



The Planetary Health Diet in Theory and Practice

Interventions along the agri-food value chain to achieve climate-smart nutrition

Nutrition transition with climate-smart dairy in Kenya

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Berlin, 2019



THE PLANETARY HEALTH DIET IN THEORY

Interventions along the agri-food value chain to achieve climate-smart nutrition

Audience

This policy brief is for public sector decision makers, international organizations with an interest to promote food system transition and companies in the dairy and other value chains operating in countries with different dietary settings.

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Key Messages

“Food is the single strongest lever to optimize human health and environmental sustainability on Earth.” (EAT Lancet Commission 2019)

The current global population experiences three forms of malnutrition in large numbers:

- 820 million people are undernourished
- 2 billion people are micronutrient deficient
- 2.1 billion adults are overweight.

Global population growth and climate change increase the challenge by putting more pressure on natural resources and food production. The current global food system (production + consumption) does not operate in a way to solve the challenge. A large-scale transition is needed, involving all stages of global food supply chains.

How is the global food transition supposed to happen?

Interventions at production and consumption stages are needed and should be designed in an interlinked way. The following solutions are available:

- **Production:** climate-smart agriculture, sustainable intensification, climate change adaptation and mitigation along the entire value chain.
- **Consumption:** demand-side measures, i.e. reducing food loss and waste, plus nutrition shift to a climate-smart, healthy diet.

The outcomes are better nutrition status, more climate resilience of food systems, less GHG emissions – in other words, climate-smart nutrition.

In this policy brief, we focus on dietary shift – first conceptually, then by providing a case study from Kenya.

We show how policy makers can integrate climate change considerations in nutrition agendas and nutrition considerations in climate change agendas.

ISSUE

“Global food production threatens climate stability and ecosystem resilience. It constitutes the single largest driver of environmental degradation and transgression of planetary boundaries.

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Taken together the outcome is dire. A radical transformation of the global food system is urgently needed. Without action, the world risks failing to meet the UN Sustainable Development Goals and the Paris Agreement.”

Prof. Johan Rockström PhD

On the global scale, **the impacts of the current food system** on the environment are severe. The agro-industrial revolution has made it possible to increase food production at a price. Agriculture now uses around 70% of the world's freshwater supply and 38% of the world's land, mainly for livestock and their feed.¹ Expansion of agricultural land is a known driver of deforestation and biodiversity loss. The sector produces around 10-12% of global GHGs.¹

The way we eat as a global community needs to change. Unsustainable food production and changing diets are putting the planet increasingly under pressure. Climate change enhances the problem by negatively affecting food and nutrition security.

People across geographies are affected differently, but we are all affected. Undernutrition is much more prevalent in the Global South, while over-nutrition has been growing in industrialized countries for decades and is now appearing in developing economies. Micro-nutrient deficiency can paradoxically occur in both groups. With an increasing population, more demand for food is expected. At the same time, the consumption of less nutritious food is increasing, leading to the triple burden of malnutrition.

Historically, **diets have always changed,** mostly due to increasing incomes and migration from rural to urban areas. These changes in nutrition have largely taken place in industrialized countries already and are now being observed in transitioning and developing economies. As a result, too many of us either eat a “**lose-lose diet**”¹ (Figure 1) that is characterized by being high in calories, added sugars, saturated fats, processed foods and red

meat; or some form of a lose-win diet, that performs poorly on health or environmental outcomes. These are stereotypical and simplified forms of diets. A poor person living in rural areas might also have access to healthy, nutrient rich foods, but it is not the global majority. An urban affluent person might also eat seasonal, local and low environmental impact foods, but good infrastructure usually makes available and affordable foods from around the globe, often as highly processed (yet healthy) products. The global transformation needs to happen towards enabling people anywhere to access a climate-smart win-win diet.

OPPORTUNITY: CLIMATE-SMART NUTRITION

Climate-smart nutrition taps synergies between nutrition, climate change adaptation and mitigation outcomes to fulfill the **Sustainable Development Goals (SDG) for Zero Hunger (SDG 2) and Climate Change (SDG 13)**. Climate-smart nutrition is the result of interventions at the production, as well as the consumption end (Figure 2). Not all three of these benefits (optimized nutrition, climate change adaptation and mitigation) will be achievable at each stage of the supply chain, for each beneficiary group or at the same time. Optimization of benefits needs to happen at the system level more than at the individual intervention level, where only one or two of the three benefits might materialize. The following table (Table 1) goes into more detail and shows an illustrative overview of measures along all stages of a typical agri-food value chain. Production stage measures can be summarized under the term climate-smart agriculture and take place on farm and often involve the input industry (e.g. fertilizer, seeds). From the storage stage onwards, measures to reduce food loss and waste become an important ingredient in the climate-smart interventions menu in order to avoid unnecessary emissions and resource use,

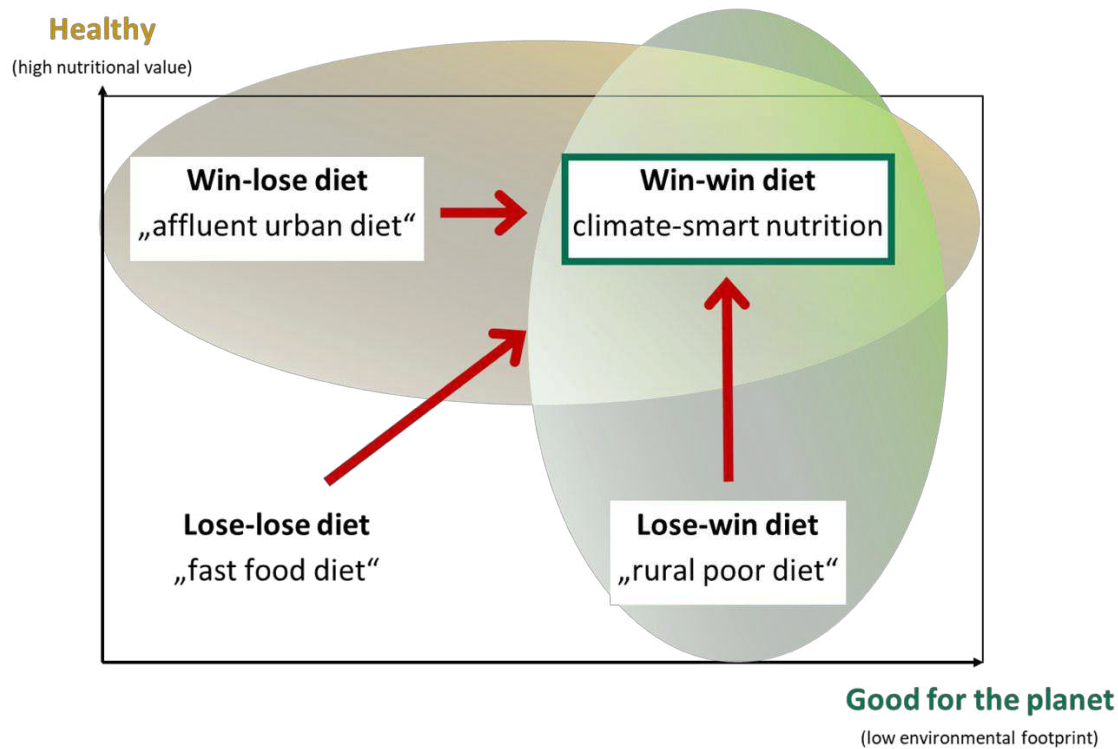


Figure 1: Diet types and transition pathways (red arrows) to a healthy and sustainable diet

Source: Own elaboration based on EAT 2019

besides other nutrition sensitive interventions. So called demand-side measures set in throughout the processing, trade and marketing stages and include consumer oriented interventions such as educational and communication measures. Potential nutrition, climate change adaptation and mitigation benefits are shown in the right column. The *Kenyan case study – the planetary health diet in practice* gives specific examples along the dairy value chain.

It is important to note that benefits per intervention reach different groups of people, usually not simultaneously. Food production measures benefit most directly the producers. Smallholder farmers and less sophisticated value chain players usually benefit most from capacity building in the area of food handling, storage and processing. Trade and marketing interventions benefit retailers, supermarkets, caterers, petty traders, street food vendors and informal sellers,

often in peri-urban or urban areas. Consumers can indirectly benefit from all of these measures.

RECOMMENDATIONS FOR DECISION-MAKERS

Advocate at national level for the inclusion of environmental footprints into dietary recommendations. Based on thorough evidence and user-friendly flagship publications, some few countries have started doing so. Development cooperation can support countries in releasing recommendations on how to eat in a way that ensures health not just for humans but also for the entire planet bringing together the boundaries of sustainable production and consumption.

