecasts for the year. This approach incorporates elements of emergency programming, which can pose challenges in providing consistent support to the same country, region, and relevant stakeholders. Consequently, there may be issues regarding sustainability and continuity when collaborating with other stakeholders in the HGSF.

"So, school feeding is a multi-sector program, right? Whether we're talking about regular school feeding or homegrown school feeding. These are largely multi-sectoral programs. Even when it's WFP that is leading the implementation, you still require the involvement of other sectors. With the HGSF you add another layer because HGSF is about linking schools to farmers. Let's go for demand as a market, you know for smallholder farmers. So, we work with governments of course, but we also work with the private sector, we work with farming communities, we work with social development, for example, we work with researchers. Let me say it's just a platform where you engage with different sectors, and you know (…) one of our core pillars in school feeding is nutrition. So, we have all these sectors, health, education, agriculture, finance you know, to some extent, even local government and water and sanitation and all these other key sectors involved in the programs.

So, what happens? Ideally, at the government level, we support. There are supposed to be sectoral committees that coordinate everybody else, right in there, you know, and this will be, like I said, civil society, private sector, different government departments, the UN system itself and other international actors."

School Meal Advisor

Integrating locally sourced food into school meals

A key informant of WFP confirmed: one challenge in incorporating locally sourced food into school meals is ensuring a consistent supply of specific food items. This poses difficulties for schools that rely on parent-provided food, as they have limited options for the types of food they can request. The proposed tool could serve as a starting point to engage with parents and farmers on criteria for food production and sourcing, potentially catalysing a shift toward sustainability through the ongoing work that WFP is doing with Food Assistance with Assets (FFA) and SUMS. Experimental plots could be established with the school community to identify and evaluate the most planet friendly agronomic practices. In some regions, schools have extensive farming land, but access to water is crucial for agricultural purposes. For example, a school in Kitui uses its land to grow vegetables, which contributes to school meals and eases parental responsibilities, thanks to reliable water access. The need for coordinated support in developing planet-friendly production systems is evident, regardless of whether WFP is directly involved.

Tool for policy communication

The proposed tool, once further refined and successfully piloted, could serve to advocate for planet-friendly criteria in policies and programs aimed at enhancing food security and nutrition outcomes in HGSF. It necessitates analysis to uncover the underlying causes of policy challenges and the socio-economic and political factors influencing the effective implementation of a planet-friendly HGSF program. Initially, the tool could be used as a checklist to evaluate current practices from farm to school gate and to identify initial steps, through collaborative platforms involving multiple stakeholders, to enhance the implementation of a planet-friendly school feeding program. Subsequently, it could be integrated into initiatives focused on linking farmers with schools to increase production of underutilized vegetables using sustainable agricultural methods (see Case Study 6).

Case study 6: Improved livelihoods

In Busia County, Western Kenya, a HGSF approach was tested linking local farmers to schools for the supply of nutrient-rich neglected and underutilized African indigenous vegetables - (AIVs) - a group of water-efficient, underutilized vegetables with great potential to improve diets and incomes in resource-poor settings. Working on the production side of the school meals supply chain, 547 men and women farmers from Busia's seven sub-countries were trained to understand the nutritional benefits of the food they grow using sustainable agricultural practices. Farmers also strengthened their business skills to penetrate local markets, apply and win tenders from public institutions and compete with other suppliers. On the demand side, nutrition education and awareness raising activities increased the demand for indigenous vegetables in schools and, for the first time, specific tenders for AIVs were advertised creating a reliable and stable market for the farmers. The approach, piloted in 2014, stimulated local economy and created job opportunities for the smallholder farmers engaged in the scheme. At its peak, in 2016, the farm-to-school network was providing AIVs to approximately 11 schools and 5,500 pupils. Efforts were also made to cut down costs and reduce the environmental impact of transport by farming the AIVs directly on school land. Despite these successes, sustainability beyond the pilot has been an issue, highlighting the importance of a supportive policy environment for the success of HGSF programs. At present, Kenya's national budgetary commitment to school feeding was devolved to county governments. There is significant interest in similar approaches and opportunities exist to scale out.

Borelli et al. (2021) Linking farmers and schools to improve diets and nutrition in Busia County, Kenya. In: FAO, Alliance of Bioversity International and CIAT and Editora da UFRGS. 2021. Public food procurement for sustainable food systems and healthy diets - Volume 2. Rome. Pp. 338-353 https://doi.org/10.4060/cb7969en

Are some measures out of scope for WFP?

