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Sustainable food system and indigenous vegetables The Arusha case

THE ARUSHA CASE

By SASS

January 2021



Sustainable
Agrifood
Systems
Strategies

SCENARI

This e-book presents the key findings of the first report for Sustainable Agrifood Systems Strategies (SASS) project. The original report is available at the following link, [click here](#)

Sustainable food systems and indigenous vegetables

The Arusha case

Sustainable Agrifood Systems Strategies (SASS)



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Introduction

Food systems can provide healthy diets from sustainable food production, but they fail to do so at great human and ecological costs. Malnutrition is the main cause of poor health at global level, undernourishment is on the rise, while no country has reversed its obesity epidemic. Food systems are major drivers of climate change, land-use change and biodiversity loss, depletion of freshwater resources, and ecosystem pollution. Given the scale of these health and environmental challenges, **a global transformation towards healthy diets from sustainable food systems is urgently needed.** Taking into account the high variability in local factors, such as consumption patterns, input use and poverty, as well as in the political will and policy space for renewal, transformation of food systems requires strong interdisciplinary research delivering context-specific programs and policies in partnership with local actors.

Together with persistent malnourishment and climate change, main challenges in African food systems include demographic growth, poor livelihoods, urbanisation, and dietary shifts. Specifically, strengthening food systems means to contribute to SDGs related to sustainable food systems (target 2.2), ecosystems (target 6.6), responsible production and consumption (SDG 12), and climate action (SDG 13). **In Tan-**

zania, the food systems are facing a complex web of interlinked challenges and opportunities that hinder or help to achieve economic, environmental and social sustainability. In the Arusha region, despite its status as a breadbasket area in Tanzania, malnourishment is still high. Diets are poor in nutrient-rich foods and dominated by staples. Agriculture is the most important sector for livelihoods, but the fertile areas are pressured by a growing population through intensive food production, urban encroachment, climate change, and competing land uses, such as by Arusha's national park.

One pathway to more sustainability is to support diversified agroecological systems, that can contribute to more competitive, environmentally sustainable, and food and nutrition secure food systems. A key strategy for diversification consists of a better integration of indigenous vegetables, which are highly nutritious, require fewer natural resources, and can lead to higher profit margins.

In this video, an employee at the Prime Minister's office states that Indigenous vegetables and nutrition awareness can create a healthier population and stimulate the economy



As described in **Figure 1**, indigenous vegetables' integration in the Arusha food system can reasonably allow to improve all the three main dimensions of sustainability. However, **indigenous vegetables are routinely neglected by policymakers**. The reasons include a

poor economic competitiveness compared to staple crops, technical requirements and organisation required along the value chain, lack of the related nutritional information, and negative associations with poor rural lifestyle and low social status.