Overview of measures to enable food system transition

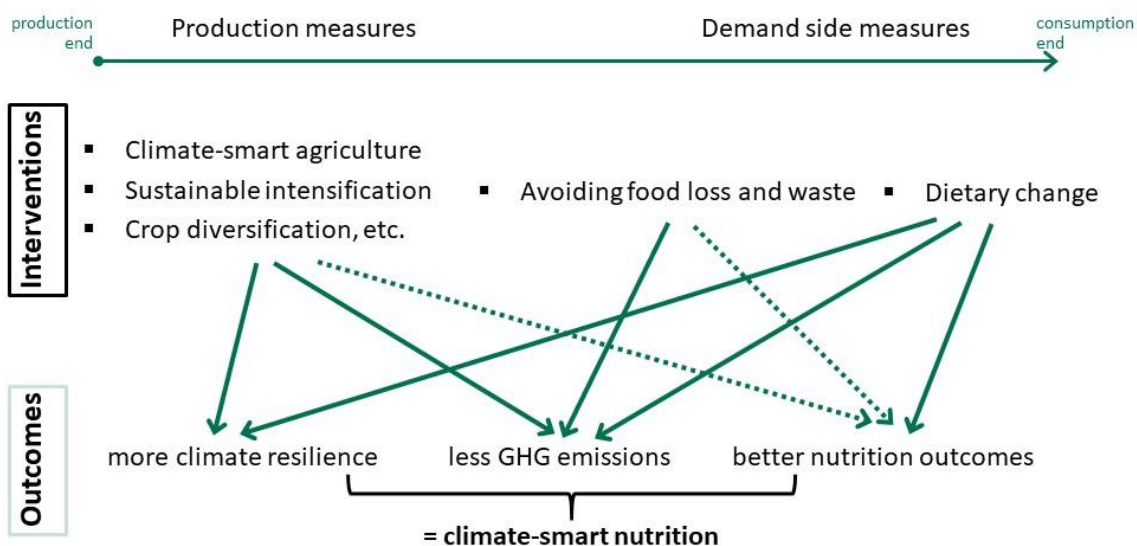


Figure 2: Climate-smart interventions and outcome examples

Source: Own elaboration

Actively communicate and promote the multiple benefits of climate-smart nutrition, i.e. the planetary health or win-win diet. A nutritious, balanced and healthy diet for humans has environmental benefits. A diet based on low environmental footprint foods is mostly healthy and balanced. Promoting healthy diets as environmental activity is a big step forward. Trade-offs do exist in nuances and need to be identified and overcome.

Use the following steps to ‘climate-proof’ nutrition agendas and programs:

1. Analyze potential climate risks of the current program: Which program components could generate unnecessary GHG footprints and/or decrease climate resilience now or in the future?
2. Analyze potential climate benefits of the current program: Which program components could save GHGs and/or increase climate resilience now or in the future?

3. Change program design to better cater to the triple benefit of nutrition, climate change adaptation and mitigation outcomes.

As an example, the above logic can lead to the following change of focus in a nutrition program:

- Stronger promotion of seed banks to ensure climate resilience
 - Expand investments on storage capacity, especially for perishable goods, to ensure climate resilience; use renewable energy solutions
- Apply a climate-smart approach to crop diversification: apart from nutritional value, take into account adaptation benefits and options to reduce GHGs
- Promote stronger emphasis on climate resilient agricultural practices at various levels
 - Enable communication between agriculture, nutrition and climate experts during stakeholder consultations etc.

Table 1: Measures in the food system that enable climate-smart nutrition

Stage of the value chain	Examples	Nutrition, climate change adaptation and mitigation benefits
Food Production	<ul style="list-style-type: none"> ▪ Diversification and sustainable intensification of agricultural production ▪ Promoting nutrition-sensitive livestock and fisheries ▪ Supporting biodiversity for food and nutrition (variety of seeds/community seed banks) ▪ Biofortification for subsistence and semi-subsistence farmers ▪ Promotion of urban and peri-urban agriculture ▪ Timing of planting and harvest according to market demand to reduce food loss at later stages 	<p>Adaptation and nutrition benefits:</p> <ul style="list-style-type: none"> ▪ increased availability and affordability of food, prospect of an additional income and purchasing power ▪ production and consumption of nutrient-rich animal source foods for vulnerable groups with suboptimal diets; availability of nutritious food for urban poor (e.g. safe milk) <p>Mitigation benefits: Best agricultural practices can reduce total GHGs or GHG intensity per output unit (e.g. liter of milk).</p>
Food handling, storage and processing	<ul style="list-style-type: none"> ▪ Nutrition-sensitive post-harvest handling, storage and processing ▪ Food fortification ▪ Measures to reduce food loss and waste 	<p>Adaptation and nutrition benefits: Income generation from food value addition; small packaging can reach poor consumers; increased economic resilience for smallholder producers through possibility of direct marketing.</p> <p>Mitigation benefits: Decreased GHG emissions per liter of milk through avoided spoilage of milk in a closed cooling chain.</p>
Food trade and marketing	<ul style="list-style-type: none"> ▪ Trade for nutrition (government tariffs and quotas) ▪ Food marketing and advertising practices ▪ Food price policies for promoting healthy diets ▪ Food labeling ▪ Measures to reduce food loss and waste 	<p>Adaptation and nutrition benefits: Possibility to balance food deficits and surpluses; better food quality and safety resulting in fewer losses (e.g. for fresh milk); low-income consumer segment gains access to nutritious product.</p>
Consumer demand, food preparation and preferences	<ul style="list-style-type: none"> ▪ Nutrition education and behavior change communication ▪ Nutrition-sensitive social protection ▪ School food and nutrition programs ▪ Nutrition-sensitive humanitarian food assistance ▪ Nutrition education and behavior change communication 	<p>Adaptation and nutrition benefits: Improved diets nutrition status; possibility to buy the needed amount and/or the affordable amount; (e.g. increased consumption of fresh and safe milk).</p> <p>Mitigation benefit: Less GHG emissions through avoided spoilage at home (e.g. fresh), due to smaller bought amounts.</p>

- Identify entry points for the private sector to produce/deliver climate-resilient and nutritious food.

Use the following steps to ‘nutrition-proof’ agricultural agendas with a climate change focus:

1. Analyze potential nutrition risks of the current program: Which program components could generate adverse nutrition outcomes (under-, over- or malnutrition) now or in the future?
2. Analyze potential nutrition benefits of the current program: Which program components could increase nutrition outcomes (and for whom?) now or in the future?
3. Change program design to better cater to the triple benefit of nutrition, climate change adaptation and mitigation outcomes.

As an example, the above logic can lead to the following change of focus in a climate change program:

- Promote stronger focus and more investment in production systems that produce healthy and nutritious foods
- Value chain analysis of a product to identify potential mitigation opportunities
- Apply a nutrition approach to crop diversification: apart from climate resilience and options to reduce GHGs, take into account nutrition outcomes
- Enable communication between agriculture, nutrition and climate experts during stakeholder consultations etc.
- Identify entry points for the private sector to produce/deliver nutritious food.
- Promote and collect more evidence on how healthy diets are better for the planet.

Use the Kenyan case study to replicate climate-smart nutrition interventions in other contexts. The milk dispensers tick many boxes for both nutrition outcomes and climate benefits. Outcomes improve with added productivity and food safety investments. These benefits materialize at different stages of the value chain and for different beneficiary groups.

Conduct systematic and comprehensive analyses of the nutrition status of populations in the face of climate change in order to bring climate-smart nutrition to the national, regional and local levels. Such studies could result in a gap analysis between the status quo and the ideal average nutrition that satisfies both health and sustainability requirements.

Adapt your choice of interventions according to the baseline nutrition situation, consumption trajectory, and value chain.

Dairy in Kenya is highly GHG intensive, essential for nutrition and demand is projected to increase with population growth and urbanization. At the same time, the country is on a trajectory to worsen the triple burden of malnutrition, meaning that certain consumer groups have hit the ceiling in recommended consumption of certain foods already while others remain undernourished. The selected intervention - milk dispensers – partially addresses these challenges. Low GHG intensity sectors, foods that need an encouraged uptake, or population groups that face a different nutrition challenge (e.g. sole undernutrition or sole overnutrition) will need different interventions.

For program design, consider the demand-side implications of production-side measures. The example shows that interventions at production stage can have demand-side effects as well, in this case increasing the availability of milk for direct household consumption of smallholders. The production-side interventions should be chosen

production-side interventions should be chosen based more strongly on the demand-side baseline dietary situation of the target markets.

Constant supply of raw materials, infrastructure and lack of consumer awareness hinders the uptake of climate-smart nutrition interventions – consider addressing them at program design stage.

The barriers for scaling up the milk dispenser technology are similar to the challenges faced by the dairy sector in Kenya as a whole. A constant supply of milk, ensuring consistent quality and providing the necessary infrastructure (electricity, machinery, collection and sales places) remain challenges, as well as reserved consumers facing a new product. Addressing these issues at systems level can ensure achieving climate-smart nutrition outcomes, as this has been shown in the case study.

Advocate for locality specific consumer studies to inform the formulation of national level nutrition recommendations in order to customize one-size-fits-all recommendations. In the end, consumption patterns boil down to consumer behavior and preferences. These are locally diverse and influenced by cultural and other factors.

