Leveraging Indigenous Knowledge and Modern Science for Sustainable Food System Transformation

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Abstract

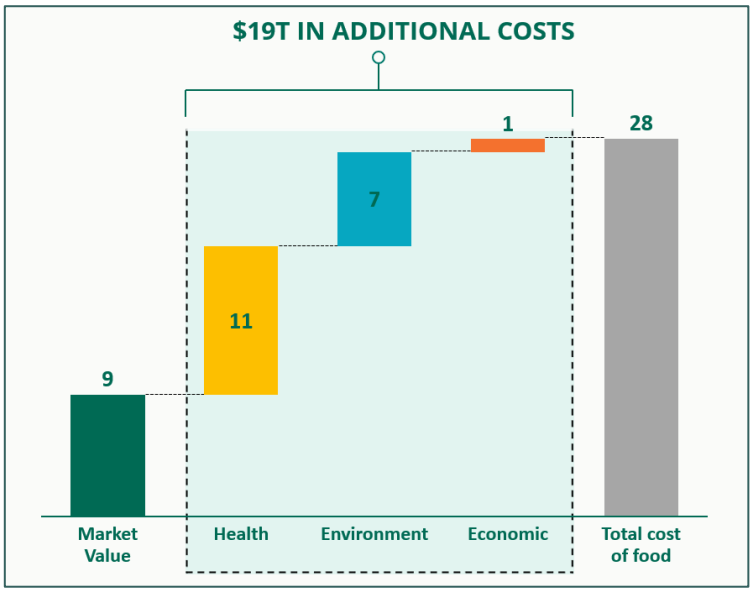
This document underscores the urgency for a sustainable transformation of the global food system, which currently incurs significant environmental, social, and health costs while failing to provide universal access to affordable and nutritious food. Drawing on the integration of indigenous knowledge and modern science, the narrative navigates through the inherent sustainability of Indigenous Peoples' food systems and the potential of whole foods to enhance food security and sustainability. As an example, it explores the historical transition from whole to refined grains and advocates for a return to whole foods consumption. Leveraging institutional procurement channels, particularly school meals, presents a strategic opportunity to facilitate shifts in consumption patterns towards whole foods. The document concludes by highlighting The Rockefeller Foundation's commitment to expanding school meal programs in low- and middle-income countries (LMICs), with a focus on incorporating principles of sustainability, nutrition and equity into food system initiatives.

1. Introduction: Urgency for Sustainable Food System Transformation

The current food system is deficient, driving more than twice its economic value in additional costs. Current food systems are not sustainable. They generate substantial environmental, social and health costs while failing to provide affordable food to all (UNFSS, 2021). With a market value of $9 trillion, the global food system imposes an additional $19 trillion burden in negative health, environment and economic externalities, totaling $28 trillion in costs as illustrated in Figure 1.

- *Health costs:* In addition to the direct impact of agricultural pollution on public health, food systems generate widespread malnutrition. Unhealthy dietary patterns, perpetuated by the prevailing food environment, contribute to one every five deaths worldwide (Global Nutrition Report, 2020).
- *Environmental costs:* Current food system generates 25-33% of all greenhouse gas (GHG) emissions fueling climate change and playing a central role in the ongoing biodiversity crisis (The Food and Land Use Coalition, 2019).
- *Socio-economic costs:* Two-thirds of the 740 million people living in extreme poverty (on less than $1.90 a day purchasing power parity) are agricultural workers and their dependents (The Food and Land Use Coalition, 2019). This reality underscores the structural inequities embedded within our current food system, which perpetuates cycles of poverty and vulnerability.

Figure 1: True Cost Analysis of the Food System Globally



In light of the evident shortcomings in the food system, the inquiry arises as to how indigenous knowledge and modern sciences can jointly inform a sustainable food system transformation. This transformation aims to mitigate environmental, social, and health costs while ensuring universal access to nutritious and affordable food.