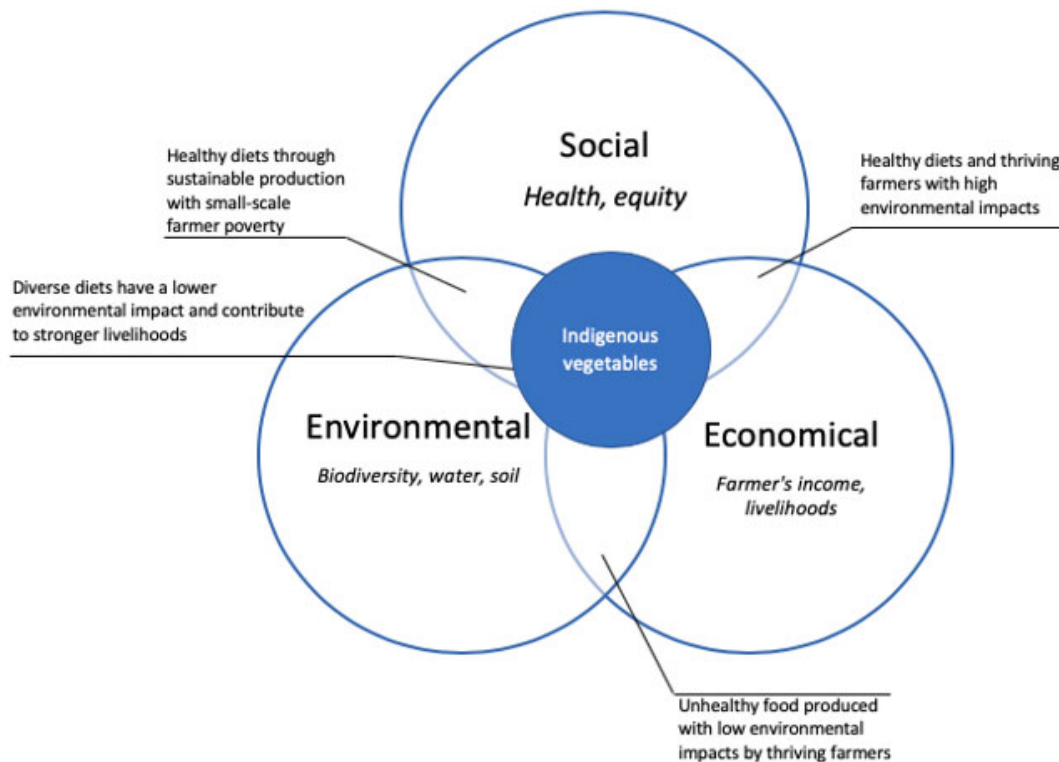


Figure 1 - Sustainability's dimensions showing the trade-offs of food, centred on indigenous vegetables (adapted from Mabhaudhi et al., 2015).

This report, major outcome of the **Sustainable Agrifood Systems Strategies (SASS) programme**, aims at filling this knowledge gap, by describing the preliminary results of two years of **interdisciplinary research and dialogue activities in Arusha**, Tanzania, on the diversification pathway. An efficient way to address this issue is given by the Food Systems approach, that is recognised as a broad conceptual framework for interdisciplinary research into the complex dynamics of food production, distribution, consumption (and recycling/disposal). In particular, a food system comprises the processes related to growing, harvesting, storing, processing, packing, transporting, marketing, consuming and disposing of food as well as the political,

economic, social, technological and cultural issues that drive and/or constrain their dynamics. Main components, relationships and drivers of the Food System are schematized in Figure 2 – Overall Framework for e-book: a food system is steered by different socio-economic drivers, such as social organisations, markets and policies, as well as environmental drivers, including land, climate and biodiversity. This report analyses the economic, social and environmental sustainability of the Arusha food system, with special attention on studying the Arusha’s food system governance and the potential role of indigenous vegetables to advance sustainability through their integration.