Use the outline of the present publication for future studies of supply chains representing medium GHG intensity (fruits and vegetables, fish, poultry, for example), and low GHG intensity (grains

and pulses) food products or foods selected based on their nutritional values (e.g. comparing protein or micro-nutrient sources). Interventions along those value chains should equally be analyzed regarding their nutrition as well as climate outcomes (negative and positive) and take into account interventions at different scales from local to national level.

Provide business development support for identified climate-smart nutrition business cases such as milk dispensers in Kenya.

Upscaling barriers can be overcome by training actors in food safety and handling procedures; targeted marketing strategies for new sales channels; and involving frequently visited public institutions in the marketing and positioning strategy.

Include findings from Kenya in your work in other emerging economies. Emerging economies are hotspots for climate-smart nutrition, due to their dynamic markets, emerging new consumer segments and the existence of various forms of malnutrition. Comparisons between emerging economies and industrialized countries across continents would have the added benefit of enabling South-South capacity development and knowledge exchange on the topic.

Use a nutrition lens in agriculture and climate projects, and a climate lens in traditional nutrition projects. By integrating the two aspects, outcomes can be optimized for a growing world population facing climate change today and in the future.

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Berlin, 2019

KENYA CASE STUDY – THE PLANETARY HEALTH DIET IN PRACTICE

Nutrition transition with climate-smart dairy in Kenya



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LIST OF ABBREVIATIONS

AFOLU	Agriculture, forestry and other land uses
BMI	Body mass index
CSA	Climate-smart agriculture
FAO	Food and Agriculture Organization
FBDG	Food-based dietary guidelines
GDP	Gross domestic product
GHG	Greenhouse gases
HLPE	High Level Panel of Experts on Food Security and Nutrition
IPCC	Intergovernmental Panel on Climate Change
Kcal	Kilocalories
KDB	Kenya Dairy Board
Kg	Kilogram
KNBS	Kenya National Bureau of Statistics
NFNSP	National Food and Nutrition Security Policy
OECD	The Organization for Economic Cooperation and Development
SDG	Sustainable Development Goals
TEEB	The Economics of Ecosystems and Biodiversity
UHT	Ultra-high temperature
UNSCN	United Nations System Standing Committee on Nutrition
WRI	World Resources Institute

GLOSSARY

Food system: all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food and the outcomes of these activities. This includes nutrition and health status, socio-economic growth and equity, and environmental sustainability (HLPE, 2014).

Climate smart agriculture (CSA): enhancing food security and addressing climate change by i) sustainably increasing agricultural productivity and incomes; ii) adapting and building resilience to climate change; and iii) mitigating greenhouse gas emissions (FAO, 2013).

Demand-side measures: climate change mitigation options in the land use sector – reducing food loss and waste, changes in human diets, or changes in wood consumption that have potential for economic, social and environmental co-benefits (IPCC, 2014).

Food loss and waste (FLW) refers to a decrease, at all stages of the food chain from harvest to consumption, in loss of food that was originally intended for human consumption, regardless of the cause (HLPE, 2014).

Food security: when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). The four dimensions of food security: availability, access, utilization and stability (FAO, 2006).

Malnutrition: is undernutrition (including micronutrient deficiencies) or overnutrition: an abnormal physiological condition caused by inadequate, unbalanced or excessive consumption of macronutrients and/or micronutrients (United Nations System Standing Committee on Nutrition, 2017).

Macronutrients: proteins, carbohydrates and fats.

Micronutrients: vitamins, minerals and other elements that are required by the body in small amounts.

Nutrition-sensitive agriculture: seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner (FAO, 2017).

Planetary health diet: a new term put forward by EAT-Lancet Commission to highlight the critical role that diets play in linking human health and environmental sustainability and the need to integrate these often-separate agendas into a common global agenda for food system transformation to achieve the SDGs and Paris Agreement (EAT Lancet Commission, 2019).

Stunting: children too short for their age, often a result of chronic or recurrent malnutrition. The devastating effects of stunting can last a lifetime (UNICEF, WHO and World Bank 2016).

Triple burden of malnutrition: the co-existence of undernourishment, micronutrient deficiency, and overweight in the same country. It is estimated that about 1 billion people consume too few calories, at least 3 billion don't have sufficient nutrients, and over 2.5 billion consume too much (IFPRI 2018).

Undernutrition: insufficient food intake, repeated infection and poor care resulting in one or more of the following: underweight for age, short for age (stunted), thin for height (wasted) or functionally deficient in vitamins and/or minerals (micronutrient malnutrition) (United Nations System Standing Committee on Nutrition, 2017).

Wasting: children too thin for their height; an acute form of malnutrition, result of recent rapid weight loss or the failure to gain weight. A child who is moderately or severely wasted has an increased risk of death, but treatment is possible (UNICEF, WHO and World Bank 2016).

1 EXECUTIVE SUMMARY

The way we eat as a global community needs to change. Unsustainable food production and changing diets are putting the planet increasingly under pressure. Climate change enhances the problem by negatively affecting food and nutrition security.

People across geographies are affected differently, but we are all affected. Undernutrition is much more prevalent in the Global South, while over-nutrition has been growing in industrialized countries for decades and is now appearing in developing economies. Micro-nutrient deficiency can paradoxically occur in both groups. With an increasing population, more demand for food is expected. At the same time, the consumption of less nutritious food is increasing, leading to the triple burden of malnutrition¹.

Integrating nutrition into climate change programs and vice versa – taking climate change into account when planning interventions that affect the production of food and improving nutrition – opens opportunities to significantly contribute to the Sustainable Development Goals. We introduce the term climate-smart nutrition to express this new paradigm. There is sufficient evidence about the theoretic potentials, but few concrete examples exist.

In this study, we explore the synergies between nutrition, climate change adaptation and mitigation outcomes across the food system – first conceptually, then by providing a case study from Kenya. This analysis is meant to contribute to a transition towards more sustainable production and consumption. Such a transition can best be showcased by using the example of a climate-smart nutrition intervention that is working and is potentially profitable – cow milk dispensers.

We chose Kenya as an example of emerging economy, where agriculture, and specifically livestock farming, is a key sector for employment. Dairy represents a high GHG emission intensity product with growing demand. Dairy plays an important role in people's diets and nutrition and growing demand is inevitable. The nutritional value of fresh milk is recognized as a remedy for undernutrition and micronutrient deficiency. Finding a balance between nutritional value and GHG footprint remains a challenge.

Our analysis shows that milk dispensers are a technology worth promoting in Kenya and beyond, as the business case is given, demand is growing and the development impact (nutrition and climate benefits) is promising. Ensuring a constant supply of milk at consistent quality and providing the necessary infrastructure (electricity, machinery, collection and sales places) remain upscaling barriers. The findings of this study can be used to advocate for a nutrition lens in agriculture and climate projects, as well as a climate lens in traditional nutrition projects – climate-smart nutrition. By integrating the two aspects, outcomes can be optimized for a growing world population facing climate change today and in the future.

¹ Triple burden of malnutrition is the co-existence of undernourishment, micronutrient deficiency, and overweight in the same country. It is estimated that about 1 billion people consume too few calories, at least 3 billion don't have sufficient nutrients, and over 2.5 billion consume too much (IFPRI 2018).

2 THEORETICAL OVERVIEW

Integrating nutrition into climate change actions and vice versa – taking climate change into account when planning interventions that affect the production of food and improving nutrition – opens opportunities to significantly contribute to the Sustainable Development Goals (SDG). There is sufficient evidence about the potentials. Changing the way people eat should be used to contribute to SDG 13 on climate change, SDG 14 on life below water, SDG 15 on life on land, and the targets on sustainable agriculture within SDG 2 on zero hunger (Development Initiatives, 2017). SDG 3 on good health and well-being in turn can also immensely benefit from the integrated vision of other SDGs.

Enabling wider access to healthy and nutritious food (SDG 2 on zero hunger) that is regionally produced can benefit rural producers and urban consumers, reduce greenhouse gas emissions along the food supply chain and make the entire food system more resilient to climate change (SDG 13 on climate change). Such comprehensive approaches hold potential for significant additional benefits. Well implemented and scaled, it is a development intervention that has both adaptation and mitigation co-benefits.

The global food system is facing a number of challenges to keep providing food for people while limiting the negative impacts on the environment that it is causing. One of the main objectives of the food system is to provide affordable and nutritious food. The challenge is to feed the growing population, which is projected to reach over 9 billion by 2050 (UNDESA, 2017). Despite many achievements in agriculture, hundreds of millions of people remain hungry and about 2 billion people suffer from various forms of malnutrition.

At the same time, agriculture and related land-use change generate one quarter of annual GHG emissions and food production uses almost half of the world's vegetated land (WRI, 2018). In simple terms, both planetary and human health is in dangerous shape: while the global food system has many different negative environmental impacts (e.g., GHG through deforestation), there are still many groups of people who are not eating enough and there are many groups of people who are not eating the right kind of (nutritious) food (see Table 1).