2. Elevating Indigenous Peoples' inherently regenerative food systems

Indigenous People's food systems offer invaluable insights into transforming our current food systems to enhance sustainability and human health. Historically grounded in wild and cultivated food environments and community exchange networks, many Indigenous Peoples' food systems inherently prioritize sustainability across environmental, socio-cultural, and human health dimensions (Ahmed, Dupuis, de la Parra, Adams, & Chunlin, 2022).

- *Environmental attributes:* From an environmental standpoint, these systems emphasize low-intensity practices that support ecosystem services and environmental health. They embrace principles such as utilization of local seasonal biodiversity, land stewardship, and ecological agricultural methods. Research shows that indigenous practices, such as agroforestry, rotational farming, and seed saving, can increase biodiversity and promote ecosystem resilience (Tianyu, García-Martín, & Plienninger, 2021; Swiderska, et al., 2022). Finally, indigenous communities have developed and refined strategies for coping with environmental change and variability over centuries, which can be invaluable for climate change adaptation (Santini & Miquelajauregui, 2022).
- *Socio-cultural attributes:* From a socio-cultural viewpoint, which encompasses spiritual dimensions, Indigenous Peoples' food systems uphold the cultural identities of their communities, recognizing food practices, rituals and socio-cultural significances that have evolved and passed down through generations (Smith, et al., 2019).
- *Health attributes:* Moreover, Indigenous food systems contribute to human health by enhancing dietary quality and diversity, promoting holistic health concepts and traditional food-as-medicine approaches. A research article published in the journal Current Developments in Nutrition reveals that numerous Indigenous foods boast high nutrient density, offering abundant macro- and micro-nutrients essential for a balanced diet (Sarkar, Walker-Swaney, & Shetty, 2020). Importantly, the study underscores the

significance of preserving traditional knowledge as a vital approach to combating diet-related chronic diseases within Indigenous communities. Finally, it is important to note that indigenous food systems prioritized the consumption of whole foods to conserve all existing nutrients. While food was lightly processed and prepared by soaking, drying, grinding, pounding, and cooking, the components generally were not separated.

Considering the environmental, socio-cultural, and health attributes outlined above, it is imperative to prioritize, elevate, and endorse indigenous knowledge and practices in initiatives aimed at achieving regenerative food system transformation.

The succeeding passages delve more deeply into one of the key learnings from Indigenous Peoples' food systems: the prioritization of whole foods' consumption, and particularly whole grains. Through the lens of modern science, this article will analyze the implications of consuming whole grains for human health and food system sustainability.

3. Advancing Modern Science on Fortified Whole Grains

In tandem with the indigenous practices of eating foods whole with only minimal processing, modern science heralds a paradigm shift towards fortified whole grain (FWG) and fortified whole blend (FWB) foods as pivotal in enhancing food security, promoting healthier diets, and buffering food systems against crises (Milani, et al., 2023).

3.1. Historical perspective: Transition from whole to refined grains

Grains have served as foundational elements in global food systems since ancient times, predating the emergence of agriculture itself. The consumption of grains by humans played a pivotal role in the inception of agriculture. Notably, wheat, rice, and maize, often referred to as the "Big 3", constitute nearly half of worldwide caloric and protein intake (Hunter, et al., 2020), and 42% of protein intake in low and middle-income countries (LMICs) (CIMMYT, 2019).

A combination of factors drove the widespread consumption of refined grains since the 19th century. Technological innovations, notably the introduction of the roller mill in Britain, drastically reduced production costs of refined flour while extending its shelf life. Concurrently, consumer preferences favored refined flour for its perceived cleanliness and associated status symbol. Market dynamics, particularly influenced by the Green Revolution, concentrated grain production and consumption on varieties already commonly consumed in refined form. Byproducts from grain refining processes were redirected to the animal feed sector, further solidifying the dominance of refined grain consumption.