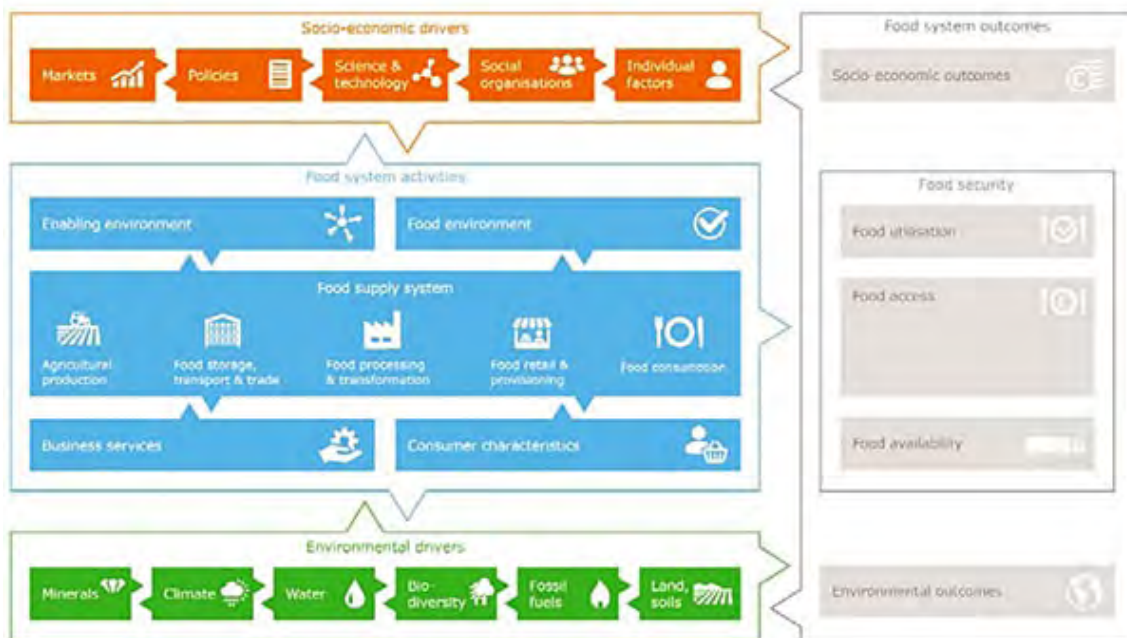


Figure 2 - Overall Framework for e-book: a way of mapping the relationships of the Food System to its drivers (WUR, 2018).

Objectives

The aim of this project is to describe the food system of rural, peri-urban and urban areas in and around Arusha, to diagnose the drivers and constraints for **better integration of indigenous vegetables**, and to help to decide on pathways towards more sustainability.

Methodology

Locations

The study area is the Arusha Region in the north-east of Tanzania, bordering Kenya and Kilimanjaro (Figure 3). The region includes seven districts that are Monduli, Arusha Urban, Karatu, Arusha Rural, Ngorongoro, Longido and Meru. The capital of the region is Arusha City, representing the major strategic and diplomatic hub of the East African Community.

SASS teams and methods

SASS programme includes a wide range of competences through seven main teams, namely: **UNIMIB's Animal, Plant and Biodiversity** and **UNICATT's Soil Biology** for the assessment of impact of agricultural practices in terms of environmental sustainability; **UNIMIB's Sociology** for the analysis of the market orientation and the role of social organisations; **UNIPV's Development Economists** for the investigation of the indigenous vegetables value chain, farms and markets; **UNIMIB's Anthropology** unit studying food production and consumption in a Masaai community; **UNISG's Gastronomic Science** for the analysis of the social structure and dynamics of food markets; and **UNIPV's Nutrition** for the study of dietary adequacy. The activities entailed field visits, interviews with experts and desk research, multistakeholder workshop and group discussions with researchers and experts, both at local and international level.