Table 2: Global nutrition related health statistics

Sources: (UNDESA, 2017; WHO, 2018)

Indicators	Year	Global
<i>Population</i>	<i>2017</i>	<i>7.6 billion</i>
Overweight rates among adults	2018	1.9 billion
Underweight rates among adults	2018	462 million
Wasting rates among children under 5 years old	2018	52 million
Extreme wasting rates among children	2018	17 million
Stunting rates among children	2018	155 million
Overweight or obesity rates among children	2018	41 million

The objective of this study is to explore the synergies of nutrition, adaptation and mitigation outcomes across the food system (when possible), and through this analysis contribute to an understanding of possible transition pathways towards more sustainable production and consumption. We believe it is best suitable to showcase such a possible transition by use of example of a climate-smart nutrition business case that is working and potentially profitable, not donor dependent.

We first give a general overview of potential interventions along the agri-food value chain, nutrition and climate benefits. We then illustrate the ongoing dynamics of food production and consumption in a high GHG intensity supply chain in a country burdened simultaneously by triple burden of malnutrition (under- and over-nutrition, micro-nutrient deficiency). Notwithstanding that, among many emerging cases, we selected the example of dairy in Kenya. As a possible approach, we present a concrete climate-smart nutrition measure introduced in Kenya a few years ago and gaining interest from the private sector and consumers alike – so-called “milk dispensers” (also known as milk ATMs). We conclude by outlining further potential interventions that optimize nutrition outcomes while adapting to climate change and mitigate GHGs in the Kenyan dairy supply chain, together with an outlook on scalability of climate-smart nutrition interventions in developing countries and emerging economies as it is a challenge in such contexts to ensure nutrition and climate outcomes and the evidence is scarce.

2.1 The need for climate-smart nutrition

One of the indicators of the food systems on human populations is the nutrition and health status of people. Table 1 presented in the Policy Brief above illustrates statistics that it is not only for hunger (underweight rates among adults, and rates of stunting and wasting) but also presents alarming rates of obesity and over-weight rates among both adults and children (WHO, 2018) – all of which grouped under the term malnutrition. This multi-faceted manifestation of malnutrition (i.e., triple burden of

malnutrition) is a result of what is coined as ‘**nutrition transition**’²: the term that describes changing diets of people due to increasing incomes and migration from rural to urban areas. These changes in nutrition transition have already taken place in industrialized countries but are now being observed in transitioning and developing countries as well, where in some cases several forms of malnutrition are found at the same time (e.g., hunger and obesity).

On the global scale, the **impacts of food systems on the environment** and planet are severe. Industrial and agricultural revolution has made it possible to increase food production but with the price on the environment. Food production puts great pressure on natural resources: it uses around 70% of the world’s freshwater supply and 38% of world’s land – livestock sector using 70% of agricultural land (Development Initiatives, 2017). Expansion of agricultural land is a known driver for deforestation (CAT Decarbonisation Series, 2018). The impact of agriculture and food production are also immense drivers for the continuing loss of biodiversity: looking at the shift in the relative biomass of different species mammals, recent studies show that humans account for 36% of the biomass of all mammals, livestock account for 60%, and while wild mammals only for 4% (Bar-On, Phillips, & Milo, 2018).

The interlinkages among food system, nutrition and climate change are complex. If we focus solely on malnutrition and climate change in more detail, highlighting the concepts of nutrition, climate change adaptation and mitigation, the challenge becomes more nuanced.

On the adaptation side, the climate-nutrition interface is linked to malnutrition and adaptive capacity of vulnerable people. The impacts of climate change on nutrition are decreased food quantity and access, decreased dietary diversity, and decreased food nutritional content (Fanzo, McLaren, Davis, & Choufani, 2017).

At the same time, people’s nutrition status and diet choices affect their capacity to cope with and adapt to climate change and to mitigate climate change within the food supply system (IFPRI, 2015). Climate change further exacerbates the enormous existing burden of malnutrition by affecting food and nutrition security. Climate change signals such as increasing temperatures or occurrence of extreme weather events (e.g., severe droughts, extreme winds) can have impacts on crop yields, crop nutrient content, and post-harvest losses as some examples. The nutritional status of people, in turn, is also affected by global nutrient supply, which affects their ability to cope with and adapt to climate change being affected by food price increases and volatility and with lower purchasing power of nutritionally healthy foods (Myers et al., 2017). For the poorest groups, the seasonal cycles of food availability, infection, and time use remain a significant challenge to nutrition security and provide a stark indicator of the vulnerability of populations to climate risk (IFPRI, 2015).

For mitigation, the situation is slightly different: large parts of production and consumption (especially over-nutrition), and all the supply chain stages in-between, have a negative effect on the environment, including causing substantial GHG emissions that contribute to climate change. As of 2010, agriculture and land-use change contributed one-quarter of total GHG emissions – 12 gigatons (Gt) measured as carbon dioxide equivalent (CO₂e) (WRI, 2018). Projections show that by the year 2050 total agricultural emissions to be 15 Gt, which would account for the 70% of the allowable “emissions budget” for holding climate warming to the global target of 2 degrees Celsius (2°C) (WRI, 2018).

² The stages of nutrition transition are: over time, people’s diets content shift from grains, fruits and vegetables towards increased consumption of sugars, fats and ultimately towards highly processed foods with little fiber content. Each stage of the nutrition transition is shadowed by nutrition problems, where a transition towards more sugar, fat and processed foods results in nutritional deficiencies and increases in overweight and obesity rates.

In summary, climate change negatively affects food and nutrition security, while unsustainable food production and changing diets negatively affect the climate. These thematic complexes affect people differently across geographies. Undernutrition is much more prevalent in the Global South, while over-nutrition has been growing in industrialized countries for decades but is now appearing in developing economies as well. Micro-nutrient deficiency can paradoxically occur in both groups. With an increasing population, more demand for food is expected.

What is climate-smart nutrition?

In light of these global challenges, the urgent need to transition away from the current system to a more sustainable one is widely recognized. **Climate-smart nutrition taps synergies between nutrition, adaptation and mitigation outcomes across the food system** to help this transition. Climate-smart nutrition links two fields: climate-smart agriculture (CSA) and nutrition community. Climate-smart interventions for enhanced nutrition are needed to meet both agricultural and nutritional needs (Global Panel, 2015). Not all three of these benefits (optimized nutrition, climate change adaptation and mitigation) will be achievable at each stage of the supply chain, for each beneficiary group or at the same time. Therefore, optimization of benefits needs to be seen at the system level more than at the individual intervention level, where only one or two of the three benefits might materialize.

2.2 Interventions along the agri-food value chain

In general terms, value chains consist of various actors and the sequence of activities carried out to bring a product from production to the consumer (Miller and Jones 2010). Value chain analysis is commonly used to identify the actors and factors affecting constraints in efficiency, productivity and competitiveness in value chain (Kiff et al. 2016). The food supply chain encompasses all activities that move food from production to consumption (including production, storage, distribution, processing, packaging, retailing and marketing) (HLPE 2017). Using the value chain analysis for the case of milk dispensers in Kenya helped to identify the potential climate and nutrition benefits along the supply chain.

Interventions on production and demand side

Climate-smart interventions can be classified along the agri-food value chain and the IPCC differentiates between supply (i.e., production) side and demand (i.e. consumption) side measures (see Glossary). Demand-side measures are mitigation options in the AFOLU (Agriculture, Forestry and Other Land Use) sector such as reducing losses and waste of food, changes in human diet, or changes in wood consumption that have potential for economic, social and environmental co-benefits (IPCC, 2014). Figure 1 below illustrate potential interventions between production side (SCA) and consumption (demand-side) measures (i.e., dietary change) and outcomes that lead to climate-smart nutrition.

Overview of measures to enable food system transition

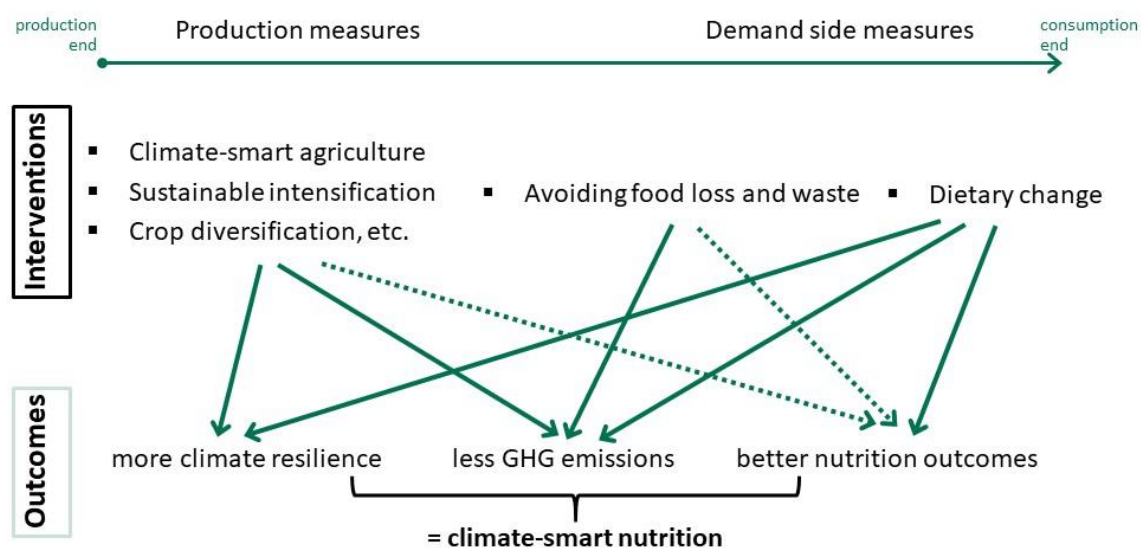


Figure 3: Climate-smart interventions and outcomes' examples

Source: Own elaboration

Table 1 “Measures in the food system that enable climate-smart nutrition“ (page v of the policy brief) gives an overview of intervention typologies along a typical agri-food value chain. These measures are for illustrative purposes and do not represent an exhaustive list.