3.2. The case for shifting to fortified whole grains and whole blend foods

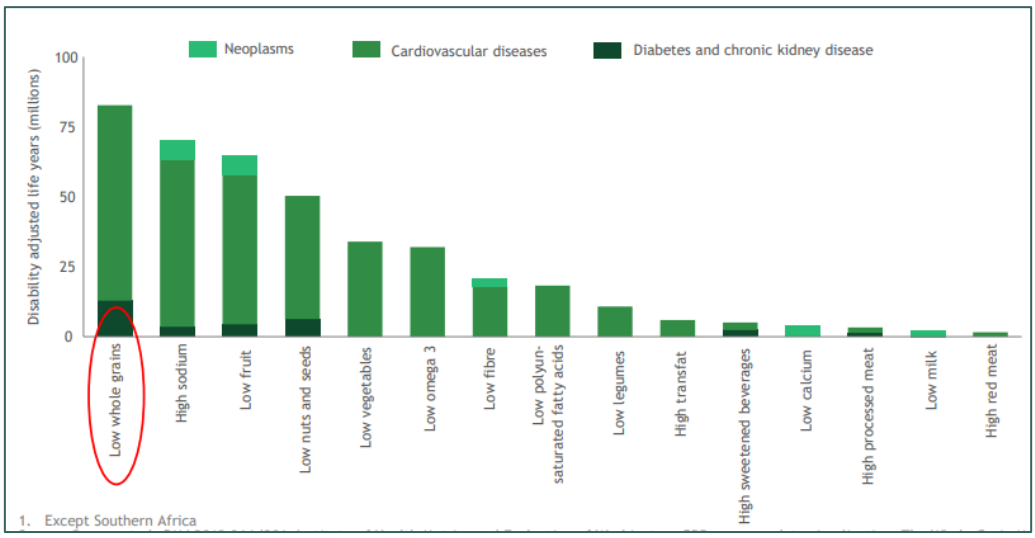
Shifting from refined grains to fortified whole grains (FWG) and fortified whole blends (FWB) presents a transformative opportunity with substantial health and environmental benefits, without additional costs.

- *Health benefits:* Shifting to whole grains offers significant health benefits by preserving essential nutrients and fiber lost in refined grains, thus bolstering efforts to combat food insecurity. Currently, only 20-30% of grains are consumed in their whole form, leading to nutrient depletion and resource wastage (Milani, et al., 2023). Low consumption of whole grains is a major contributor to global mortality and disease burden as illustrated in Figure 2, with increased whole grain intake associated with reduced risks of various chronic diseases including cancer, cardiovascular disease, diabetes, and metabolic syndrome (IHME, 2019). Conversely, high intake of refined grains has been linked to

elevated mortality and cardiovascular disease risks (Tieri, et al., 2020). Major dietary guidelines advocate for high consumption of FWG and FWB as part of a healthy diet.

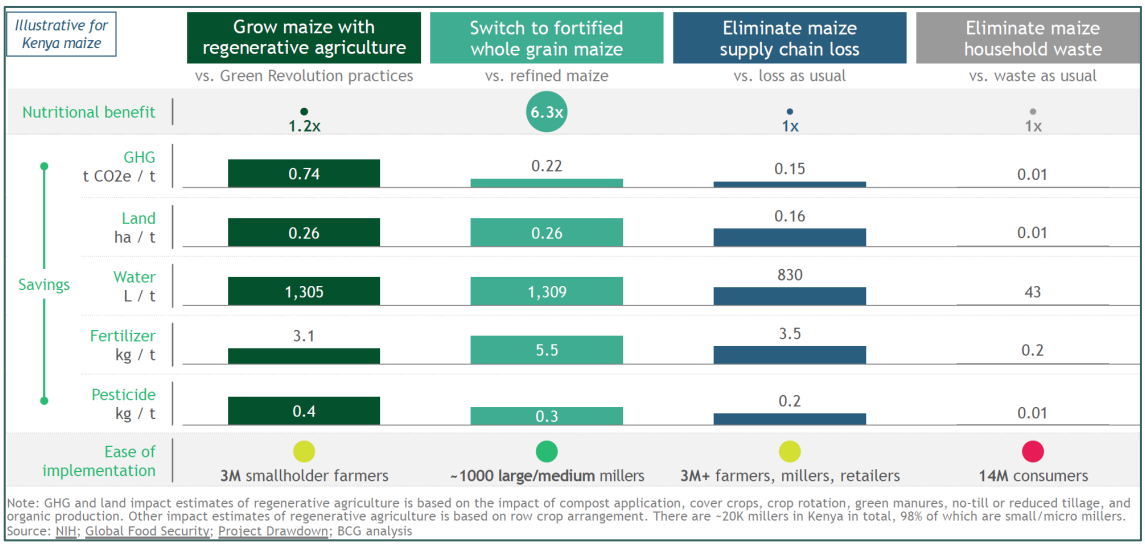
Figure 2: Specific dietary risk factor contributing to disease burden

