

Integrating Food and Health Systems in Africa

A High-Return Investment in Health

August 2026

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Image courtesy of Solid' Africa





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Solid'Africa feeds vulnerable patients in Rwanda's public hospitals and, since 2024, students in public schools, through an integrated farm-to-fork model that connects local agriculture directly to the people who need nutrition most. Founded in 2010, Solid'Africa has grown from serving 60 hospital patients a day to operating a full public nutrition infrastructure: sourcing ingredients from a network of over 7,000 smallholder farmers, preparing meals in centralized clean-energy kitchens, and delivering through last-mile logistics to public institutions. In 2025, Solid'Africa served 3.2 million meals across Rwanda, reaching 130,000 patients and caregivers across six public hospitals and 15,000 students across six public schools. By pairing clinical nutrition with school feeding and farmer-linked supply chains, and formalizing partnerships with national agencies, Solid'Africa is building toward its 2035 goal of reaching one million patients annually across all public hospitals in Rwanda.



The Rockefeller Foundation

The Rockefeller Foundation's mission is to promote the well-being of humanity throughout the world. Today the Foundation uses advances in power, health, food, and finance sectors to ensure everyone has good jobs, good food, good health, and more at a time when climate change's effects are taking lives and undermining livelihoods. At the intersection of food and health, the Foundation is scaling Food is Medicine programs across the United States to address chronic diseases, while globally working to help 100 million children gain access to nutritious, sustainable, and regenerative school meals: including in Africa, where the Foundation has maintained a regional presence since 1966. Across these efforts, the Foundation pioneers research into nutrition access and agricultural practices; supports evidence-informed solutions to support farmers and reduce the burden of diet-related disease; and invests in scalable solutions that connect regenerative food suppliers with sustainable markets around the world.



The Fortified Whole Grain Alliance (FWGA)

The Fortified Whole Grain Alliance (FWGA) is a global coalition of stakeholders, including nonprofit and private sector members. They work across the food system and are committed to increasing the global production and consumption of fortified whole grain foods (FWGs) in low- and middle-income countries (LMICs). By bringing together governments, development partners, research institutions, food manufacturers, millers, and the private sector, FWGA provides catalytic support through technical assistance, market development, formative research, policy support, and social behavior change interventions that improve dietary quality and strengthen food systems. Work is already underway across multiple countries with an initial focus on maize, rice, and wheat, to support a shift to fortified whole grains. In future, the Alliance aims to increase the share of FWG that is blended with sorghum, millet, and other local nutritious and hardy grains. Its long-term vision is that by 2032, at least 50% of grain foods consumed in institutional markets and 25% of grain foods consumed in consumer markets in LMICs will be fortified whole grain, contributing to better nutrition, healthier populations, and more resilient food systems.

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Executive Summary

Health systems are responsible for outcomes driven by food systems

Africa's health systems are increasingly treating outcomes that are shaped upstream by food systems. As diets become less diverse, more processed and refined, countries are facing a dual burden: persistent undernutrition alongside a rapid rise in diet-related non-communicable diseases (NCDs). That rising disease burden carries a direct fiscal cost, and this comes at a time when health systems are already under strain. Interest payments now absorb over 10% of government revenues across the region, more than double a decade ago, and development funding for health is projected to decline by up to ~50% in 2026 from 2024 levels.¹ With limited fiscal space to treat diseases that are growing more prevalent, governments face pressure to find preventive levers that can improve outcomes at lower long-run cost.

This report argues that food systems should be treated as core health infrastructure. Food systems determine what is produced, how it is processed, what institutions such as schools and hospitals procure, what households consume, and ultimately which health outcomes emerge over time. Yet food and health policy are still designed largely in parallel. The opportunity is to use food policy, institutional procurement, and care delivery together rather than as separate agendas.

This report focuses on school meals as the most effective place to begin. Across Africa, school feeding is one of the largest publicly financed food platforms and is increasingly supported through domestic budgets.² Because institutional meals generate predictable demand and reach children early in life, they can influence both diet quality, upstream supply chains and long-term eating habits. Within school meals, grains are the most practical intervention lever since they assume approximately two

thirds of both public meals and household diets. Shifting away from refined wheat, maize and polished rice toward whole and underutilized grains can improve nutrition, resilience, and local value creation without redesigning the entire school meal system.

This report draws on evidence across East Africa, with Rwanda as its primary case study. Rwanda combines policy ambition, institutional momentum, and a tractable implementation context that makes it a credible proof point for broader application across the African continent. The government has committed to universal healthy school meals by 2030 and meal provision already reaches 90% of students. Students account for roughly 30% of the population and grains make up an estimated 40% to 60% of a typical school meal.³ Rwanda has also demonstrated strong acceptance of whole-grain foods in school pilots, with lessons that translate directly to comparable systems across the region.

A full transition to underutilized grains and whole-grain maize and rice in Rwanda's school feeding system could generate an estimated \$115 million to \$155 million in annual combined health, fiscal, and environmental benefits. This includes \$50 million to \$60 million in direct monetary savings equivalent to approximate 10% of Rwanda's health expenditure as of latest published information in FY2022/23.

The broader implication is not that school meals are the whole solution. It is that they are the best place to start. From there, governments can embed food into clinical care, link procurement to local supply chains, and reinforce healthier food practices in communities.

1. OECD, 2026:

https://www.oecd.org/content/dam/oecd/en/publications/reports/2026/06/oda-projections-for-2026-and-the-near-term_10979bc6/d7c74fa2-en.pdf

2. Ghana increased its school feeding budget by 33% in 2025, from approximately \$106m to \$141m, and further to \$156m in 2026

(Ghana Ministry of Finance, Budget Statement, March 2025; November 2025): <https://mofep.gov.gh/index.php/budget-statements/2025>

3. Rwanda School Feeding Operational Guidelines 2021.

<https://www.fao.org/docs/devschoolfoodlibraries/materials-from-countries/rwanda-school-feeding-operational-guidelines.pdf>



Africa's Dietary Shift is Creating a Health Crisis – and a Fiscal one

Across Africa, food systems are becoming a central determinant of both disease burden and health-system sustainability. As diets shift toward refined staples and more processed foods, they contribute to the **growing and costly reality faced by health systems: the rise of non-communicable diseases (NCDs)**.^{4,5} This is not simply a nutrition challenge. It is a structural health and fiscal challenge.

The financing context makes this shift more urgent. Development funding for health is projected to decline in 2026 by up to 50% since 2024.⁶ At the same time, interest payments now absorb over 10% of government revenue across the region, more than double the share ten years ago.⁷ **Financial sustainability will therefore depend not only on efficient treatment of disease, but increasingly on preventing it.**

4. Adolescents' dietary patterns, their drivers and association with double burden of malnutrition in adolescents: a cross-sectional study in Kenya's urban slums. <https://jhpn.biomedcentral.com/articles/10.1186/s41043-024-00664-7>

5. The Nutrition Transition and the Double Burden of Malnutrition in Sub-Saharan African Countries: How Do These Countries Compare with the Recommended Lancet Commission Global Diet? <https://www.mdpi.com/1660-4601/19/24/16791>

6. OECD 2026: https://www.oecd.org/content/dam/oecd/en/publications/reports/2026/06/oda-projections-for-2026-and-the-near-term_10979bc6/d7c74fa2-en.pdf

7. Debt Dilemmas in Sub-Saharan Africa: Some Principles and Trade-Offs in Debt Restructuring. Regional Economic Outlook: Sub-Saharan Africa Analytical Note. <https://www.imf.org/-/media/files/publications/reo/afr/2023/october/english/debt-note2.pdf>

Historically, many African diets were more diverse and nutrient dense. They drew on underutilized crops such as sorghum, millet, legumes, and a broader range of vegetables and fermented foods. Today, consumption is concentrated around a narrow set of staples, the “big 3”: maize, rice and wheat, which account for roughly 60% of caloric intake.⁸ These are often consumed in refined or highly processed forms. Urbanization has accelerated this trend, as convenient packaged foods displace traditional staples and preparation practices.