Measures close to the food production stages target mainly smallholder farmers and processors to increase their productivity to contribute to food availability and food safety. They also introduce technologies to reduce food loss and waste and promote nutrition quality of food (i.e. fortification). Interventions closer to consumption aim at educating consumers regarding nutrition, and by this changing their behavior towards more nutritious foods and nudging consumers towards smaller portions or choosing healthier foods, reducing food waste through enabling environment.

Most **measures that target reduction of food loss and waste at the producer level** are technological such as harvesting and storage techniques to preserve the produce for a longer period. Measures at the consumption stage of FSC target seasonal/regional consumption, portion size control, and food redistribution. All of these measures result in reduced GHG emissions of the food that otherwise would have been wasted; but also the measures make more food available for consumption and create opportunities for additional income.

While **demand-side measures for enhancing nutrition outcomes** in the context of changing diets target consumption behavior to reduce demand for food in general, certain measures also cover production aspects and promote nutritious diets. For example, in order to achieve access to (nutritious) food, it is foremost necessary to produce certain categories of food such as staple crops. This is especially relevant in the areas and regions where people are experiencing under-nutrition, and consumption of such food is vital for their well-being.

Info box: Climate-smart or nutrition-smart agriculture?

There are different conceptual approaches that address the linkages between nutrition, agriculture and climate change.

The concept of **Climate-smart agriculture (CSA)** captures the linkage between agriculture (food production and food security), climate change mitigation (reduction of GHG) and climate change adaptation (building resilience to climate change) (FAO, 2013).

Nutrition-sensitive agriculture is “an approach that seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner” (FAO, 2017).

Both CSA and nutrition-sensitive agriculture are conceptual approaches with the same goal, i.e., provision of food but focusing on different angles, e.g. production of food and consumption angle. For our approach in this report, we propose a wider definition of **climate-smart nutrition** that includes and focuses on the demand-side of the agri-food value chain. Because every meal is an agricultural act, food consumption cannot be seen separately from food production, or agriculture. Nutrition, adaptation and mitigation outcomes should be equally optimized along global value chains to sustainably benefit producers and consumers across economies in various development stages.

2.3 Where do interventions already take place?

In developing country policies, as well as in development cooperation targeted at these countries, nutrition outcomes are so far largely disconnected from the climate sphere. This is understandable as many developing countries are still facing enormous undernutrition and agricultural production challenges, and bear little responsibility for contributing to global climate change. However, additional challenges are adding up on the top of undernutrition issues. The emergence of new forms of malnutrition, specifically over-nutrition and other unsustainable consumption patterns, is a recent phenomenon and occurs in certain (mostly affluent) population groups within these countries, who have traditionally not been the focus of development efforts.

Industrialized countries however have mostly overcome undernutrition, except for relatively smaller parts of their populations, and have a long history of unsustainable consumption and agricultural production patterns. In this group of countries, policy makers have started to design consumption policies targeted at reducing unsustainable consumption. An example is the development of national healthy and sustainable dietary guidelines by a number of industrialized countries. Food-based Dietary Guidelines (FBDG) are a set of recommendations given by policy-makers on how its citizens can eat well and they serve as tools to promote healthy diets and as the basis for elaborating food and agriculture policies. Out of 83 countries that have FBDGs (out of possible 215) as of 2016, four countries included sustainability in their guidelines (FAO & Food Climate Research Network, 2016). A summary of the messages of these four FBDGs is presented in Annex II – National dietary guideline examples.

There are some examples from developing countries that also address food consumption (food access and affordability). The program called Marketplace, supported by GAIN and USAID runs in four African countries: Kenya, Tanzania, Mozambique and Rwanda. The program supports small and middle size enterprises (SMEs). Through the Community of Practice, the program disseminates information and knowledge to stakeholders, and through the Innovation Accelerator, the program provides technical and financial support to entrepreneurs along the food supply chain to make nutritious food available and affordable to (poor) consumers. During program implementation, USD

3.04 million was disbursed to businesses in private sector in four years, leveraging 53% of fund invested. Companies received support in forms of grants and technical assistance. The assessment of this program showed that:

- Providing support to SMEs can result in profitability for the business and reduce production costs
- The proximity and appearance of retail locations are important for targeting low income consumers
- Small serving sizes increased the likelihood that food reached low income populations
- Where innovations around convenience were introduced, they were largely successful³.

3 KENYA CASE STUDY

3.1 Why Kenya?

- Kenya is exposed to the impacts of climate change such as droughts and floods and is highly vulnerable due socio-economic vulnerabilities such as the triple burden of malnutrition.
- Agriculture directly contributes 24% to GDP and is the largest employer, accounting for about 60% of the total employment.
- The dairy sector plays an important role in contributing to an improved nutrition situation while having great potential for GHG mitigation through improvements in production efficiency.
- Dairy production is concentrated mainly in the Rift Valley and the drier North East region. Western Kenya, where the study site of Kisumu county is located, is considered a milk deficit region and is dependent on milk imports from the neighboring counties.
- Kenya faces more than one form of malnutrition (see Figure 4):

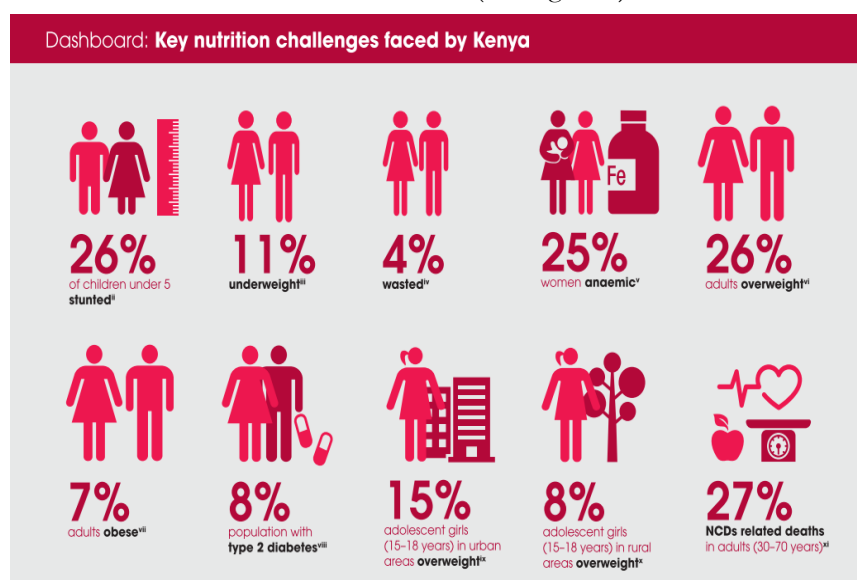


Figure 4: Key nutrition challenges in Kenya

Source: GAIN, 2018

³ <https://www.gainhealth.org/programs/marketplace-for-nutritious-foods/#marketplace-for-nutritious-foods>

- The rates of malnutrition forms vary between urban and rural areas. Stunting rates among rural children is higher (29%) than urban children (20%). Despite large urban areas showing a lower than average poverty rate, stunting prevalence remains high due to the large headcount of poor people within the county limits⁴ (KNBS, 2015). Different picture is for obesity rates: the rates are higher among urban adolescent girls (15%) than among rural adolescent girls (9%) (KNBS, 2014).
- Nutrition outcome is correlated with wealth in Kenya. The proportion of households with borderline scores on food poverty decreased with increasing household wealth from 2005/06 to 2015/16⁵. Data show that the rates of stunting among children decrease as household wealth increases (KNBS, 2014).
- Overall, the proportion of poor households on national level has declined (from 46.6% in 2015/16 to 36% in 2015/16) – rural poverty rates declining faster than among urban households. Though one third of Kenyan households are considered poor, the changes in the last decade show the incidence of food poverty dropped by over 13 percentage points (KNBS, 2015).

3.2 Kenya country context

Being part of the Greater Horn of Africa region, Kenya is exposed to the impacts of climate change such as droughts and floods and is highly vulnerable due to socio-economic challenges such as triple burden of malnutrition. The complex relationship of these factors create development challenges for the country. In this context, the dairy sector plays an important role in acting on climate change and contributing to the improved nutrition situation.