Total DALYs lost by dietary risk factor, global, all sexes and age groups, 2017



- *Environmental benefits:* Shifting from refined to whole grains and diversifying crop consumption can lead to more diverse and resilient food systems, reducing reliance on a few staple crops like wheat, rice, and maize. This broader movement encompasses grains like sorghum, millet, and neglected grains, as well as pulses, nuts, and seeds, promoting sustainable diets for all. Additionally, transitioning to fortified whole grains offers significant environmental benefits, including reduced land, water, and fertilizer usage compared to conventional production as illustrated in Illustration 1. While other practices like regenerative agriculture may have a greater impact on greenhouse gas emissions and pesticide use, the nutritional benefits of fortified whole grains outweigh these factors.

Illustration 1: Environmental and Nutritional Benefits per tonne of cereal unit from different levers (non-nutrition-weighted)

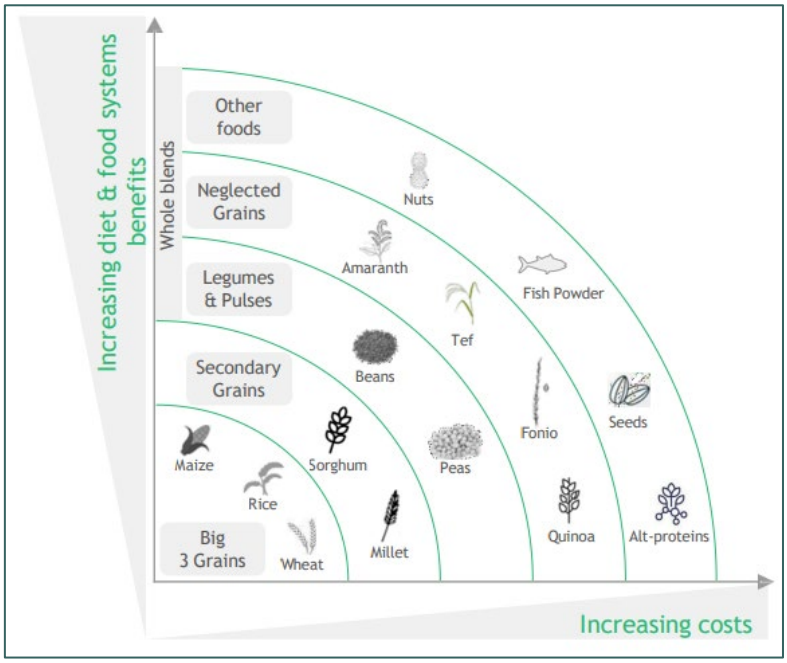


- *Economic benefits:* Switching to fortified whole grains presents a compelling economic case, offering enhanced nutritional value at a cost-effective rate. Fortifying grain-based foods, including flours and rice, is an efficient method to address nutritional deficiencies, particularly in undernourished populations. Unlike other fortification methods, whole grain foods inherently contain a wealth of micronutrients, making them a health-protective option. Additionally, fortification extends shelf life and mitigates nutrient absorption issues, further enhancing their value proposition. From a production standpoint, fortified whole grain foods can be budget-neutral substitutes for refined products, with higher extraction rates leading to increased yield. This higher yield offsets the costs of fortification, making fortified whole grain foods financially feasible. Bran and germ byproducts, typically sold at lower prices for animal feed, further contribute to cost savings (Milani, et al., 2023).