This concentration creates both nutritional and systemic risks. Diets become less diverse and less nutrient-dense, while food systems become more exposed to climate variability due to lower resilience of non-indigenous crops, fertilizer price shocks, trade disruption, and foreign exchange pressure. The exposure is acute because the continent relies heavily on imports to meet staple demand. For example, Replace sentence with 'in East Africa, combined wheat and rice import dependence has averaged ~55% between 2020 and 2021.⁹ The result is a food system that is simultaneously less resilient and less health-promoting.

This dual burden is already visible in the data.

Undernutrition and micronutrient deficiencies continue to undermine immunity, child survival, and development. For example, among children with pneumonia, the risk of death doubles when a child is moderately underweight.¹⁰ At the same time, overweight, hypertension, diabetes, and other diet-related NCDs are rising across urban and peri-urban populations. In Kenya, adolescent girls consuming more processed diets are more than twice as likely to develop NCDs as those consuming more traditional, less processed diets. It is also estimated that one in 10 adolescents in sub-Saharan Africa, mostly school-going children, have elevated blood pressure.¹¹ Globally, the prevalence of hypertension in adolescents doubled to 7% between 2000 and 2020.¹²

Food insecurity and poor diet quality are also strongly associated with metabolic risk factors for diet-sensitive NCDs across sub-Saharan Africa,¹³ reinforcing the central role of food systems in shaping health outcomes.

Implication

NCDs already present an unsustainable cost to African health systems, which will only increase as populations age. With rising rates of elevated blood pressure in adolescents in Africa echoing global trends, the window for timely prevention is narrowing. Interventions that act through food systems now cost less than treating the consequences later, through health systems.



8. FAOSTAT 2010 -2021. <https://phys.org/news/2024-01-africa-food-based-wheat-rice.html>

9. FAO, FAOSTAT Food Balances (2010-), Eastern Africa regional aggregate, 2020 to 2023. <https://www.fao.org/faostat/en/#data/FBS>

10. The impact of childhood malnutrition on mortality from pneumonia: a systematic review and network meta-analysis. <https://gh.bmj.com/content/6/11/e007411>

11. Elevated blood pressure among adolescents in sub-Saharan Africa: a systematic review and meta-analysis [https://www.thelancet.com/journals/langlo/article/PIIS2214-109X\(23\)00218-8/fulltext](https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(23)00218-8/fulltext)

12. Global prevalence of hypertension among children and adolescents aged 19 years or younger: an updated systematic review and meta-analysis: [https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642\(25\)00281-0/abstract](https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(25)00281-0/abstract)

13. Association between food insecurity and key metabolic risk factors for diet sensitive non communicable diseases in sub Saharan Africa: a systematic review and meta analysis: <https://www.nature.com/articles/s41598-021-84344-0.pdf>

EXHIBIT 1

As Africa's GDP grows, non-communicable disease is expected to rise

GDP per capita by share of burden from NCDs



Source: Share of Burden from NCDs: Global Burden of Disease collaborative network - Study from 1990 – 2019

Exhibit 1 shows the correlation between GDP per capita and share of disease burden from NCDs across countries. As incomes increase, lifestyle risk factors associated with NCDs, particularly transitioning diets, also rise and drive up the NCD burden. In Egypt and Morocco, where GDP per capita is \$11,000, NCDs already account for >70% of the disease burden, while the rest of Africa with average GDP per capita of \$2,000-5,000 shows a lower disease burden share of under 45%. Given that approximately \$10 billion is spent annually on treating NCDs¹⁴, and a growing share of deaths on the continent are now linked to NCDs that can be prevented or mitigated through improved diet, it is imperative to take measures now to change this trajectory.

Dietary interventions present a strong economic case for action. The World Health Organisation's (WHO)

“Best Buys” analysis of the most cost-effective NCD interventions identifies food-based interventions as among the highest-return investments in health systems, with modeled returns of up to \$14 per dollar invested, approximately double those of tobacco control in comparable regions.

However, food and health systems remain structurally disconnected. Agricultural policy, school feeding, nutrition, and healthcare delivery are still managed largely in parallel, with limited system-level frameworks, shared metrics, coordinated funding and standards, and accountability. This limits proactive planning and prevention, instead entrenching a reactive model in which health systems pay for failures that food systems help to create.

14. Estimate derived by applying Kenya's NCD expenditure share (5.7–6.2%, National Health Accounts) to Africa's total health expenditure (~US\$146bn, World Bank). Providing conservative, bottom-up approximation of continent-wide NCD spending

How Food Systems Drive Health Outcomes

Health outcomes are not determined by healthcare alone; they are shaped by how food systems function

EXHIBIT 2

Food system pathways shape health outcomes

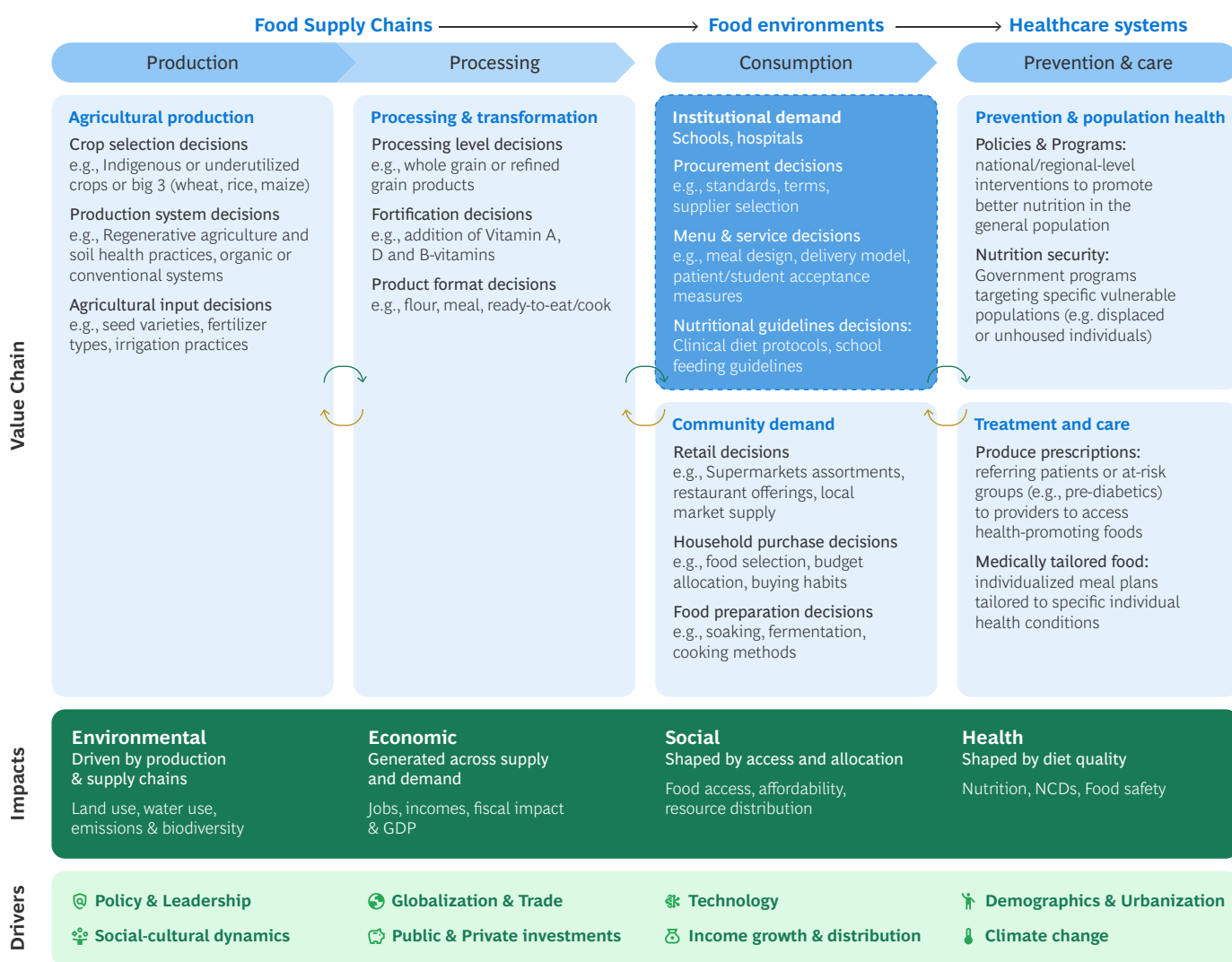


Exhibit 2 illustrates the complexity of food systems and their relationship with health outcomes. Food systems operate as an interconnected set of pathways that shape what food is produced, how it is processed, where it is accessed, and how it is ultimately consumed.