The country can be divided into two regions with vast differences in terms of climatic conditions and suitability of agricultural production: lowlands, including the coastal and Lake Region lowlands; and highlands, which fall on both sides of the Great Rift Valley. Rainfall and temperatures are influenced by altitude and proximity to the Indian Ocean. The coastal region has a tropical climate, with both rainfall and temperatures higher than the rest of the country throughout the year (see Figure 5). The climatic conditions determine the agricultural activity.

Info box: Kenya quick facts

- Population: 49 million (2017)
 - 40% under the age of 14
 - 60% under the age 24
 - 4% age group of 60 and above
- Population growth rate: 3%
- Expected population by 2050: 95 million (UNDESA, 2017)
- Territory: 582,646 km²
- Administrative territories: 47 counties
- Land area: 80% arid or semi-arid, 20% arable (FAO, 2011)

The dairy production is concentrated mainly in the Rift Valley and drier region of North Eastern with considerably less number of dairy cattle (KDB, 2018). The region of Western Kenya where the study site of Kisumu county is located is considered a milk deficit region (KDB, 2018) and is dependent on milk imports from the neighboring counties.

The agricultural sector is the backbone of the Kenya's economy. The sector directly and indirectly contributes 24% and 27% of the Gross Domestic Product (GDP) respectively. The sector is the

⁴ The KNBS data on the relationship between the level of stunting and poverty is visualized here: http://www.ieakenya.or.ke/number_of_the_week/level-of-stunting-in-kenya

⁵ Counties with low severity in stunting and poverty, below the national average include Kericho, Lamu, Kakamega, Taita Taveta, Trans Nzoia, Nakuru, Embu, Siaya, Kiambu, Nyeri, Makueni, Kisumu and Murang'a.

largest employer in the economy, accounting for about 60% of the total employment with over 80% of the population, especially living in rural areas, derive their livelihoods from agricultural related activities. As a result, Kenya's food and nutrition security is intricately linked to the performance of the agricultural sector.

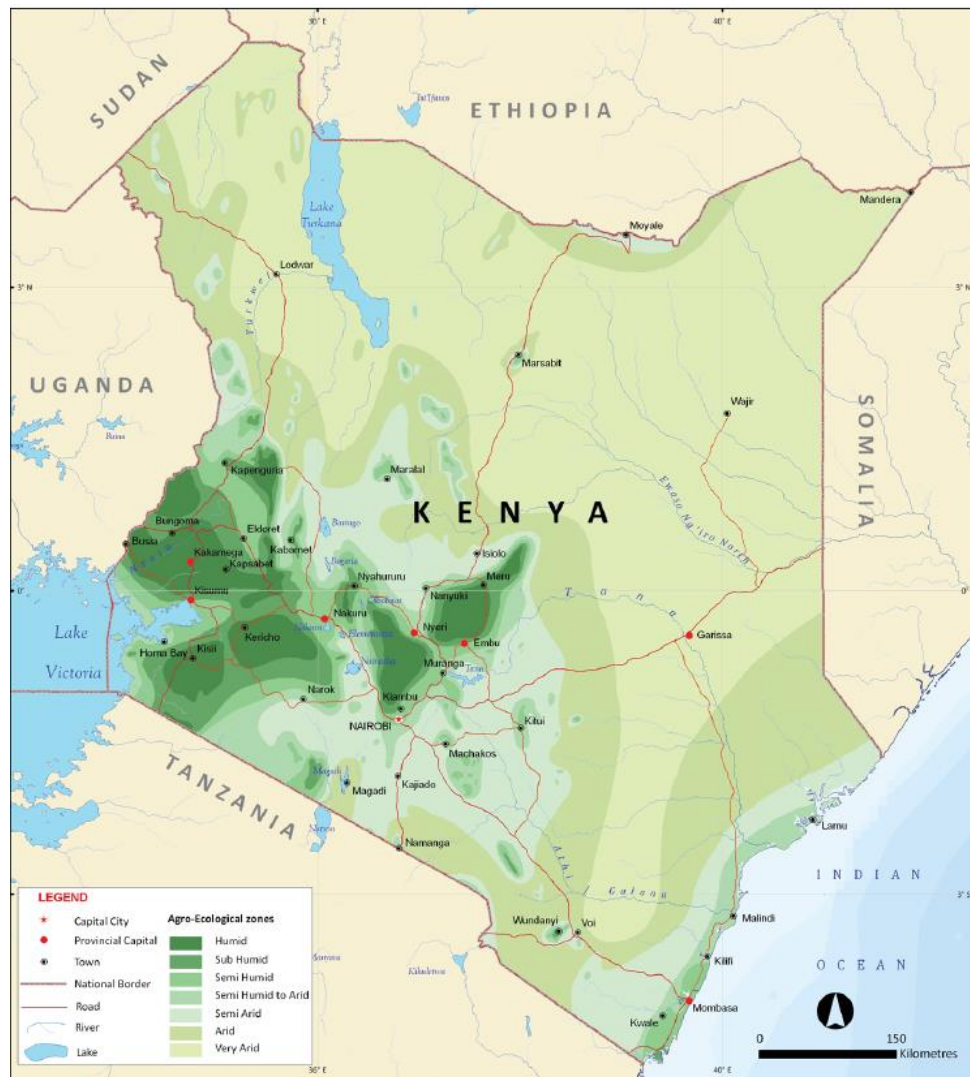


Figure 5: Agro-ecological zones of Kenya

Source: Government of Kenya, 2011

The importance of dairy

Milk is Kenya's most important livestock product, providing about 70% of the total gross value of livestock's contribution to the agricultural sector (IGPALD & IGAD, 2011). The dairy sector in Kenya plays an important role in contributing to the nutrition of its population. Milk is an important source of calories and income, particularly for smallholder farmers.

Kenya has one of the highest levels of per capita milk consumption in sub-Saharan Africa (ILRI, 2007). It is estimated that national annual per capita milk consumption in Kenya is around 100 – 110 liters (FAO, 2011), which is more than five times the milk consumption in other countries in East

Africa (CGIAR, 2008). It is projected that per capita milk demand to expand from the current levels to 220kg per in 2030 (Ministry of Agriculture, Livestock and Fisheries of Kenya, 2017). Estimated annual per capita milk consumption ranges from 19 kg in rural areas to 125 kg in urban ones (FAO, 2011). Milk consumption is dependent on wealth: as the income increases, so does the milk consumption. Milk expenditure is an important item in the basic food both for rural and urban households: the share of unpacked milk in the Food Poverty Basket has increased from 0.070 in 2005/06 to 0.080 in 2015/16 (KNBS, 2015).

Info Box: The two sides of animal source foods

In the industrialized world, animal source foods (ASF) consumption is associated with the rise of non-communicable diseases (including diabetes, heart disease, stroke and cancer) along with increasing overweight and obesity rates. Worldwide overweight and obesity rates are associated with more deaths than due to underweight (HLPE, 2017). In such contexts, measures addressing reduction of ASF consumption should be promoted.

In contrast, in developing countries access to ASF remains limited, especially among the poorest and vulnerable groups of population, which affects health status of these groups. ASF make considerable contribution of important nutrients, such as calcium in dairy, and zinc and iron in meat (HLPE, 2017). These nutrients of ASF are especially important for young children, pregnant and breast-feeding women, as well as for all people suffering from malnutrition. Especially milk consumption is linked with stunting prevention and milk consumption is associated with cognitive development (HLPE, 2017). In such context, the challenge is addressing malnutrition and promoting optimal level of ASF consumption to achieve health outcomes.

3.3 The challenge

Milk is processed and sold in essentially two parallel chains: the cold chain and the warm chain. Milk delivered to processors constitutes the 'cold chain' or the pasteurized milk system, while milk sold raw to consumers constitutes the 'warm chain' (USAID, 2015). The warm chain is categorized as informal and includes mobile traders, milk bars and kiosks, dispensers, and cooperatives. Smallholder dairy producers in rural areas sell their (mostly morning milk) directly to neighbors, door-to-door, to the milk bars, or to the cooperatives that collect milk. The formal chain includes milk processors, cooperatives, supermarkets, and retail shops and kiosks, milk bars and any other actor that handles processed milk products.

Informal milk marketing poses various risks for consumer safety from poor milk handling practices common among milk traders. These include:

- **Poor hygiene:** It is challenging to control how milk is handled by the producers and traders. Poor hygiene practices have negative impacts on food safety due to significant bacterial load, with risks and implications for health and nutrition of consumers. Furthermore, it can lead to the early spoilage of milk, with related economic (and environmental) losses.
- **Adulteration:** In order to gain more volume and sales of milk, producers and traders dilute milk with water, margarine (to give impression of 'fatty' milk), or other preservatives. As most of the smallholder producers sell their morning fresh milk, sometimes they mix the evening milk with the morning milk in order to sell more milk. These practices have also negative impacts on health and nutrition of consumers and can lead to the spoilage of milk.
- **Containers:** Use of non-food grade containers and public transport in delivering milk to the point of sale. Milk is transported in various containers (aluminum, plastic containers, etc.) that are not

cooled. This leads to the spoilage and loss of milk, which creates incentives for adding various preservatives. At the collection centers (of cooperatives), collected milk from the producers is put in one container and the quality is not always checked.