In summary, shifting to FWG and FWB offers substantial health and environmental benefits, providing an economically viable solution to address nutritional deficiencies and promote sustainability in food systems.

Finally, promoting a transition towards fortified whole grains and whole blends is a multi-step journey with increasing food systems benefits. In the short term, the transition to FWG and FWB should start by making affordable whole meals of the “Big 3” grains, with gradual incorporation of secondary grains such as sorghum and millet. As we progress into the medium to long term, product development should evolve to incorporate blends of the "Big 3" grains, sorghum, and millet with legumes and pulses, and later expanding to include neglected grains and other nutrient-dense foods.

Illustration 2:The transition from refined grains to whole blend foods

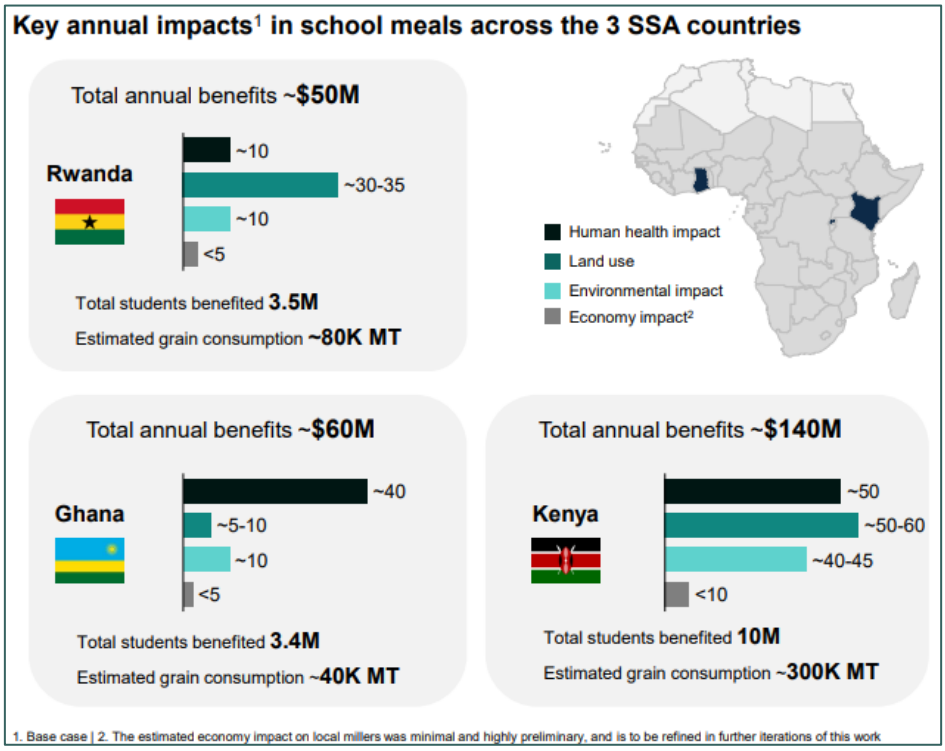


4. Intervention opportunities: Leveraging Institutional Markets as Catalysts for Sustainable Consumption

Shifting consumption patterns towards whole foods can be facilitated through the strategic utilization of institutional procurement channels, such as school meals, where children exhibit openness to dietary shifts. Leveraging the influence of institutional procurement channels, particularly in settings like school meals, presents a prime avenue for steering consumption patterns towards whole foods, FWG and FWB. Notably, children within these settings often exhibit greater receptivity to dietary changes, making them pivotal agents for broader shifts in eating habits. The effectiveness of institutional demand in driving supply chain shifts has been demonstrated previously. For example, in 2013, India initiated a pilot program introducing fortified rice in school midday meals. By 2021, India achieved self-sufficiency in fortified kernel production, benefiting over 400 million people (WFP, 2022).