Many of the strategies aimed at reducing emissions linked to food storage, cold chains, transportation, and processing may require broader governance and policy reforms that fall outside the remit of WFP's current food procurement mechanisms. For instance, these reforms could include changes to food and manufacturing policies, such as introducing market-based measures, subsidies, and incentives to encourage investment in critical technologies. Furthermore, there is a need for research and development to identify energy-efficient and effective cold chain solutions. The tool could be expanded to incorporate a secondary layer of information that assesses the existing infrastructure in each country where WFP operates, facilitating comparisons and identifying potential solutions. Manufacturers could be encouraged to adopt energy-saving technologies through incentives, while governments could improve public service infrastructure—such as reliable internet and electricity supply—to enhance the efficiency of supply chain processes and reduce overall emissions.

Reducing transport emissions

Reducing emissions from transportation requires broader collaboration involving government entities to ensure improved road and rail networks, particularly in high-production areas, and the adoption of more efficient transport modes. This effort is crucial not only for reducing fossil fuel consumption but also for mitigating post-harvest food loss and waste. Providing incentives for the production, importation, and use of transport solutions that specifically reduce food waste, such as refrigeration, could be part of the solution package, although this may not be universally applicable. Discussions should explore alternative solutions to traditional cold chains, such as drying methods for perishable items like green leafy vegetables, alongside the development of recipes that yield nutritious meals that are culturally accepted and palatable. This could involve convening global practitioners to exchange best practices and share knowledge on strategies to minimize post-harvest food loss. Proposed measures include broader policy initiatives like promoting food loss and waste reduction among farmers and schools, as well as encouraging behavioral and design changes to enhance energy efficiency in existing cold storage facilities. These changes might include optimizing temperature-controlled food transfers between units, leveraging natural cooling opportunities (i.e. during cooler evening temperatures), designing systems for efficiency under typical temperatures, and enhancing insulation to minimize refrigerant leakage. Improved room insulation alone has the potential to deliver substantial energy savings, estimated at 25%.

Limited markets and supply chain development up to the school gate and into the schools

Limited markets and supply chain development limit the integration of non-staple crops such as legumes and dark, green leafy vegetables into school meal programs in turn impacting diversity in production systems. Traditional cooking methods using firewood emit smoke, impacting air quality in schools. If the procurement of environmentally friendly food is successful, the introduction of clean energy solutions for cooking in schools, as demonstrated by the Rwandan pilot project to provide clean energy for cooking in schools, is an important addition.

> "For example, the Government of Rwanda even did a study last year to look at clean energy for cooking in schools (…). Rwanda is looking at what type of energy they can integrate into the school feeding programme"
>
> *School Meal Advisor*

There are opportunities for schools to grow foods

Schools often possess arable land that can be used to grow crops for income generation. By using these fields, schools can serve as community hubs for sustainable food production and information, fulfilling the following functions for the benefit of local communities:

- **Nutrition**: by cultivating legumes, and traditional vegetables and fruits that are often in short supply, schools can provide such nutritious foods in school meals
- **Local economy**: by selling surplus production locally, schools can connect with the market and with farmers, reducing the food burden on contribution from parents
- **Education**: by acting as education hubs for children and local communities and promoting the importance of local foods and culture, schools can contribute to raising awareness about healthy and sustainable diets.

In Busia County, Kenya, cultivating vegetables on school-owned land created significant opportunities for establishing educational gardens. This allowed students to gain practical experience in on sustainably growing local crops as part of their curriculum, while also learning about nutrition and economics (Borelli et al. 2021).

To achieve these objectives and for sustainability of the scheme, it is essential to appoint a dedicated coordinator, possessing expertise in local production, distribution, and marketing, rather than relying solely on the initiatives of individual teachers. This coordinator should collaborate closely with local extension services and local groups of farmers and women. As a starting point, in May 2024, the Government of Kenya invited partners to assist in developing a *National School Garden Guide* aimed at enhancing school capacity in establishing school farms. This guide will complement the existing *School Menu Guide*, which currently lacks directives on cultivating food within schools. Moreover, the National School Garden Guide will incorporate in-school demonstration plots as a means of integrating local farmers into school feeding programs. It will also complement the *Teachers' Reference Manual on Agriculture and Nutrition Curriculum*. The evaluation tool proposed in this study can be employed to determine which agronomic practices and food processing procedures schools should adopt to qualify their efforts as planet friendly.

Reporting mechanisms

The evaluation tool employs a straightforward scoring method. Further exploration is needed to determine the optimal stage for conducting evaluations. One possibility is integrating it at the food sourcing stage within the school food value chain. This would enable regular reporting on the sustainability level of sourced foods, facilitating ongoing monitoring of potential improvements and evaluation of innovations.