The information environment surrounding these pathways further shapes consumption behaviors and choices by influencing what people know, desire and demand. These pathways collectively determine diet quality, which in turn drives health outcomes over time.

A comprehensive ecosystem view is essential to identify where interventions can deliver the greatest impact across both food and health systems. In Africa, and even globally, that intervention point is often institutional demand. The following paragraphs provide a more detailed description of the elements of Exhibit 2, and illustrate the interconnectedness of food system pathways and health outcomes.

Food supply chains: Production & processing

At the foundation of the system, agricultural production and food processing determine the assortment, availability, affordability, and nutritional quality of food. Across Africa, production remains concentrated in a narrow set of staples, primarily maize, rice, and wheat, despite the region's rich agricultural biodiversity. Underutilized grains such as millet, teff, fonio and sorghum, along with other nutrient-dense and climate-resilient crops, remain underutilized. Such narrowing of crop choices reduces dietary diversity and increases vulnerability to climate and trade shocks. Sorghum alone contains iron levels of up to 61 mg/kg,¹⁵ making it one of the most micronutrient-dense cereals available in sub-Saharan Africa. Yet it remains marginal in both production and procurement.

Farming practices further shape nutritional outcomes through their impact on soil health. Soil biomes influence the micronutrient content of crops. Regenerative agriculture, for example, can restore microbial diversity and ecosystem function, improving the availability of micronutrients such as magnesium and zinc by as much as 50% vs conventional farming,¹⁶ while reducing chemical residues in food.

Processing is another critical lever. The refinement of staple grains removes fiber, vitamins, and minerals, contributing to diets that are calorie-sufficient but nutrient-poor. For example, polishing brown rice into white rice destroys 90% of vitamin B6, 80% of vitamin B1, 67% of vitamin B3, and virtually all of the dietary fiber and essential fatty acids.¹⁷ In contrast, whole-grain milling and fortification can significantly improve the nutritional profile of widely consumed foods. Decisions made at the production and processing stages therefore have direct implications for diet quality and population health.

Food environments: Institutional demand

Food environments determine how food moves from supply to consumption. Institutional environments, particularly schools and healthcare facilities, have an outsized influence on both diets and supply chains. Because institutions procure food at scale and generate predictable demand, they act as anchor buyers that shape upstream production and distribution.

In schools, food programs influence dietary habits early in life, shaping taste preferences, nutritional knowledge, and long-term consumption patterns. In healthcare settings, nutrition can be integrated into treatment pathways, improving clinical outcomes and reducing healthcare utilization through approaches such as medically-tailored meals.

When procurement is linked to nutrition standards, institutions can create stable demand for more diverse and nutritious foods, including whole grains and underutilized crops. This, in turn, can catalyze investment across the value chain, from farming to processing and distribution. In Benin, for instance, the government's local food procurement for school feeding contributed over \$23 million to the national economy in 2024, and increased direct purchases from smallholder farmers by 800%, benefiting more than 23,000 people.¹⁸

Food environments: Community demand

Institutions influence only part of a nation's diet. Most consumption decisions are still made in community and household environments, where access, affordability, knowledge, and cultural norms shape what people eat. This is particularly important in early childhood and in the first 1,000 days, when nutrition has lasting effects on cognitive development, immune function, and disease risk. Local markets, formal and informal vendors, and household choices define the diversity and quality of diets.

Preparation practices matter as much as food access. Fermentation, soaking, and gentler cooking methods can improve mineral bioavailability and nutrient retention, while poor preparation can significantly reduce nutritional value. For example, boiling leafy vegetables can cut vitamin C by up to 50%, whereas steaming retains most micronutrients. Fermentation can increase iron absorption by 2–3x in plant-based diets.

15. Musidzaramba TJ et al, Nutritional profile and food safety of raw and value-added food products of sorghum and millets in sub-Saharan Africa and South Asia: <https://doi.org/10.1080/23311932.2025.2461628>

16. Montgomery D.R et al, Soil health and nutrient density: preliminary comparison of regenerative and conventional farming. <https://peerj.com/articles/12848/>

17. Kalita T et al, Effect of Different Processing Methods on the Nutritional Value of Rice; DOI 10.12944/CRNFSJ.9.2.31

18. WFP report: 20 million more children in Sub-Saharan Africa now receive government-led school meals.

<https://www.wfp.org/news/wfp-report-20-million-more-children-sub-saharan-africa-now-receive-government-led-school-meals>

Social norms also matter. Processed foods are increasingly seen as more convenient and imported staples as more aspirational than indigenous alternatives. Across Nigeria, Tanzania and Uganda, ultra-processed food consumption already accounts for 32% of diets among middle-income groups compared to 12% among the poor, with vegetable and bean spending showing the inverse pattern, at 17% of food budgets and 25% over the same income range.¹⁹ These norms are accelerating a shift away from traditional diets and eroding the transmission of indigenous nutritional knowledge and practices.

Sustainable dietary change therefore depends not only on availability, but also on building awareness that influences behaviors and knowledge at community level.

Health systems: Prevention and care

The combined effects of supply chains and food environments are reflected in dietary intake, which drives health outcomes over time.

Where diets are diverse and nutrient-dense, the short-term effects include better satiety, cognitive performance, daily functioning and recovery from illness. Over time, good dietary choices build stronger immunity, support physical development, reduce the prevalence of diet-related diseases and improve treatment outcomes in patients. These gains accumulate into better school performance, higher labor productivity and lower long-run fiscal pressure on health systems.

Where diets shift toward refined and processed staples, the same pathways run in reverse. Poor dietary quality undermines cognitive and physical development, raises the prevalence of conditions like anemia, diabetes and cardiovascular disease, and drives higher care costs that compound into structural fiscal pressure over time. The number of people living with type 2 diabetes in Sub-Saharan Africa is projected to rise from 19 million in 2019 to 47 million by 2045, a trajectory directly tied to the shift toward refined and processed diets.²⁰

Taken together, these pathways show that improving health outcomes at scale requires action beyond healthcare, with food systems presenting a key lever for long-term impact.



Image courtesy of TICAH

19. Dolislager M et al, Consumption of healthy and unhealthy foods by the African poor: Evidence from Nigeria, Tanzania, and Uganda. <https://doi.org/10.1111/agec.12738>

20. Alemayehu ZG et al, Traditional diets and cultural beliefs affecting diabetes prevention and control in Africa. <https://doi.org/10.1177/22799036261430965>



Image courtesy of Solid Africa

The Intervention Point: Where Food Policy and Health Policy Converge

Why school meals and why grains

A systems lens reveals many intervention points. This report focuses on grains in school meals because that is where health, agriculture, and public finance intersect most clearly - and where a scalable, evidence-backed first step is available.

School feeding programs are among the largest institutional food platforms on the continent, reaching over 85 million children across Africa, with over 80% of these programs financed domestically.²¹ The African Union champions Home-Grown School Feeding programs that source locally-grown foods to supply school demand, and related guidance to countries emphasizes the importance of health when planning school feeding.²² That makes schools one of the few public platforms capable of

influencing diets at population scale while also creating a predictable demand signal for farmers, millers, processors, and distributors.

Grains are the most practical lever within that platform. Across much of Africa, they account for up to two thirds of calories in both household diets and institutional meals. In Rwanda, for example, maize and rice - two of the “big 3” grains - make up an estimated 40% to 60% of a typical school meal.²³ Shifting the grain basket therefore changes a large share of the plate with comparatively limited operational complexity. And because procurement decisions are made institutionally, the policy lever is direct and immediate.