The transformation of institutional demand, notably within school meals, presents a significant opportunity. For instance, the potential annual societal benefits of adopting fortified whole grains in school meals across Rwanda, Ghana, and Kenya could reach up to $250 million, as depicted in Illustration (McKinsey & Company, 2022). This impact has already been partially demonstrated in an 18-month pilot study by The Rockefeller Foundation in Rwanda[1], showcasing the feasibility of a large-scale, budget-neutral shift towards fortified whole-grain foods.

Illustration 3: Annual societal benefits of adopting fortified whole grains in school meals across Rwanda, Kenya and Ghana



Five key steps would be crucial for a successful transition to sustainable foods within public food programs (example for switching to Fortified Whole Grains in School Meals):

[1] The Rockefeller Foundation supported a pilot between August 2020 and December 2021 in Rwanda to replace refined maize flour in school meals with FWG flour. The pilot, implemented by Vanguard Economics in collaboration with the World Food Programme (WFP), developed an FWG maize flour for procurement by WFP for its school feeding program.

- *Building awareness about the importance of healthy foods in diets:* This involves sensitizing the school community and the general population through nationwide social marketing campaigns about the benefits of more sustainable foods. The pilot study conducted in Rwanda exemplified the efficacy of awareness campaigns in fostering shifts in consumer preferences, especially among children. By the end of the pilot, a remarkable 73% of schoolchildren demonstrated awareness of the nutritional advantages associated with FWG foods. Moreover, an overwhelming 97% of Grade 6 students expressed a preference for whole grain over refined equivalents.
- *Switching maize flour procurement for schools to FWG locally produced flour*: By transitioning all maize flour procurement to FWG flour, budget-neutrally, structured demand can be provided to encourage investment by millers.
- *Investing in production economics to increase affordability*: This step entails investing in new machinery to efficiently produce FWG to meet the demand of national school feeding programs, while also engaging local farmers and aggregators to improve quality along the value chain.
- *Increasing distribution networks to enable access to FWG*: Investment in packaging, transportation, and storage infrastructure is necessary to ensure the safe, efficient, and sustainable delivery of FWG products to schools.
- *Including FWG in other government food programs*: By integrating FWG into safety nets instead of refined grains and investing in the transition for government subsidy programs, broader accessibility and acceptance can be achieved.

After establishing institutional demand, the next phase involves scaling production and reshaping consumer preferences towards FWG products. This entails a multifaceted approach, including raising awareness about FWG's benefits through various channels such as social media and partnerships with culinary experts. Additionally, investment in research and development is vital to enhance product quality and scalability, while expanding distribution networks ensures the widespread availability of FWG products, fostering sustainable consumption habits.

5. Conclusion

In conclusion, the path to fixing our deficient food system lies in a harmonious integration of Indigenous knowledge and modern science advancements. By embracing whole foods with minimal processing, we can preserve their nutritional integrity, optimize crop utilization, and enhance food system yields, thus bolstering food security and reducing environmental impact, supported by emerging scientific evidence. Leveraging new technologies enables us to achieve light processing and fortification of whole foods in a commercially viable manner, while meeting organoleptic qualities and shelf-life requirements. Furthermore, shifting consumption patterns towards whole foods can be facilitated through the strategic utilization of institutional procurement channels, such as school meals, where children exhibit openness to dietary shifts.

The Rockefeller Foundation is actively engaged in expanding school meal programs in low- and middle-income countries (LMICs) through sustainable public finance, and we aspire to integrate the principles outlined above in collaboration with our partners, forging a path towards a more sustainable and equitable food future.

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