References

Abate, Gashaw T., Tanguy Bernard, Alain De Janvry, Elisabeth Sadoulet, and Carly Trachtman. 2021. 'Introducing Quality Certification in Staple Food Markets in Sub-Saharan Africa: Four Conditions for Successful Implementation'. *Food Policy* 105 (December):102173. https://doi.org/10.1016/j.foodpol.2021.102173.

Antolini, Federico, Eric Tate, Brent Dalzell, Nathan Young, Kris Johnson, and Peter L. Hawthorne. 2020. 'Flood Risk Reduction from Agricultural Best Management Practices'. *Journal of the American Water Resources Association* 56 (1): 161–79. https://doi.org/10.1111/1752-1688.12812.

Beig, Bilal, Muhammad Bilal Khan Niazi, Zaib Jahan, Arshad Hussain, Munir Hussain Zia, and Muhammad Taqi Mehran. 2020. 'Coating Materials for Slow Release of Nitrogen from Urea Fertilizer: A Review'. *Journal of Plant Nutrition* 43 (10): 1510–33. https://doi.org/10.1080/01904167.2020.1744647.

Berkhout, Ezra D., Mandy Malan, and Tom Kram. 2019. 'Better Soils for Healthier Lives? An Econometric Assessment of the Link between Soil Nutrients and Malnutrition in Sub-Saharan Africa'. *PLOS ONE* 14 (1): e0210642. https://doi.org/10.1371/journal.pone.0210642.

Boone, Lieselot, Veerle Van linden, Steven De Meester, Bart Vandecasteele, Hilde Muylle, Isabel Roldán-Ruiz, Thomas Nemecek, and Jo Dewulf. 2016. 'Environmental Life Cycle Assessment of Grain Maize Production: An Analysis of Factors Causing Variability'. *Science of the Total Environment* 553:551–64. https://doi.org/10.1016/j.scitotenv.2016.02.089.

Borelli, Teresa, A Manjella, Danny Hunter, and L Wasilwa. 2021. 'Linking Farmers and Schools to Improve Diets and Nutrition in Busia County, Kenya'. In *Public Food Procurement for Sustainable Food Systems and Healthy Diets – Volume 2*, edited by LFJ Swensson, Danny Hunter, S Schneider, and F Tartanac, first, 338–53. FAO; Bioversity International and Editora UFRGS. https://openknowledge.fao.org/server/api/core/bitstreams/a8b27ad3-5dca-4e85-bf40-f571865f872b/content.

Bradbury, John, Michael Kirk-Smith, Sophie Crossette, Lucien Joseph, and Simon Hann. 2023. 'Assessing Climate Impact: Reusable Systems vs. Single-Use Takeaway Packaging'. Bristol, UK: Eunomia Research & Consulting Ltd. https://circulareconomy.europa.eu/platform/sites/default/files/2023-09/Assessing-the-Climate-Impact-Reusable-systems-vs.-Single-Use-Takeaway-Packaging-v-2.2.pdf.

Brempong, Mavis Badu, Patricia Amankwaa-Yeboah, Stephen Yeboah, Eric Owusu Danquah, Kennedy Agyeman, Agbesi Kwadzo Keteku, Abigail Addo-Danso, and Joseph Adomako. 2023. 'Soil and Water Conservation Measures to Adapt Cropping Systems to Climate Change Facilitated Water Stresses in Africa'. *Frontiers in Sustainable Food Systems* 6 (January). https://doi.org/10.3389/fsufs.2022.1091665.

Brender, Jean D. 2020. 'Human Health Effects of Exposure to Nitrate, Nitrite, and Nitrogen Dioxide'. In *Just Enough Nitrogen: Perspectives on How to Get There for Regions with Too Much and Too Little Nitrogen*, edited by Mark A. Sutton, Kate E. Mason, Albert Bleeker, W. Kevin Hicks, Cargele Masso, N. Raghuram, Stefan Reis, and Mateete Bekunda, 283–94. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-030-58065-0_18.

Bundy, Donald A. P., Carmen Burbano, Margaret Grosh, Aulo Gelli, Matthew Jukes, and Lesley Drake. 2009. *Rethinking School Feeding: Social Safety Nets, Child Development, and the Education Sector*. Directions in Development. Human Development. Washington, DC: World Bank.

Burek, Jasmina, and Darin W. Nutter. 2020. 'Environmental Implications of Perishables Storage and Retailing☆'. *Renewable and Sustainable Energy Reviews* 133 (July 2019): 110070–110070. https://doi.org/10.1016/j.rser.2020.110070.