SUSTAINABLE FOOD SYSTEMS AND INDIGENOUS VEGETABLES

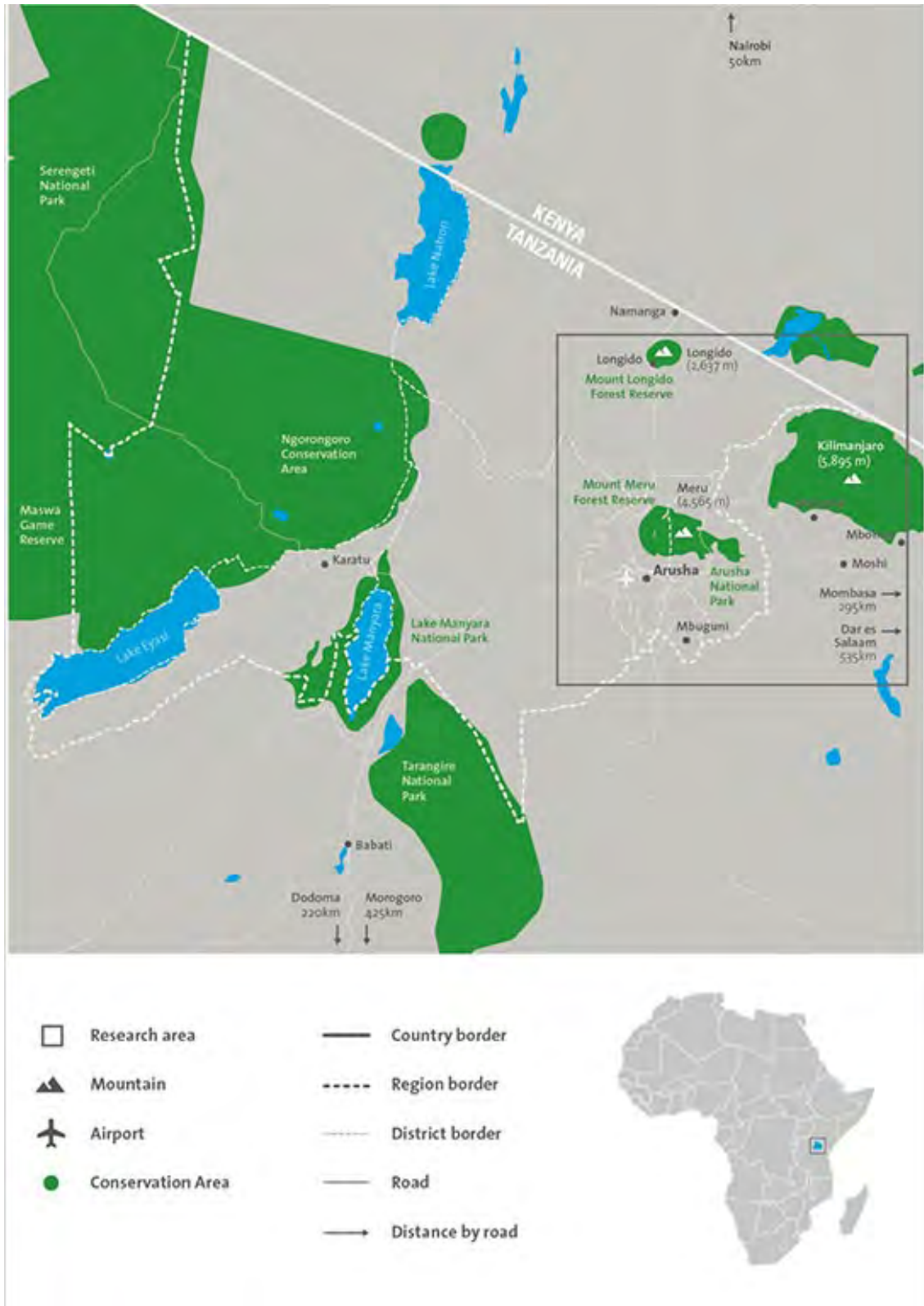


Figure 3 - Location of the research area, Arusha, Tanzania.

Chapter 1

Food system drivers

1.1. Socio-economic drivers

Food systems drivers are defined as processes and events that are known, or simply theoretically expected, to have an impact on food systems (Béné et al, 2019). Examples of major socio-economic drivers include urbanisation, economic and population growth. Here follows a description of the main socio-economic drivers in the Arusha food system.

Population

Most Tanzanians live on the northern border or the eastern coast, and the rest of the country is sparsely populated. **Cities are growing rapidly due to demographic growth and rural-to-urban migration**, and over a third of citizens living in urban areas. The population is characterised by a young age structure¹, a higher life expectancy than

¹ The 44.1% of the Tanzanian population is under 15, 53.3% between 15 and 64, and only 3% aged 65 or older.

country average, and its growth is exerting a significant pressure on the government social service delivery capacity, local natural resources and the job market. About 49% of Tanzanians is living on less than USD 1,90 per day, and the country displays **one of the lowest Human Development Index scores in the world**. Also, urban and rural citizens show significant disparities in terms of access to basic services such as electricity, water and sanitation.



Figure 4 - Urban landscape, Iringa Town (by Cecilia D'Alessandro, ECDPM).

Markets

Agriculture is a key economic sector, contributing to almost a third of the gross domestic product and employing 66% of economically active Tanzanians. However, Arusha people engaged in purely agricultural economic activities has decreased from 60% between 2008-09 to 47% in 2014-15. **Farming and livestock remain key economic activities, alongside beekeeping, food transformation, timber and charcoal production, tanzanite and coal extraction and small manufacturing.** Export horticulture and flower industry benefit from the favourable climate and the relatively good

international airfreight connection. Small and medium-sized farms produce crops and livestock for domestic, regional and international markets. In Arusha City, employment is more diverse thanks to two large industrial areas (Themis and Ngiro Ward) and to important commercial areas and food markets.

Tanzania plays an important role in regional staple food trade across East and Southern Africa, **exporting significant quantities of cereals and pulses to neighbouring countries**, including Kenya, Malawi, Zambia, Uganda, Rwanda, Burundi and the Democratic Republic of Congo. For processed foods such as sugar, milk, wheat flour, and canned products, Tanzania is still a net-importer. **The Tanzanian regional market trade recently increased, and trade relations have shifted away from Europe towards Asia**, with India and China representing both significant markets for exports and key import sources. While gold and precious stones are the largest category of exports, food items, together with agricultural raw materials, constitute most of the country's exports revenues, with horticultural products, tobacco, oilseeds, coffee and tea, but also sisal, cut flowers and pyrethrum.