21. <https://au.int/en/newsevents/20260228/11th-african-day-school-feeding-adsf>

22. https://www.nepad.org/sites/default/files/resourcefiles/Guidelines%20for%20HGSF%20Implementation_EN.pdf

23. Rwanda School Feeding Operational Guidelines 2021.

<https://www.fao.org/docs/devschoolfoodlibraries/materials-from-countries/rwanda-school-feeding-operational-guidelines.pdf>

A credible proof point for African application

Rwanda combines the policy ambition, institutional momentum, and implementation context needed to demonstrate what integrated food-health systems can deliver.

The government has committed to ensuring every child receives a healthy meal by 2030 under the National Comprehensive School Feeding Policy and Strategy.²⁴ Students represent roughly 30% of the population, giving school meals an unusually broad reach – with the national school feeding program now the largest institutional market for select staples (maize, beans, rice) in the country. This creates an environment that’s conducive to demonstrating how school meals can serve as a bridge between food policy and health outcomes.

Early evidence suggests the transition is both feasible and acceptable.

In Rwanda, a 2021 pilot led by The Rockefeller Foundation and the World Food Programme introduced fortified whole-grain maize into stiff maize meal porridge, reaching 13,500 students. Acceptance was high: **97% of students preferred the whole-grain porridge to the refined**

alternative. Students reported greater satiety and energy, and 73% demonstrated awareness of nutritional benefits.

As the program scaled to more than 74,000 children across 81 schools, acceptance remained strong. Parental support was near universal, with **99% expressing approval and many indicating interest in adopting whole-grain products at home**, suggesting spillover demand beyond the school system.

Three design principles maintained high acceptance:

- 1 familiar formats**
- 2 gradual transition through flour blends**
- 3 preparation methods that improve texture and taste, such as soaking sorghum.**

These principles are replicable across other African school feeding systems, making Rwanda not just a case study but a design template.



24. Global School Meals Coalition: Nutrition, Health and Education for Every Child Country Commitment https://schoolmealscoalition.org/sites/default/files/attachments/files/RWA_Commitments.pdf



Image courtesy of Solid Africa

The Business Case (Rwanda Example): \$115 million–\$155 million in Annual Savings from Grain Reform Alone

Using Rwanda as a case study, we conducted analysis to estimate the value of shifting school feeding from refined maize flour and polished rice, toward locally produced whole-grain maize, unpolished rice and sorghum. This choice of focus reflects the fact that grains comprise a large share of both the plate and public procurement, making them a high-leverage intervention for health, resilience, and local market development.

Assuming substitution across the full student population, replacing refined maize and polished rice in the national school feeding program alone could generate an **estimated \$115 million to \$155 million in annual combined health, fiscal, and environmental benefits.**

This includes \$50 million to \$60 million in direct monetary savings, equivalent to approximate 10%²⁵ of Rwanda's health expenditure as of latest published information in FY2022/23.²⁶

The model captures both direct and indirect value.

Direct savings include lower healthcare costs from a reduced disease burden, reduced fertilizer subsidies, and procurement savings from greater use of underutilized grains. Indirect benefits include environmental gains and broader economic value from reduced disability-adjusted life years.²⁷ Assumptions are based on publicly available data, and further methodological details are provided in the appendix.

25. \$50M and \$60M correspond to 7% and 8% of CHE FY2022/2023

26. Rwanda Health Expenditure Report 2020–2023

27. Disability-Adjusted Life Years (DALYs) quantify number of years of healthy life lost to death, disability or other impairment

Our model assesses two complementary policy pathways that together define whole grain transition.

Pathway 1 substitutes refined maize and polished rice with whole-grain maize and unpolished rice, optimizing for immediate scale and system value within existing menus and supply chains.

Pathway 2 substitutes refined maize and polished rice with blended whole-grain maize, whole grain sorghum and unpolished rice, optimizing for fiscal affordability, climate resilience and local sourcing through the introduction of sorghum.

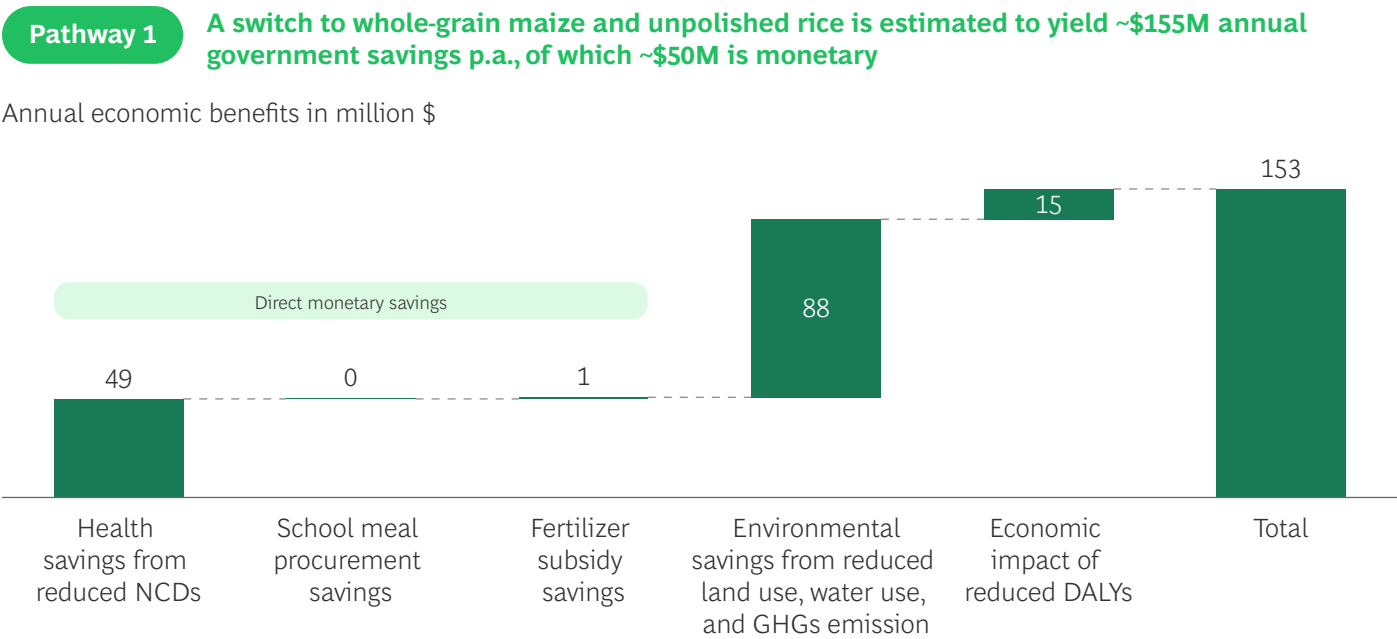
The two pathways do not rank simply by ambition. They optimize for different outcomes. The choice between them depends on which benefits a government prioritizes in the short to medium term.

Pathway 1 Transitioning to whole-grain maize and unpolished rice

This pathway is estimated to deliver the largest immediate annual system value at ~\$155 million, including \$50 million direct government monetary savings per annum, and is a feasible entry point for transition. It builds on existing menus and supply chains, with strong annual health savings of ~\$50 million (driven by reduced incidence of diet-related NCDs including type 2 diabetes, coronary heart disease, stroke and colorectal cancer, as well as iron-deficiency anemia) and environmental gains of ~\$90 million (valued using standard social cost estimates for reduced GHG emissions, land and water use). As a first step, it enables rapid scale and early wins, creating fiscal and operational headroom to support more complex diversification over time.

EXHIBIT 3

System-level and fiscal savings²⁸ from transitioning to whole-grains



Note: Analysis focuses on maize and rice whole grains, reflecting the composition of Rwanda's school meal program; wheat is excluded

28. Estimates based on 2025 market prices for whole grain maize, brown rice and sorghum with a USD/RWF conversion rate of 1,400. Actual system value will vary with commodity price movements and implementation scope

Pathway 2 Integrating whole-grain maize, unpolished rice and sorghum to improve climate resilience, agrobiodiversity, local sourcing and fiscal affordability.