Chakori, Sabrina, Ammar Abdul Aziz, Carl Smith, and Paul Dargusch. 2021. 'Untangling the Underlying Drivers of the Use of Single-Use Food Packaging'. *Ecological Economics* 185 (July):107063. https://doi.org/10.1016/j.ecolecon.2021.107063.

Coates, Sarah J., Wendemagegn Enbiale, Mark D. P. Davis, and Louise K. Andersen. 2020. 'The Effects of Climate Change on Human Health in Africa, a Dermatologic Perspective: A Report from the International Society of Dermatology Climate Change Committee'. *International Journal of Dermatology* 59 (3): 265–78. https://doi.org/10.1111/ijd.14759.

Cramer, Laura, Josh Drake, Bianca Flokstra, Stuart Gillespie, Ranjiv Khush, Corey Luthringer, Rahul Rawat, and Leah Salm. 2023. 'Climate Change, Food Systems, and Nutrition: Challenges and Opportunities for Children's Health in Sub-Saharan Africa'. Seattle, San Francisco, Washington DC, Paris: Camber Collective's. https://cambercollective.com/wp-content/uploads/2023/01/Climate-Change-Food-Systems-Nutrition-in-SSA.pdf.

Crippa, M., E. Solazzo, D. Guizzardi, F. Monforti-Ferrario, F. N. Tubiello, and A. Leip. 2021. 'Food Systems Are Responsible for a Third of Global Anthropogenic GHG Emissions'. *Nature Food* 2 (3): 198–209. https://doi.org/10.1038/s43016-021-00225-9.

Dickerson, Sarah, Mallory Cannon, and Brian O'Neill. 2022. 'Climate Change Risks to Human Development in Sub-Saharan Africa: A Review of the Literature'. *Climate and Development* 14 (6): 571–89. https://doi.org/10.1080/17565529.2021.1951644.

Diop, Massamba, Ngonidzashe Chirinda, Adnane Beniaich, Mohamed El Gharous, and Khalil El Mejahed. 2022. 'Soil and Water Conservation in Africa: State of Play and Potential Role in Tackling Soil Degradation and Building Soil Health in Agricultural Lands'. *Sustainability* 14 (20): 13425. https://doi.org/10.3390/su142013425.

Dube, Edith, and Grace Emily Okuthe. 2024. 'Plastic and Micro/Nanoplastic Pollution in Sub-Saharan Africa: Challenges, Impacts, and Solutions'. *World* 5 (2): 325–45. https://doi.org/10.3390/world5020018.

Dubey, Pradeep Kumar, Ajeet Singh, Rajan Chaurasia, Krishna Kumar Pandey, Amit Kumar Bundela, Rama Kant Dubey, and Purushothaman Chirakkuzhyil Abhilash. 2021. 'Planet Friendly Agriculture: Farming for People and the Planet'. *Current Research in Environmental Sustainability* 3 (January):100041. https://doi.org/10.1016/j.crsust.2021.100041.

Falconnier, Gatien N, Rémi Cardinael, Marc Corbeels, Frédéric Baudron, Pauline Chivenge, Antoine Couëdel, Aude Ripoche, et al. 2023. 'The Input Reduction Principle of Agroecology Is Wrong When It Comes to Mineral Fertilizer Use in Sub-Saharan Africa'. *Outlook on Agriculture* 52 (3): 311–26. https://doi.org/10.1177/00307270231199795.

FAO, ed. 2019. *Moving Forward on Food Loss and Waste Reduction*. The State of Food and Agriculture 2019. Rome: Food and Agriculture Organization of the United Nations. https://openknowledge.fao.org/server/api/core/bitstreams/11f9288f-dc78-4171-8d02-92235b8d7dc7/content.

———. 2023. 'Towards the Development of a Voluntary Code of Conduct on the Sustainable Use of Plastics in Agriculture'. 6 September 2023. https://www.fao.org/fsnforum/call-submissions/voluntary-code-conduct-sustainable-use-plastics-agriculture.

FAO, Alliance of Bioversity International and CIAT, and Editora da UFRGS. 2021. *Public Food Procurement for Sustainable Food Systems and Healthy Diets - Volume 1*. Vol. 1. Rome, Italy: FAO; Bioversity International; https://doi.org/10.4060/cb7960en.

FAO, and WFP. 2018. 'Home-Grown School Feeding Resource Framework - Synopsis'. Rome, Italy: FAO and WFP. https://openknowledge.fao.org/server/api/core/bitstreams/b1c248bf-c8e1-4969-acce-8020cbe4b2d1/content.