- **Lack of cooling facilities:** cooling facilities are available mainly for large processors in the cold chain and is a challenge for the smallholder producers. There are around 600 cooling and 32 processing facilities throughout Kenya (Gromko & Abdurasulova, 2018). Collected and cooled milk has to be transported in trucks in long distances. Sometimes, there is a lack of continuous cooling and milk adulteration takes place during transportation, which is not controlled (personal communication with interviewees). This has negative impacts for the milk safety and poses serious implications for consumer health and nutrition.
- **Large amount of loss and waste:** results in lost income for the producers as well unnecessary GHG emissions. Although the dimension of GHG emissions in Kenya is debated, approximately 5.2 kg of CO₂e per liter of milk are emitted (including enteric emissions and manure management) based on national dairy statistics (WRI CAIT 2.0 2017). Estimates suggest the dairy emissions are responsible for 20 to 41% of total emissions in the country (Gromko & Abdurasulova, 2018).
- **Under-served regions:** Milk production in Western Kenya is generally low and cannot meet local demand. Despite its good biophysical potential for dairy, production is still mostly at subsistence level (Waithaka et al., 2002). Almost 90% of farms produce less than 10 liters of milk per cow per day. Around 50% of marketed milk comes from outside the region with acute shortages experienced for a period of three to four months between December and March (Wanjala et al., 2014).

3.4 Solution: Milk dispensers

Given the described challenges related to the informal milk supply chain in Kenya and the specific lack of dairy supply in Western Kenya, milk dispensers (also known as milk ATMs) can be part of the solution (Figure 6). They enhance climate-smart outcomes for various stakeholders along the supply chain: they represent an innovative way for delivering safe and nutritious milk to existing and new consumers.

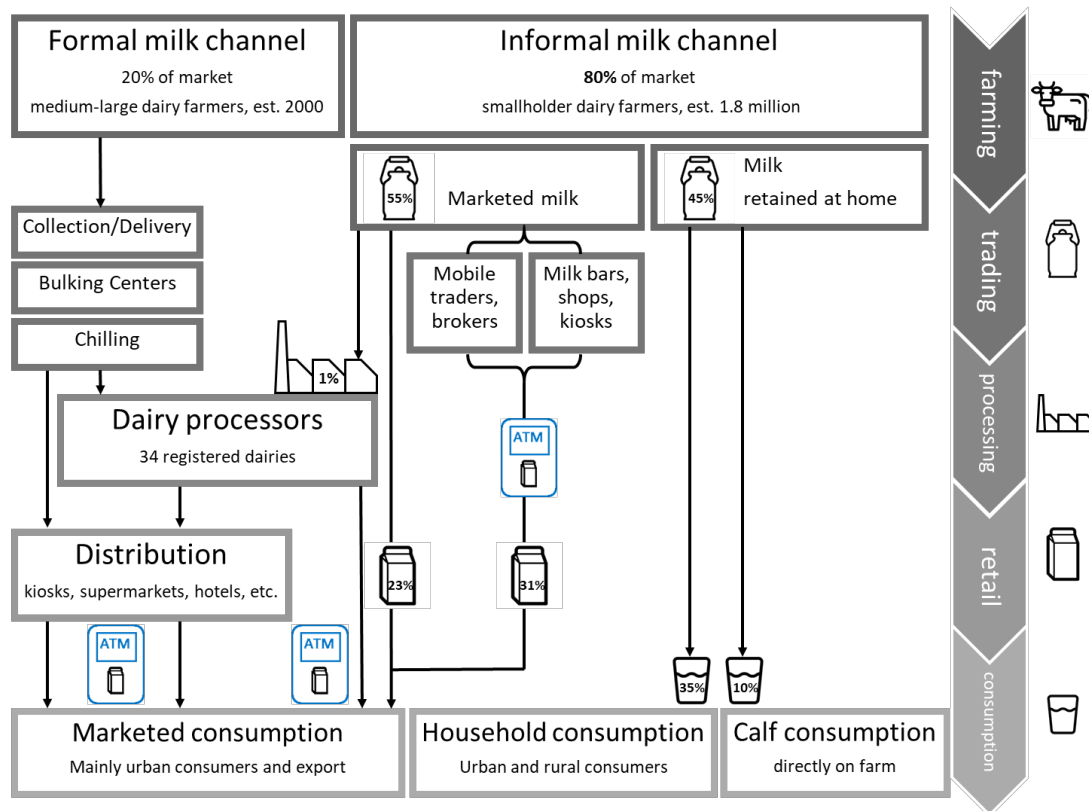


Figure 6: Overview of dairy supply chain in Kenya with market position of milk dispensers (ATM sign)

Source: own elaboration, based on various Kenyan sources

A milk-dispensing machine is an automated vending machine that provides milk to consumers after payment. The payment is deposited directly to the operators or via cash or a credit card at the machine. The structure is a steel tube with a waterproof roof. The vending machines are refrigerated and thermal insulation ensures the cold chain from the place of production to the point of sale. Usually steel or aluminum tanks (25-50 liters) are used to fill milk into the refrigerator. The milk is pasteurized and chilled, can be bought for an exactly specified amount and comes at almost half the price of packaged milk.

The vending machines are operated by sales assistants who advise consumers on the amount of milk they can buy for their cash. In most business models, the investor buys a milk dispenser and places it at a strategic location to sell fresh milk, mostly in urban and peri-urban areas. Most of the dispensers are located in supermarkets and areas with high population density to increase off-take. Approved first in 2013, currently there are about 275 milk dispensers throughout Kenya and 11 in Kisumu, out of which seven are operating⁶.

⁶ As of November 2018.

3.5 The benefits of milk dispensers

To summarize the Kenyan intervention along the various stages of the value chain, the following interventions and associated potential benefits accrue (Table 3):

Table 3: Climate-smart nutrition measures - examples from the Kenyan dairy chain

Value chain stage	General category and description of the example	potential adaptation/mitigation/nutrition benefits
Food Production	<ul style="list-style-type: none"> ▪ Diversification and sustainable intensification of agricultural production ▪ Promoting nutrition-sensitive livestock and fisheries <p>Kenyan example:</p> <ul style="list-style-type: none"> ▪ Better livestock management practices to increase milk productivity 	<p>Adaptation and nutrition benefits:</p> <ul style="list-style-type: none"> ▪ increased availability and affordability of milk, prospect of an additional income and purchasing power ▪ production and consumption of nutrient-rich animal source foods for vulnerable groups with suboptimal diets; availability of nutritious food for urban poor (e.g. safe milk) <p>Mitigation benefits: Best agricultural practices can reduce total GHGs or GHG intensity per output unit (e.g. liter of milk).</p>
Food handling, storage and processing	<ul style="list-style-type: none"> ▪ Measures to reduce food loss and waste <p>Kenyan example:</p> <ul style="list-style-type: none"> ▪ Promotion of collecting and cooling centers to reduce milk spoilage and loss, e.g. fresh milk dispensers 	<p>Adaptation and nutrition benefits: Income generation from food value addition; small packaging can reach poor consumers; increased economic resilience for smallholder producers through possibility of direct marketing.</p> <p>Mitigation benefits: Decreased GHG emissions per liter of milk through avoided spoilage of milk in a closed cooling chain.</p>
Food trade and marketing	<ul style="list-style-type: none"> ▪ Food marketing and advertising practices <p>Kenyan example:</p> <ul style="list-style-type: none"> ▪ Promoting fresh milk dispensers as new marketing channel; targeted advertisement to new consumer base 	<p>Adaptation and nutrition benefits: Possibility to balance food deficits and surpluses; better food quality and safety resulting in fewer losses (e.g. for fresh milk); low-income consumer segment gains access to nutritious product.</p>
Consumer demand, food preparation and preferences	<ul style="list-style-type: none"> ▪ Nutrition education and behavior change communication ▪ School food and nutrition programs <p>Kenyan example:</p> <ul style="list-style-type: none"> ▪ Introduction of milk dispensers in public institutions such as schools, universities, hospitals 	<p>Adaptation and nutrition benefits: Improved diets nutrition status; possibility to buy the needed amount and/or the affordable amount; (e.g. increased consumption of fresh and safe milk).</p> <p>Mitigation benefit: Less GHG emissions through avoided spoilage at home (e.g. fresh), due to smaller bought amounts.</p>

Nutrition benefits

- The major nutrition benefits of milk dispensers are experienced by consumers – especially poorer segments – in urban and peri-urban areas through having access to fresh, safe and affordable milk.
- Milk dispensers can also help reducing the adulteration of milk prevalent in informal markets, as the regulations require milk in dispensers to be pasteurized and cooled. The end product is safer for consumption.