This pathway is estimated to deliver ~\$115 million in annual system value and the largest direct government monetary savings at ~\$60 million per annum, as well as stronger health outcomes. The higher direct savings reflect the cost advantage of locally grown sorghum over imported

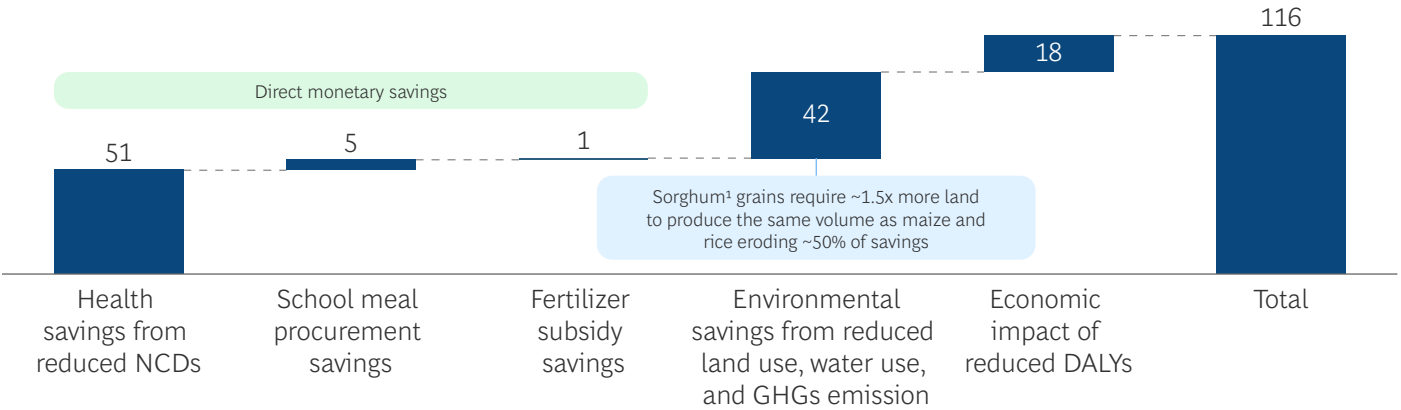
polished rice, which currently accounts for a significant share of school meal procurement spend and carries both a price premium and foreign exchange cost. Environmental gains are lower in the near term due to current yield gaps in sorghum production. Sorghum requires 2-4 times more land to produce the equivalent output of whole-grain maize and rice. Additional system value can be unlocked through targeted investment to raise productivity. Acceptance requires familiar formats and gradual introduction such as through flour blends.

EXHIBIT 4

System-level and fiscal savings from adding indigenous grains

Pathway 2 Integrating sorghum with whole-grain maize and unpolished rice is estimated to yield ~\$115M in government savings p.a., of which ~\$60M is monetary

Annual economic benefits in millions \$



Note: Refined maize is replaced with a blend of 50% whole maize flour and 50% sorghum flour, while polished rice is replaced by 50% brown rice and 50% whole-grain sorghum



Health and human capital gains

Replacing refined maize and polished rice with whole-grain maize, unpolished rice, and sorghum materially improves nutritional quality. Whole-grains deliver approximately 2-5 times the micro-nutrient density of refined alternatives. Sorghum contains over 15x the iron in polished rice²⁹, while whole-grain maize and unpolished rice retain fiber, B vitamins, and essential minerals that

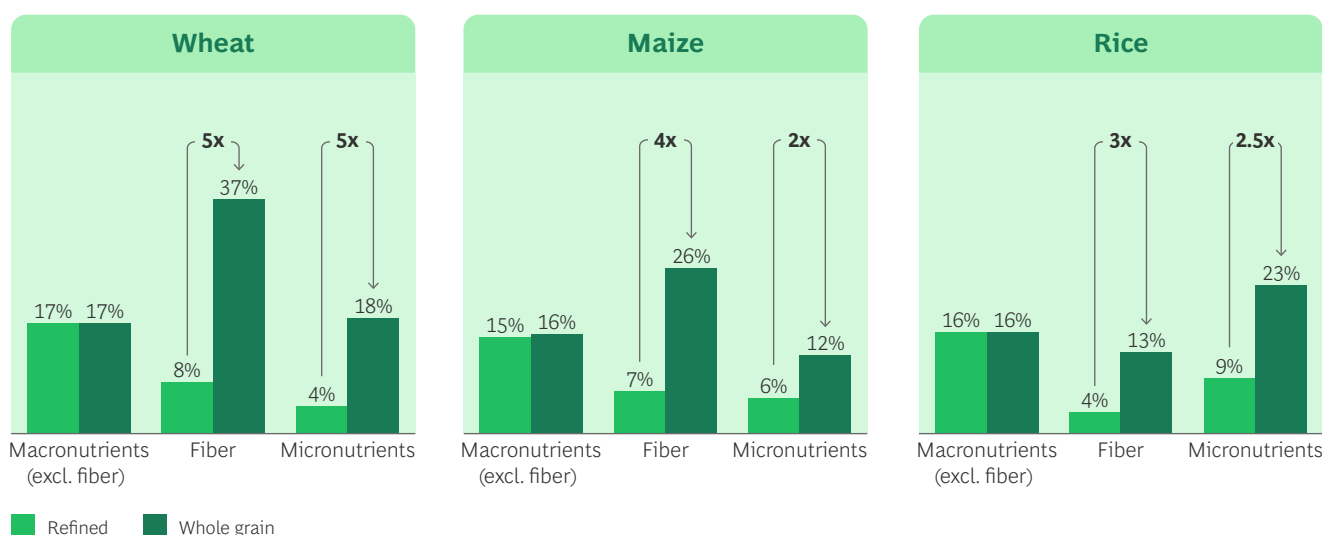
are lost during refining. These gains translate directly into measurable health outcomes: higher fiber intake reduces the risk of diet-related NCDs including type 2 diabetes and cardiovascular disease, improved iron and B vitamin intake addresses the micronutrient deficiencies that drive anemia and impaired cognitive development, and stronger overall diet quality in school-age children compounds into better learning outcomes, higher adult productivity and lower long-run demand on health systems³⁰.

EXHIBIT 5

Nutritional profile comparison of whole vs refined

Whole grains deliver more fiber and nutrients than their refined alternatives

% Daily value from 100g uncooked flour



Note: Based on FDA daily values for the United States; Macronutrients are the average of carbohydrate, protein, and lipids; Micronutrients are the average of iron, zinc, calcium, phosphorus, potassium, magnesium, manganese, copper, vitamin A, vitamin B1/B2/B3/B5/B6/B9/B12, vitamin E and vitamin K; Bioavailability note: Values reflect gross nutrient content and do not account for absorption inhibitors (phytates, tannins, oxalates) that can reduce mineral bioavailability by 30–80%. Processing techniques such as fermentation, soaking, germination and nixtamalization can recover 2–3x bioavailability for iron and zinc.

Source: FDA; USDA; WHO; BCG analysis

Unlike refined grains, whole grains preserve bran and germ components that support gut health, sustained energy release, and micronutrient absorption, all of which are critical for child growth and cognitive development. Following international evidence on improved micronutrient intake, adopting nutrient-rich staples in Rwanda's school feeding system could translate into measurable reductions in anemia and diet-related NCDs.

Direct medical cost savings from reduced NCDs and iron-deficiency anemia could reach approximately \$50 million annually when all students transition to whole grain staples and underutilized grains.

Including broader productivity gains from reduced disease burden, measured through avoided disability-adjusted life years, generates an additional ~\$15 million – \$18 million in annual economic value.

29. USDA

30. Health savings are projected based on current public sector expenditure, which varies widely between countries.

Fiscal and economic resilience

Substituting refined maize and imported rice with locally-produced sorghum, whole-grain maize, and unpolished rice improves fiscal efficiency across multiple dimensions. Within the school feeding program, whole-grain maize represents a largely cost-neutral substitution.

Blending sorghum into whole-grain maize flour and substituting polished rice equally with brown rice and sorghum could generate approximately \$5 million in annual procurement savings. Additional savings arise from lower fertilizer requirements, as sorghum requires 30% to 40% less synthetic fertilizer than maize³¹, contributing roughly \$0.5 million in annual savings within the student population.