Farmers Review Africa. 2022. 'The Controlled Release Fertilizer Market to Cross USD 3.9 Bn by 2024'. *Farmers Review Africa* (blog). 14 July 2022. https://farmersreviewafrica.com/the-controlled-release-fertilizer-market-to-cross-usd-3-9-bn-by-2024/.

Fichtinger, Johannes, Jörg M. Ries, Eric H. Grosse, and Peter Baker. 2015. 'Assessing the Environmental Impact of Integrated Inventory and Warehouse Management'. *International Journal of Production Economics* 170:717–29. https://doi.org/10.1016/j.ijpe.2015.06.025.

Frison, Emile A., Jeremy Cherfas, and Toby Hodgkin. 2011. 'Agricultural Biodiversity Is Essential for a Sustainable Improvement in Food and Nutrition Security'. *Sustainability* 3 (1): 238–53. https://doi.org/10.3390/su3010238.

Fuhrimann, Samuel, Iris van den Brenk, Aggrey Atuhaire, Ruth Mubeezi, Philipp Staudacher, Anke Huss, and Hans Kromhout. 2022. 'Recent Pesticide Exposure Affects Sleep: A Cross-Sectional Study among Smallholder Farmers in Uganda'. *Environment International* 158 (January):106878. https://doi.org/10.1016/j.envint.2021.106878.

Gelli, Aulo, and Ruel Ruel. 2023. 'Unlocking Opportunities for Planet-Friendly School Meals'. IFPRI : International Food Policy Research Institute. 2023. https://www.ifpri.org/blog/unlocking-opportunities-planet-friendly-school-meals.

Green Schools. 2020. 'Green Schools® Certification Program for the MENA Region'. Information. Green Schools. 2020. https://www.greenschools.me/.

Halpern, Benjamin S., Melanie Frazier, Juliette Verstaen, Paul-Eric Rayner, Gage Clawson, Julia L. Blanchard, Richard S. Cottrell, et al. 2022. 'The Environmental Footprint of Global Food Production'. *Nature Sustainability* 5 (12): 1027–39. https://doi.org/10.1038/s41893-022-00965-x.

Hammond, Sean T., James H. Brown, Joseph R. Burger, Tatiana P. Flanagan, Trevor S. Fristoe, Norman Mercado-Silva, Jeffrey C. Nekola, and Jordan G. Okie. 2015. 'Food Spoilage, Storage, and Transport: Implications for a Sustainable Future'. *BioScience* 65 (8): 758–68. https://doi.org/10.1093/biosci/biv081.

HLPE. 2024. 'Strengthening Urban and Peri-urban Food Systems to Achieve Food Security and Nutrition, in the Context of Urbanization and Rural Transformation'. 19. HLPE Report. Rome, Italy: CFS HLPE-FSN. https://sfcs.fao.org/docs/devhlpelibraries/report-19/hlpe-19---main-report_en_cd1459en.pdf.

Horak, Ilzé, Suranie Horn, and Rialet Pieters. 2021. 'Agrochemicals in Freshwater Systems and Their Potential as Endocrine Disrupting Chemicals: A South African Context'. *Environmental Pollution* 268 (January):115718. https://doi.org/10.1016/j.envpol.2020.115718.

Jones, M. 2021. 'Public Food Procurement and the Sustainable Development Goals'. In *Public Food Procurement for Sustainable Food Systems and Healthy Diets - Volume 1*, by FAO, Alliance of Bioversity International and CIAT, and Editora da UFRGS, 1:78–98. Rome, Italy: FAO; Bioversity International; https://doi.org/10.4060/cb7960en.

Joseph, Sarah, Manijeh Komeili, Maria Besiou, and Jonas Stumpf. 2024. 'Measuring the Greenhouse Gas Emissions & Waste of Humanitarian Supply Chains - a Quantitative Research Study on the Environmental Impacts of Humanitarian Disaster Response'. Hamburg, Germany: Kühne Logistik University.

Kihara, J., P. Bolo, M. Kinyua, J. Rurinda, and K. Piikki. 2020. 'Micronutrient Deficiencies in African Soils and the Human Nutritional Nexus: Opportunities with Staple Crops'. *Environmental Geochemistry and Health* 42 (9): 3015–33. https://doi.org/10.1007/s10653-019-00499-w.

Krall, Stephan. 2015. 'What Is Sustainable Agriculture?' *GIZ*.

Larramendy, Marcelo L., and Sonia Soloneski. 2019. *Pesticides: Use and Misuse and Their Impact in the Environment*. BoD – Books on Demand.