- Rural consumers who do not produce their own milk gain nutrition benefits from milk through milk bars, specialized shops for fresh milk. Fresh milk in these bars and from dispensers is more affordable in comparison to packaged milk.

Resilience to climate change

- Additional income especially for smallholder producers who can access new sales channels. Resulting in better economic resilience of households.
- When economic benefits incentivize to increase milk production at the household level, this can also increase milk consumption, especially by women and children.
- This adaptation benefit is strongly linked to nutrition and an example of how health contributes to improved resilience of households and individuals.

Climate change mitigation

- Our hypothesis is that milk dispensers reduce spoilage and therefore GHG emissions from unnecessarily wasted milk. There is lack of numerical evidence however, as it was not possible to estimate the amount of milk loss reduced at the selling point of milk dispensers. This is an important caveat and subject for future research.
- Theoretically, additional GHG savings could be reached through linking production-side measures for producers selling to milk dispensers. This can be done, for example, by promoting improvements in per cow productivity through better feed and management practices (USAID, 2018) which would reduce GHG intensity (i.e., GHG emissions per unit of product).

Crosscutting benefits

- Better nutrition of households, especially of vulnerable groups such as women and children has positive impacts on the resiliency of households (e.g. better performance at school, physical strength, ability to work, etc.).

Trade-offs

Achieving simultaneous and multiple benefits with milk dispensers remains a challenge. Based on our assessment, most benefits from milk dispensers are achieved at the consumer end and in the area of nutrition, and less directly in the climate change adaptation and mitigation categories. Increased resilience comes as a secondary and indirect benefit from improved nutrition. There is lack of quantitative data for measuring the indirect improvements at production stage (resulting from the presence of milk dispensers in the value chain), as well as GHG emission savings.

Economic benefits have not been assessed and can also be important. Smallholder producers might increase their income through a new marketing channel such as milk dispensers. However, this is only possible if smallholder producers are able to supply their milk at the milk collection centers, cooperatives or directly to the traders.

Info box: Do milk dispenser contribute to affordable win-win diets?

In Western Kenya, consumers buy a liter of raw milk at KES 60, whereas milk cooperatives and milk bars pay between KES 30 and KES 55 per liter of milk delivered by farmers. The majority of consumers (households, hotels and institutions) prefer fresh unpasteurized milk (63%) compared to fresh pasteurized (25%) and UHT (12%) milk. It is estimated that only 37% of milk consumed in Kisumu is produced locally. The local demand is more than 70 million liters of milk, yet local farmers only produce 26 million liters (KDB, 2017).

A study of four milk-dispenser operators in Nairobi and its suburbs showed that the business is profitable, with estimated gross margins between 8.7% and 26%. The cost of the dispensers varies based on capacity. The 100-liter dispenser costs KES 120,000 (EUR 1,050), while the 200-litre dispenser costs KES 180,000 (EUR 1,572). The technology can also offer lower prices to end consumers compared to processed and conventionally packaged milk. The price differential is between KES 10 (EUR 0.09) and KES 26 (EUR 0.23) per liter. The figure below shows the Gross Margins Analysis for Milk Dispensing Enterprises (per month). (USAID KAVES 2015)

4 CHALLENGES AND CONSIDERATIONS FOR PROMOTING CLIMATE-SMART NUTRITION SOLUTIONS

The Kenyan milk dispenser case offers valuable lessons on promoting climate-smart nutrition interventions elsewhere and in other value chains as well:

- **Awareness raising: Explore the business case for the private sector to promote climate-smart nutrition among customers – against the current trend of highly packaged and processed foods.** There is usually limited awareness among consumers about new technologies and marketing channels, especially regarding their economic and health benefits. Marketing needs to include these aspects and make it an attractive lifestyle choice to eat healthy and sustainably.
- **Food safety: Promote capacity building on food safety and handling among all actors of the value chain to overcome negative perceptions and realities of unsafe perishable products.** Bulking and pasteurizing centers can help smallholders supplying to milk dispensers, cooperatives and operators of milk dispensers need to be trained on milk handling and safety. Strict enforcement of controls and regulations can help increase consumer trust in new technologies and the consumption of fresh products.
- **Supply chain development: Actively promote the formation of cooperatives and collective marketing groups in order to ensure a steady supply of raw materials. The constant supply of milk is a challenge for milk dispenser owners for example. Working with smallholder farmers is not a viable option for this business model and entrepreneurs prefer working with cooperatives or processors. Connecting smallholder producers with collectors, cooperatives and processors should be a main focus of climate-smart rural development to ensure nutrition outcomes.**
- **Regional focus: For perishable goods, focus on linking actors inside a region before moving to a larger scale; adapt new technologies to regional requirements such as sizing.** Closer linkages between the source and the sales point reduce transportation distance and the likelihood of spoilage. **Smaller size dispensers** can be used in areas where production and/or demand for milk is low in order to further save costs and wastage of unsold milk.

- **Perceived competition with the existing processors: Involve existing operators in the formal value chain to attract investment and avoid unnecessary competition.** Milk dispensers are also a marketing option for the few existing larger scale processors in Kenya. Business models such as leasing need to be explored to create win-wins for smaller and larger players.
- **Higher infrastructure demand of new technologies: Promote and finance renewable energy solutions to operate cooling technologies in remote areas.**
- **Electricity availability:** A main barrier to operate milk dispensers in rural areas is the unreliable access to electricity. Off-grid solutions such as **solar panels** can overcome this barrier, especially if costs are lower than connecting to the grid.

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ANNEX I – METHODS

The information used in this report was compiled using desk research, personal interviews, and insights from other project work. The authors first reviewed existing literature on nutrition and climate-smart agriculture. It revealed a notable lack of climate-smart nutrition case study examples in developing countries and emerging economies. Follow-up interviews and availability of information led to the selection of the dairy value chain in Kenya as a case study, based upon the following criteria:

- the prevalence of a triple burden of malnutrition in the country;
- the relevance of the selected supply chain for a) mitigating existing forms of malnutrition, b) for the national economy and specifically agricultural value-addition; and c) for potential climate action impacts (positive and negative);
- the existence of a concrete example (business case) of an intervention targeted at climate-smart nutrition and/or reducing food loss and waste;
- an initial perception of potential profitability of the business case;
- and notable potential to positively benefit (directly or indirectly) smallholder farmers.

In order to illustrate both positive and negative impacts in terms of climate change adaptation, mitigation and nutrition outcomes, we selected with dairy a high GHG intensity supply chain that at that provides crucial nutrition outcomes and supply addition. The case was elaborated using available literature, but primarily focused on interviewing companies and other actors in the dairy supply chain of Kenya. As it was not possible to interview every key actor in the selected supply chain, the study focused on key actors for implementing the intervention. For example, milk dispenser operators were a key source of information. Additionally, organizations that are indirectly involved in promoting the intervention (NGOs, international development organizations) and organizations on the regulatory side of the supply chain (Kenya Dairy Board) were interviewed in order to better understand the context of the intervention.

In summary, milk dispensers in Kenya serve for illustrating various key aspects of climate-smart nutrition dynamics.

ANNEX II – NATIONAL DIETARY GUIDELINE EXAMPLES

	Germany	Brazil	Sweden	Qatar
Fruits and Vegetables	Choose mainly plant-based foods. Enjoy 5 portions of fruit and vegetables daily	Eat foods mainly of plant origin. Chose seasonal and locally grown produce.	Eat lots of fruit and vegetables (at least 500g per day) Choose high fiber vegetables.	Eat vegetables with most meals, including snacks. 3-5 servings of vegetables and 2-4 of fruits every day.
Meat	Eat meat in moderation. White meat is healthier than red meat.	Try to restrict the amount of red meat.	Eat less red and processed meat (no more than 500 grams of cooked meat a week).	Choose lean cuts of meat. Limit red meat (500g per week). Avoid processed meats.
Dairy	Consume milk and dairy products daily. Choose low fat.	Milk drinks and yogurts that are ultra-processed foods and should be avoided.	Choose low-fat, unsweetened products enriched with vitamin D.	Consume milk and dairy products daily and choose low fat. Ensure intake of calcium and vitamin D rich foods.
Fish	Once to twice a week.	--	Eat fish and shellfish two to three times a week.	At least twice a week.
Fat and oil	Fat and fatty foods in moderation. Choose fats and oils from vegetable origins.	In moderation.	Choose healthy oils when cooking (i.e., rapeseed) and healthy sandwich spreads.	Avoid saturated fat and hydrogenated or tans fat. Use healthy vegetable oils such as olive, corn and sunflower in moderation.
Processed food	--	Limit the consumption of processed foods and avoid ultra-processed foods.	--	Eat less fast foods and processed foods.
Behavioral advice	Preferably cook foods on low heat, for a short time, using little amount of water and fat. Use fresh ingredients whenever possible. Take your time and enjoy eating.	Eat regularly and carefully in appropriate environments and, whenever possible, in company. Be wary of food advertising and marketing.	Try to maintain energy balance by eating just the right amount.	Build and model healthy patterns for your family by keeping regular hours for meals and eat at least one meal together daily.



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