Import substitution further strengthens macroeconomic resilience. Rwanda currently imports roughly half of its rice consumption³², exposing public programs to foreign exchange pressures and global price volatility. Greater use of local whole grains and underutilized grains improves resilience to both.

Climate and environmental benefits

Sorghum and whole grain blends align better with Rwanda's climate trajectory than refined staples.

Substituting refined grains could reduce environmental costs in school feeding by ~\$40-90 million. They are more drought-tolerant, perform well under rainfed conditions, and use fewer inputs³³. Sorghum is ~20-30% more water-efficient than irrigated maize and rice, with significantly lower greenhouse gas emissions (for example, emissions from sorghum are ~80% lower than from refined rice). Under mid-century warming scenarios of 2°C to 4°C, sorghum shows greater yield stability than maize across Sub-Saharan Africa^{34,35}. In a climate-vulnerable region, this resilience is a strategic advantage, even if productivity constraints still need to be addressed over time.

31. Sorghum application rate/ha drawn from Biya Muhidin: Determination of Nitrogen and Phosphorous Fertilizer Requirement for Sorghum (*Sorghum Bicolor* (L.)) Production in Kersa- Jimma Zone of Ethiopia, East Africa, (2018), Maize application rate/ha drawn from Cyamweshi, A. R., Kayumba, J., & Nabahungu, N. L. (2017). Optimizing fertilizer use within the context of integrated soil fertility management in Rwanda

32. National rice development strategy 2021 - 2030

33. Mekonnen, M. M. and Hoekstra, A. Y.: The green, blue and grey water footprint of crops and derived crop products, *Hydrol. Earth Syst. Sci.*, 15, 1577–1600. <https://doi.org/10.5194/hess-15-1577-2011>, 2011

34. Omokpariola, D.O., Agbanu-Kumordzi, C., Samuel, T. et al: Climate change, crop yield, and food security in Sub-Saharan Africa. *Discov Sustain* 6, 678 (2025)

35. Faye, A., Camara, I., Diop, M. et al. Millet and sorghum yield simulations under climate change scenarios in Senegal. *Reg Environ Change* 22, 86 (2022)



The Business Case for National Scaling: up to \$560M–\$630M³⁶ in Annual Savings from Scaling to the Full Population

While school-based programs deliver meaningful savings, they capture less than 30% of the total potential. Scaling beyond schools to the full population unlocks ~4x higher savings, estimated at \$560-\$630 million in annual total benefits, including \$170-\$185 million in direct government monetary savings.

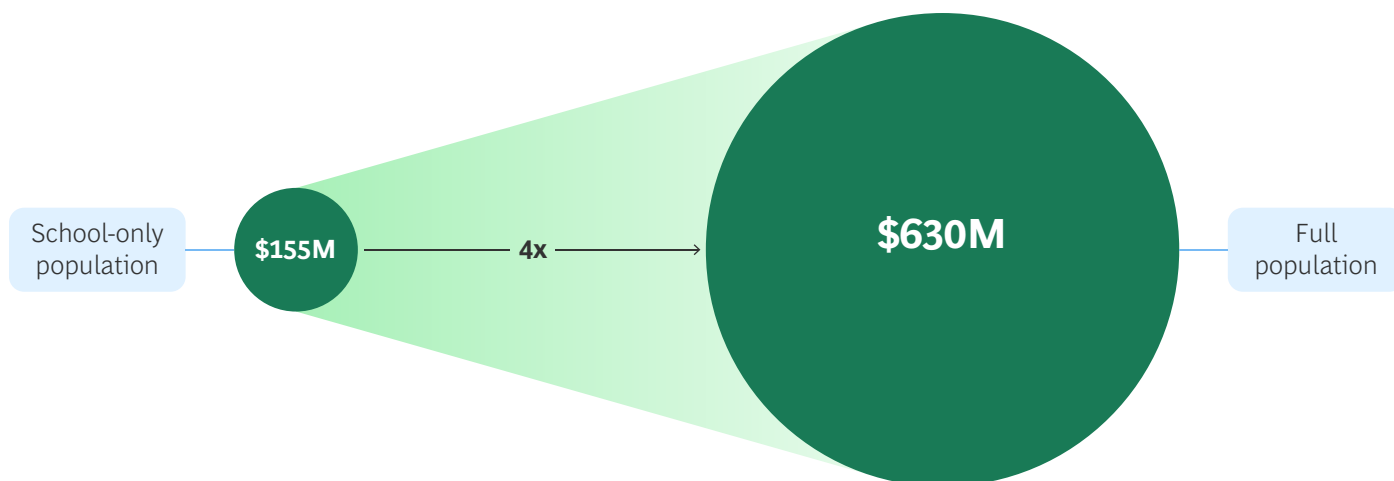
Of the total annual benefits, ~62% comes from environmental savings due to avoidance of land use emissions. ~37% is from health savings (medical costs and DALYs averted), and the remaining ~1% comes from savings in fertilizers. This business case indicates a strong return on investment, making a long-term commitment worthwhile despite the time required to adapt preferences and supply chains.

36. This savings range is based on the the same two pathways outlined in the Business case for school meals. The \$630 million upper-end estimate is based on the current 30% domestic production share. If this increases to 100%, in line with national strategy, savings would increase to \$820 million.

EXHIBIT 6

Estimated annual savings from school-only and full population implementation

Scaling whole grains beyond schools unlocks up to 4x higher savings



Note: Whole grain maize and brown rice

Beyond direct savings; private sector and market opportunity

Diversified diets and resilient crops also create broader system benefits, including new economic opportunities across the value chain. For private sector players, this translates into scalable demand for milling, blending, and fortified whole-grain products anchored in institutional procurement. Rwanda's school feeding program reaches more than four million children. Shifting approximately 30% of grain consumption toward sorghum and whole-grain blends could create a stable market of over one million daily consumers, supporting investment in processing capacity and catalyzing innovation in affordable product lines for both public and retail channels.

This opportunity aligns with evolving consumer preferences. A 2023 multi-country survey led by BCG found that approximately 70% of African consumers prefer local brands for their authentic taste³⁷. At the same time, global demand is shifting toward healthier, less processed foods, a trend that is beginning to emerge in African urban markets³⁸. Given existing familiarity with underutilized grains, which are often perceived as more natural and nutritious, companies that reformulate portfolios around locally-sourced, nutrient-dense products are well positioned to capitalize on this shift while strengthening supply chain resilience.

37. Transforming Africa's Food Systems: How food brands can lead the way
<https://www.bcg.com/publications/2024/africa-transforming-food-systems-how-food-brands-can-lead-the-way>

38. CPG Companies need a new recipe as consumers seek healthier choices.
<https://www.bcg.com/publications/2025/cpg-companies-need-new-recipe-consumers-seek-healthier-choices>



From Schools to Hospitals to Communities: A Phased Integration

School meals can establish the foundation for closer integration of food and health systems: through nutritional standards, institutional procurement relationships, and supply chains oriented toward whole and underutilized grains. Once that foundation is in place, the same logic extends naturally into other institutional food environments and the health gains compound accordingly. In African countries, integration can advance through three, interconnected stages: schools set demand and shape early-life diets; hospitals integrate nutrition into treatment and recovery; communities reinforce habits and practices in everyday life.

Healthcare feeding: the next integration pathway

Food is critical during treatment. Integrating nutrition into clinical pathways can improve recovery, support adherence, and reduce healthcare utilization. Growing evidence shows that structured dietary interventions

improve key cardiometabolic outcomes. Even in the absence of pharmacotherapy or other lifestyle interventions, they lead to a clinically significant reduction in biomarkers for elevated blood sugar and blood pressure.^{39,40}

Rwanda highlights both the gap and the opportunity. Meals are not covered under public health insurance for nearly one million annual hospital admissions, leaving patients reliant on caregivers for food during treatment. This results in uneven access and quality when nutrition matters most. Evidence for targeted nutrition approaches is strong. In the United States, medically-tailored meal programs have reduced hospitalizations by up to 47% and healthcare costs by ~20%, with potential to avert 1.6 million hospitalizations annually and generate over \$13 billion in savings.^{41,42,43}

The implication for Africa is clear: food has value across the care continuum, from prevention to treatment. The key question for the continent's systems is not whether to integrate nutrition into care, but where to start and how to fund it sustainably.