Latino, Maria Elena, Angelo Corallo, Marta Menegoli, and Biagio Nuzzo. 2022. 'An Integrative Conceptual Framework of Food Certifications: Systematic Review, Research Agenda, and Macromarketing Implications'. *Journal of Macromarketing* 42 (1): 71–99. https://doi.org/10.1177/02761467211049071.

MAXQDA. 2024. 'MAXQDA | All-In-One Qualitative & Mixed Methods Data Analysis Tool'. MAXQDA. 2024. https://www.maxqda.com/.

Mbandi, Aderiana Mutheu, Christopher S. Malley, Dietrich Schwela, Harry Vallack, Lisa Emberson, and Mike R. Ashmore. 2023. 'Assessment of the Impact of Road Transport Policies on Air Pollution and Greenhouse Gas Emissions in Kenya'. *Energy Strategy Reviews* 49 (September):101120. https://doi.org/10.1016/j.esr.2023.101120.

Mordor Intelligence. 2024. 'Polymer Coated NPK Fertilizers Market - Size, Share & Industry Analysis'. 2024. https://www.mordorintelligence.com/industry-reports/bio-degradable-polymer-coated-npk.

Mukiibi, Stuart, Steven Allan Nyanzi, Justus Kwetegyeka, Chijioke Olisah, Adewale Matthew Taiwo, Edward Mubiru, Emmanuel Tebandeke, et al. 2021. 'Organochlorine Pesticide Residues in Uganda's Honey as a Bioindicator of Environmental Contamination and Reproductive Health Implications to Consumers'. *Ecotoxicology and Environmental Safety* 214 (May):112094. https://doi.org/10.1016/j.ecoenv.2021.112094.

Mylona, Zoi, Maria Kolokotroni, Konstantinos M. Tsamos, and Savvas A. Tassou. 2017. 'Comparative Analysis on the Energy Use and Environmental Impact of Different Refrigeration Systems for Frozen Food Supermarket Application'. *Energy Procedia* 123:121–30. https://doi.org/10.1016/j.egypro.2017.07.234.

NDCs, Food Forward. 2024. 'Reducing Emissions from Energy Use in Food Storage, Cold Chains, Transport and Processing'. Food Forward NDCs. 20 February 2024. https://foodforwardndcs.panda.org/food-supply-chains/reducing-emissions-from-energy-use-in-food-storage-cold-chains-transport-and-processing/.

NEMA. 2019. 'National Environment Management Authority (NEMA) - 2 Years on: Say No to Plastic Bags'. 2019. https://www.nema.go.ke/index.php?option=com_content&view=article&id=296&catid=2&Itemid=451.

Nijdam, Durk, Trudy Rood, and Henk Westhoek. 2012. 'The Price of Protein: Review of Land Use and Carbon Footprints from Life Cycle Assessments of Animal Food Products and Their Substitutes'. *Food Policy* 37 (6): 760–70. https://doi.org/10.1016/j.foodpol.2012.08.002.

Okolo-Obasi, Nduka Elda, and Joseph Ikechukwu Uduji. 2022. 'The Impact of National Home Grown School Feeding Programme (NHGSFP) on Rural Communities in Nigeria'. *Journal of Economic and Administrative Sciences* ahead-of-print (ahead-of-print). https://doi.org/10.1108/JEAS-10-2021-0211.

Pastorino, Silvia, Darren Hughes, Linda Schultz, Samantha Owen, and Kate Morris. 2023. 'White Paper - School Meals and Food Systems: Rethinking the Consequences for Climate, Environment, Biodiversity and Food Sovereignity'. White Paper. London, UK: Research Consortium for School Health and Nutrition. https://researchonline.lshtm.ac.uk/id/eprint/4671492/13/Pastorino_etal_JAN_2024_School-meals-and-food-systems.pdf.

Piñeiro, Valeria, Joaquin Arias, Pablo Elverdin, Ana María Ibáñez, Cristian Morales Opazo, Steve Prager, and Máximo Torero. 2021. 'Achieving Sustainable Agricultural Practices: From Incentives to Adoption and Outcomes'. International Food Policy Research Institute (IFPRI). 2021. https://doi.org/10.2499/9780896294042.

Prifti, Ervin, and Alejandro Grinspun. 2021. *Impact Evaluation of the Home Grown School Feeding and Conservation Agriculture Scale-up Programmes in Zambia*. FAO.

Ragoobur, Doorgha, Esperanza Huerta-Lwanga, and Geeta Devi Somaroo. 2021. 'Microplastics in Agricultural Soils, Wastewater Effluents and Sewage Sludge in Mauritius'. *Science of The Total Environment* 798 (December):149326. https://doi.org/10.1016/j.scitotenv.2021.149326.

Roothaert, Ralph, Hosea Mpogole, Danny Hunter, Justus Ochieng, and Dyness Kejo. 2021. 'Policies, Multi-Stakeholder Approaches and Home-Grown School Feeding Programs for Improving Quality, Equity and Sustainability of School Meals in Northern Tanzania'. *Frontiers in Sustainable Food Systems* 5 (February). https://doi.org/10.3389/fsufs.2021.621608.

Saco, P. M., K. R. McDonough, J. F. Rodriguez, J. Rivera-Zayas, and S. G. Sandi. 2021. 'The Role of Soils in the Regulation of Hazards and Extreme Events'. *Philosophical Transactions of the Royal Society B: Biological Sciences* 376 (1834): 20200178. https://doi.org/10.1098/rstb.2020.0178.

Serrani, Dominique, Stefania Cocco, Valeria Cardelli, Paride D'Ottavio, Rogério Borguete Alves Rafael, Domingos Feniasse, Alcídio Vilanculos, et al. 2022. 'Soil Fertility in Slash and Burn Agricultural Systems in Central Mozambique'. *Journal of Environmental Management* 322 (November):116031. https://doi.org/10.1016/j.jenvman.2022.116031.

Shabir, Irtiqa, Kshirod Kumar Dash, Aamir Hussain Dar, Vinay Kumar Pandey, Ufaq Fayaz, Shivangi Srivastava, and Nisha R. 2023. 'Carbon Footprints Evaluation for Sustainable Food Processing System Development: A Comprehensive Review'. *Future Foods* 7 (June):100215. https://doi.org/10.1016/j.fufo.2023.100215.

Shah, Farooq, and Wei Wu. 2020. 'Chapter Five - Use of Plastic Mulch in Agriculture and Strategies to Mitigate the Associated Environmental Concerns'. In *Advances in Agronomy*, edited by Donald L. Sparks, 164:231–87. Academic Press. https://doi.org/10.1016/bs.agron.2020.06.005.

Shen, Maocai, Wei Huang, Ming Chen, Biao Song, Guangming Zeng, and Yaxin Zhang. 2020. '(Micro)Plastic Crisis: Un-Ignorable Contribution to Global Greenhouse Gas Emissions and Climate Change'. *Journal of Cleaner Production* 254 (May):120138. https://doi.org/10.1016/j.jclepro.2020.120138.

Singh, Simrat, and Gordon R Conway. 2021. 'Homegrown School Feeding – Enabling Healthy and Sustainable School Systems'. 4. Briefing Paper. London, UK: Centre for Environmental Policy, Imperial College London. https://www.imperial.ac.uk/media/imperial-college/faculty-of-natural-sciences/centre-for-environmental-policy/protective-foods-that-protect-the-planet/public/SS_Briefing-paper_HGSF_18.05.21_Final_A1.pdf.

Sithole, Nkanyiso J., Lembe S. Magwaza, and Guy R. Thibaud. 2019. 'Long-Term Impact of No-till Conservation Agriculture and N-Fertilizer on Soil Aggregate Stability, Infiltration and Distribution of C in Different Size Fractions'. *Soil and Tillage Research* 190 (July):147–56. https://doi.org/10.1016/j.still.2019.03.004.

Sluijs, Jeroen P. van der, and Nora S. Vaage. 2016. 'Pollinators and Global Food Security: The Need for Holistic Global Stewardship'. *Food Ethics* 1 (1): 75–91. https://doi.org/10.1007/s41055-016-0003-z.

Solar Freeze. 2024. 'Solar Freeze'. Welcome to SOLAR FREEZE - Post Harvest Solutions for Small Holder Farmers with Small Holders by Small Holders. 2024. https://www.solarfreeze.co.ke/solutions/?1.

Sundqvist-Andberg, Henna, and Maria Åkerman. 2022. 'Collaborative Governance as a Means of Navigating the Uncertainties of Sustainability Transformations: The Case of Finnish Food Packaging'. *Ecological Economics* 197 (July):107455. https://doi.org/10.1016/j.ecolecon.2022.107455.

Tassou, S. A., G. De-Lille, and Y. T. Ge. 2009. 'Food Transport Refrigeration - Approaches to Reduce Energy Consumption and Environmental Impacts of Road Transport'. *Applied Thermal Engineering* 29 (8–9): 1467–77. https://doi.org/10.1016/j.applthermaleng.2008.06.027.