39. Dietary interventions and glycaemic control in type 2 diabetes: A systematic review and meta-analysis. <https://publichealthinafrica.org/index.php/jphia/article/view/1325/2083>

40. The impact of dietary and lifestyle interventions on blood pressure management in sub-Saharan Africa: a systematic review and metanalysis. <https://pubmed.ncbi.nlm.nih.gov/36928004/>

41. Estimated Impact Of Medically Tailored Meals On Health Care Use And Expenditures In 50 US States. <https://www.healthaffairs.org/doi/10.1377/hlthaff.2024.01307>

42. Medically Tailored Meals Could Save U.S. Nearly \$13.6 Billion per Year <https://solutions.tufts.edu/expertise/food-nutrition/medically-tailored-meals-could-save-us-nearly-136-billion-year>

43. Medically Tailored Meals: A Case for Federal Policy Action. <https://pmc.ncbi.nlm.nih.gov/articles/PMC12652126/>



Solid'Africa provides a leading example of how nutrition can be embedded into public systems at scale. Founded in 2010, it now serves over 130,000 hospital patients in Rwanda annually and 15,000 students daily through partnerships with government and communities.

At the healthcare level, its model centers on delivering medically-tailored meals in public hospitals. Patients receive diets tailored to their specific conditions to support recovery, addressing a critical gap in public healthcare insurance, which does not cover meals. Through partnerships with the Ministry of Health, investments in hospital kitchen infrastructure are enabling a shift from ad hoc provision to integrated, system-level delivery.

At the school level, a central kitchen established in 2025, powered by clean energy, has the capacity to serve up to 20,000 children daily. The kitchen offers rotating menus designed to improve dietary diversity, with five times the number of ingredients that are included in the standard school feeding program, including indigenous crops that are often absent from institutional meals.

A core strength of the model lies in linking demand with supply. Solid'Africa is working toward sourcing at least 70% of its ingredients from farmer cooperatives, with standards tied to quality, safety, and regenerative agriculture practices. To enable this transition, it supports farmers with training on regenerative agriculture and access to inputs (seeds, composting material and green manure) through cooperative-based revolving funds. Inputs are provided upfront and repaid through produce sales, with funds recycled into future planting cycles, creating a pathway to financial self-sufficiency within one to two harvests. Nutrition education is embedded across all pillars of Solid'Africa's work - including patients, caregivers, farmers, and students – to extend impact beyond institutions into households and communities.

Key results:

- Over 12 million meals to date
- ~1,800 patients served daily across six public hospitals
- Affordable meals are provided at 50% of the World Bank benchmark cost for a healthy meal in Rwanda.
- Early evidence of a 10% reduction in malnutrition among patients at discharge.

On the supply side, Solid'Africa has also built traction:

- 7,000 farmers engaged through cooperatives, with over 5,500 transitioning to regenerative practices



Image courtesy of Solid' Africa

- Early evidence of annual farmer income increase from ~\$117 to ~\$295, driven by productivity gains, two thirds reduction in post-harvest losses, and increased prices
- Over 50% of participants are women, with youth also engaged, supporting broader economic inclusion.

Looking ahead, scaling this model will require broader ecosystem alignment, including policy changes to integrate nutrition into health financing, increased demand for diversified crops, and continued evidence generation. Ongoing work, including a health economics study in partnership with Tufts University, aims to quantify the long-term clinical and economic impact of medically-tailored meals and support policy adoption. Rwanda's national social security board currently provides an annual CSR contribution to subsidize delivery of hospital meals, and has committed to translating the evidence from this study into future benefits policy.

Community-level initiatives for scaled and sustained impact

Institutional programs at school and healthcare facilities can catalyze change, but sustained impact depends on embedding food and health practices at the community level. Moving from food provision to food practice is essential to translate system-level interventions into sustained improvements.

CASE STUDY

TICAH



TICAH (Trust for Indigenous Culture and Health) is a Kenyan organization and a leading East African example of how community-led Food as Medicine approaches can improve health outcomes, while strengthening health systems.

Working with children, people living with HIV, and food-insecure households, TICAH delivers nutrition through community health systems rather than as a standalone health intervention. The model equips Community Health Promoters and community support groups to provide nutrition education, screening, and referral services, while supporting households, schools, and health facilities to grow and access diverse indigenous foods through community farms and local food production systems. By linking food production, nutrition counselling, and healthcare delivery, TICAH enables communities to prevent and manage malnutrition, HIV-related complications, and other chronic conditions using locally available foods. The approach demonstrates how community-led, food-based interventions can improve health outcomes, reduce healthcare costs, and build long-term resilience.

Key results: Programs demonstrate improvements across health outcomes, healthcare utilization, and economic returns.

- Improved health and behavior: Under the “Chakula Ni Dawa” initiative, 68% of households reported reduced illness and opportunistic infections, while 73% reported improved dietary practices, including greater use of indigenous foods to support treatment and recovery
- Reduced healthcare utilization and costs: Average healthcare visits declined from 4.38 to 0.2 per month, while cost per visit decreased from ~\$20 to ~\$3, significantly reducing both system burden and out-of-pocket spending

Community actors such as health workers, caregivers, school administrators, and local organizations play a critical role in reinforcing preparation skills, the value of indigenous foods, and the link between diet and health. Slowing the shift to processed foods therefore requires treating food preparation and indigenous knowledge as core levers, equipping households to embed food as medicine in everyday practice.



Image generated using Figma

- Strong nutrition and economic outcomes: In Kajiado County, treatment of acute malnutrition using locally available therapeutic foods achieved a benefit-cost ratio of 12:1, with costs below conventional benchmarks and substantial net economic gains.

Beyond direct outcomes, TICAH strengthens system capacity by equipping community health workers and local groups to deliver nutrition services, improving last-mile reach and early risk detection.



International Precedent: The Cost of Acting Late

International experience reinforces the importance of acting early. Countries that delayed reform, such as the

United States, have faced significant health and fiscal costs in correcting entrenched dietary patterns.

CASE STUDY

US School Feeding Reforms – What Delayed Reform Costs

The US offers the clearest evidence of what delayed dietary reform costs, and what early action can prevent. Through the 1980s and 1990s, US school meal standards prioritized calorie provision over nutritional quality. Meals were energy-dense but nutrient-poor, with high sodium, added sugars, and refined grains. By the 2000s, childhood obesity rates had risen sharply, disproportionately affecting children from low-income households who relied most heavily on school meals.

The Healthy, Hunger-Free Kids Act of 2010 introduced mandatory alignment with national dietary guidelines: more whole grains, more fruit and vegetables, reduced sodium, and limits on saturated fat. Updated rules finalized in 2024 went further, introducing phased limits on added sugars and strengthened whole grain requirements.

The impact has been quantified. Research estimates that without the 2010 reforms, childhood obesity among children in poverty would have been 47% higher by 2018. If just 25% of children sustain healthier dietary patterns

into adulthood, implementation of the updated 2024 standards is projected to prevent approximately 7,760 deaths annually and generate around \$13.8 billion in annual healthcare savings.⁴⁴

The harder number to calculate is what the delay cost. The US spent decades, and hundreds of billions of dollars, on healthcare, treating conditions that better school nutrition standards could have reduced.

For African countries, the window to act before those patterns entrench is still open. Rwanda's commitment to provide universal healthy school meals by 2030 puts it ahead of where most high-income countries were when facing similar nutrition and dietary shifts. The AU-led continental drive to scale up Home Grown School Feeding programs, with 40 countries now having national programs in place, demonstrates the large-scale opportunity for African countries to transform health through institutional school feeding platforms.

The implication is not that Africa should copy the US model. It is that the US learned, at great expense, that nutrition reform deferred is fiscal liability accumulated. The question for African governments is not whether to act, but whether to act now or pay more later.