Tennigkeit, Timm, Adaugo Okoli, and Alexis Brakhan. 2023. 'Guidebook for Project Developers. Best Practice for Agricultural Carbon Project Development Targeting Voluntary Carbon Markets (VCM)'. GIZ.

Tidåker, Pernilla, Hanna Karlsson Potter, Georg Carlsson, and Elin Röös. 2021. 'Towards Sustainable Consumption of Legumes: How Origin, Processing and Transport Affect the Environmental Impact of Pulses'. *Sustainable Production and Consumption* 27:496–508. https://doi.org/10.1016/j.spc.2021.01.017.

UN Climate Change, COP28 UAE. 2023. 'COP28 UAE Declaration On Climate And Health'. COP28 UAE Declaration on Climate and Health. 2023. https://www.cop28.com/en/cop28-uae-declaration-on-climate-and-health.

UNEP. 2021. 'Plastics in Agriculture: Sources and Impacts'. https://www.papillons-h2020.eu/wp-content/uploads/2021/12/Plastics-in-agriculture-sources-and-impacts-UNEP-GRID-Arendal.pdf.

———. 2023. 'Everything You Need to Know about Plastic Pollution'. Home/ News, Stories & Speeches/ Story. 25 April 2023. https://www.unep.org/news-and-stories/story/everything-you-need-know-about-plastic-pollution.

Walker, Tony R. 2021. '(Micro)Plastics and the UN Sustainable Development Goals'. *Current Opinion in Green and Sustainable Chemistry* 30 (August):100497. https://doi.org/10.1016/j.cogsc.2021.100497.

WFP. 2017. 'Environmental Policy'. Policy Issues WFP/EB.1/2017/4-B/Rev.1*. Executive Board Session Report. Rome, Italy: World Food Programme. https://executiveboard.wfp.org/document_download/WFP-0000037327.

———. 2019. 'Local and Regional Food Procurement Policy'. Policy Issues WFP/EB.2/2019/4-C*. Executive Board Session Report. Rome, Italy: World Food Programme. https://executiveboard.wfp.org/document_download/WFP-0000108552.

———. 2022a. 'Implementation of the 2017 Environmental Policy - Informal Consultation'. Background paper. Rome, Italy: WFP. https://executiveboard.wfp.org/document_download/WFP-0000144558.

———. 2022b. 'WFP's Contribution to Resilient Food Systems in Vulnerable and Shock-Prone Settings', no. November.

———. 2023. 'WFP's Approach to Planet - Friendly School Meals'. Brochures and Factsheets. Saving Lives - Changing Lives. Rome, Italy: World Food Programme. https://docs.wfp.org/api/documents/WFP-0000154597/download/?_ga=2.184196902.1071165839.1720863027-237358151.1720863017.

———. 2024a. 'Home-Grown School Feeding in West Africa: A Landscape Analysis | World Food Programme'. Landscape analysis. Saving Lives - Changing Lives. https://www.wfp.org/publications/home-grown-school-feeding-west-africa-landscape-analysis.

———. 2024b. 'Smallholder Market Support | World Food Programme'. Saving Lives Changing Lives. 22 May 2024. https://www.wfp.org/smallholder-market-support.

WHO. 2022. 'How Together We Can Make the World's Most Healthy and Sustainable Public Food Procurement'. WHO Regional Office for Europe. https://iris.who.int/bitstream/handle/10665/363337/WHO-EURO-2022-6178-45943-66333-eng.pdf?sequence=3.

Wikoff, Robin, Gretchen Nurse Rainbolt, and Wayne Wakeland. 2012. 'Measuring the Longitudinal Effects of Food Carbon Footprint Training on Consumers: Knowledge, Attitudes, and Behavioral Intentions'. *Sustainability* 5 (5): 317–22. https://doi.org/10.1089/SUS.2012.9925.

Wineman, Ayala, Moses C. Ekwueme, Liliane Bigayimpunzi, Alice Martin-Daihirou, Eth Ludmilla de Gois V. N. Rodrigues, Priscilia Etuge, Yale Warner, Heidi Kessler, and Arlene Mitchell. 2022. 'School Meal Programs in Africa: Regional Results From the 2019 Global Survey of School Meal Programs'. *Frontiers in Public Health* 10 (May). https://doi.org/10.3389/fpubh.2022.871866.

Winton, Debbie, Luca Marazzi, and Steven Loiselle. 2022. 'Drivers of Public Plastic (Mis)Use — New Insights from Changes in Single-Use Plastic Usage during the Covid-19 Pandemic'. *Science of The Total Environment* 849 (November):157672. https://doi.org/10.1016/j.scitotenv.2022.157672.

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