44. Evaluation of health and economic effects of United States school meal standards consistent with the 2020–2025 dietary guidelines for Americans.
<https://www.sciencedirect.com/science/article/pii/S0002916523659593?via%3Dihub>



Opportunities for Action

The case for action is clear. Food-based interventions represent a high-impact opportunity to improve health outcomes while generating economic, social, and environmental returns.

Realizing this opportunity requires coordinated action across sectors.

Three priorities to unlock impact

The full agenda requires alignment across many actors. But three near-term priorities create the conditions for successful integration of food and health systems, and actors that move on all three simultaneously rather than sequentially will see compounding returns.

1 Make institutional procurement a nutrition lever to generate demand

State actors: Attach nutrition standards to existing school and hospital procurement contracts, specifying whole grain requirements, minimum dietary diversity thresholds, and preferred local sourcing. No new

budget is required; reorient existing spend toward disease prevention. AUDA-NEPAD's home-grown school feeding guidelines offer ready models, which could be complemented by more detailed recommendations on nutrition standards.

Private sector: Processors, millers, and manufacturers can build whole grain, blended, and fortified product lines to meet demand created by reformed procurement specifications in institutions like schools, which present a large market. Distributors should invest in sourcing, storage, and delivery networks that can reliably serve institutional buyers at scale.

2 Integrate nutrition into health financing to establish incentives

State actors: Treat nutrition as a core reimbursable intervention. Include dietary screening and counselling in primary care pathways and provide medically-tailored meals with reimbursement mechanisms in hospital settings. Models from Solid' Africa (Rwanda) and TICA (Kenya) demonstrate feasibility.

Private sector: Health insurers should incentivise and reimburse preventive and therapeutic nutrition interventions. Delivery operators should build efficient, nutritious meal services for institutional settings.

Other non-state actors: Development partners and philanthropy should de-risk innovation in food-as-medicine models and generate the evidence base needed to expand reimbursement to new settings.

3 Redirect agricultural subsidies toward nutrient-dense crops to align supply

State actors: Redirect fertiliser subsidies and extension services toward more adaptive and resilient underutilized crops to address supply constraints and improve climate resilience. Agriculture ministries should support farmer aggregation for institutional markets. India's reorientation toward millets and pulses shows this is achievable.⁴³

Private sector: Farmers should diversify production toward resilient, nutrient-dense crops. Processors and manufacturers should invest in capabilities to transform underutilized crops into viable, affordable consumer products to meet the demand signals created by upstream interventions on procurement.

Other non-state actors: Continental agencies like AUDA-NEPAD should provide more detailed, harmonised nutritional standards and align actors around a shared path to scale. Development partners should fund the evidence generation and innovation needed to shape the business case.

Other non-state actors: Development partners and philanthropy should provide catalytic financing to de-risk early-stage private investment in healthier food supply chains.

6 Coordinate policy, financing, and delivery across actors

State actors: Establish cross-ministerial coordination across health, agriculture, education, and finance with shared targets, budgets, and accountability. Finance and planning ministries should embed food and nutrition into health and development budgets. Together with other non-state actors, they can also explore pooled financing mechanisms to ensure long term procurement contracts to de-risk the model. Local governments should adapt delivery models to local supply chains and community needs.

Other non-state actors: Continental agencies and development partners should support impact measurement to sustain accountability across the system and generate the evidence needed to guide future strategies.

While these priorities reinforce each other, orchestration will be challenging, and the right mix of interventions will vary meaningfully by setting. Pilots are important not only for proof that the concept is sound, but also as the mechanism for generating localized evidence on cost, nutrition impact, and supply chain feasibility, which is needed to make the business case and guide replication. Pilots must be designed from the outset with costing analyses and impact measurement built in, or they will not produce the evidence needed to unlock scale.

The good news is that for key interventions like school feeding, the path to scale is not hypothetical, given the scale of existing institutional infrastructure. When the business case is clear and political will is present, this platform offers a route to rapid scale that few health interventions can match.

Enabling conditions for sustained impact

4 Embed behaviour change at the community level

State actors: Integrate nutrition education and food preparation practices into community health worker programs and school curricula.

Other non-state actors: Community organisations and frontline workers should deliver practical behaviour change interventions to embed healthier diets in daily life.

5 Build private sector capacity to meet reformed demand

Private sector: Processors, distributors, and financiers should invest in infrastructure, production pipelines, and supply chain capabilities to deliver against the demand created by procurement and policy reform.

45. MicroSave Consulting (2024) - Millets: The Nutritional Powerhouse for a Sustainable India

Appendix

Glossary of terms

Food is Medicine (FIM): A broad set of approaches that use food and nutrition as part of disease prevention, management, and recovery, ranging from population-level healthy food programs to more individualized clinical interventions.

Medically-tailored meals (MTM): Meals designed for patients with specific medical conditions and nutritional needs, used as part of treatment or recovery pathways.

School feeding programs: Institutional meal programs delivered through schools; in this report, discussed as a platform to improve diet quality at scale and shape agricultural demand.

Fortification: The addition of vitamins and minerals to foods during processing to improve nutritional quality.

Whole grains: Grains that retain the bran, germ, and endosperm, and these parts must remain in the same proportions as they naturally occur in the grain. Whole grains preserve more fiber and micronutrients than refined grains.

Underutilized crops: Traditional local crops such as sorghum, millet, legumes, and some vegetables that are often more nutrient-dense and climate-resilient than dominant refined staples.

Regenerative agriculture: Farming practices that restore soil health and biodiversity while improving long-term productivity and resilience.

Non-communicable diseases (NCDs): Chronic diseases that are not passed from person to person, such as diabetes, cardiovascular disease, and some cancers.

Dual burden of malnutrition: The coexistence of undernutrition and micronutrient deficiencies alongside overweight, obesity, and diet-related NCDs.

Dietary diversity: The variety of foods or food groups consumed; used here as a proxy for better diet quality and micronutrient adequacy.

Epidemiological transition: The shift in disease patterns over time from mainly infectious disease and high child mortality toward chronic, non-communicable diseases.

Disability-adjusted life years (DALYs): A standard measure of disease burden, combining years of life lost and years lived with disability.

Quantitative Model Methodology

The mathematical model quantifies the impact of transitioning to healthier and more sustainable grains by comparing a baseline diet with two reform scenarios across five dimensions: procurement, health, environment, fertilizer use, and economic productivity.

The model follows a structured, bottom-up approach. It first estimates total grain consumption based on population segments (for example, students or share of total population), meals served, and grams per meal. This establishes the baseline volume of key staples, primarily refined maize flour and white rice.

The first policy pathway models the substitution of refined grains with whole-grain alternatives (for example, whole-grain maize, unpolished rice), while the second policy pathway extends this to include underutilized crops such as sorghum.

For each policy pathway, the model recalculates grain volumes by product type. It then applies relevant assumptions to estimate impacts:

Procurement savings: change in government procurement costs when shifting to the new mix of grains: based on the volumes needed, their unit prices, and current subsidy rates.

Health savings: cost of treating future NCDs that could be avoided by consuming whole grains instead of refined grains. We drew our assumptions from global research on the risk of future NCDs associated with childhood diets: with a focus on type 2 diabetes, coronary heart disease, stroke, colorectal cancer and anemia.

Environmental savings: difference in monetized greenhouse gas emissions, land use and water use if producing whole versus refined grains. This difference is driven by the fact that whole grains have a higher extraction rate and are less resource-intensive to produce, requiring less raw grain means less land farmed, less water used and lower emissions.

Fertilizer savings: difference in monetary value of fertilizer needed to grow the raw grain required to produce a given volume of whole vs refined flour, adjusted for existing subsidy rate. This saving comes from the same extraction rate effect as above (as whole grains need less raw grain per kilogram of flour, they also need less fertilizer to grow it).

DALYs economic impact: Calculated the broader economic value of a healthier population by estimating the disability adjusted life years (DALYs) avoided, and valuing each of those healthy years using GDP per capita.

Outputs are presented as the difference between baseline and scenario results, with impacts driven by both the scale of adoption and the composition of grain substitution.

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