With regard to the touristic sector, the main attraction is the Arusha National Park, that is part of the Tanzania Safari Northern Circuit, comprising high-value natural areas in Serengeti, Tarangire and Kilimanjaro National parks and the Ngorongoro Conservation area. **Tourism flow is an important resource for the entire area** and employs over half a million people. However, due to the lack of education, skills, financial resources and investment capacities, its **economic potential is still largely unexploited by local communities**.

Farming systems

Agricultural production in the region is dominated by smallholders, and maize is the most important crop in terms of area planted and quantity harvested (Figure 3). **Most farmers intercrop maize with other staples such as beans, cowpeas, pigeon peas**

and sometimes with vegetables. Commercially grown vegetables target both the domestic, particularly fresh urban markets, and the export market. Main crops grown for domestic markets are tomato, onion, and cabbage. Export markets target the high-end produce of these vegetables and more exotic crops like French beans. The **production of vegetable and flower seeds** has also developed.

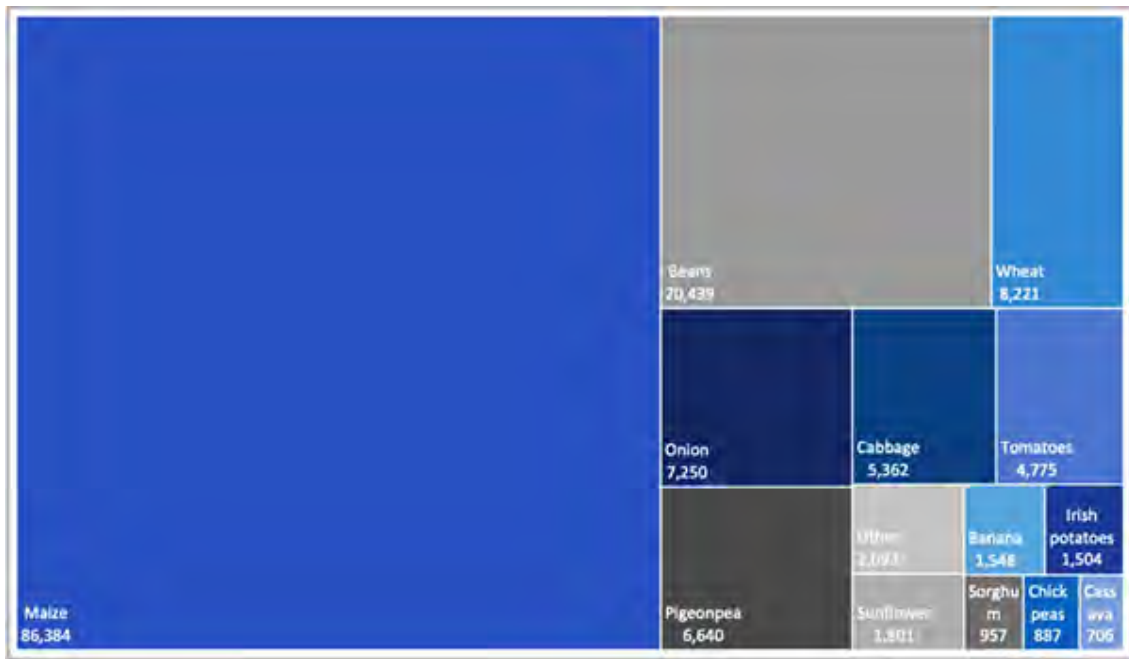


Figure 5 - Main crops produced in Arusha in 2016-2017 (tonnes) (authors' elaboration based on the 2016/17 Annual agriculture sample survey - URT, 2017).

Popular indigenous vegetables include African eggplant, amaranth, mustard, okra, roselle, spider plant, jute mallow, celosia, cowpea leaf, and African nightshade. **The top leafy indigenous vegetables in the researched area in Arusha, common among farmers and produced in large quantities, are African nightshade, amaranth and Ethiopian mustard (Table 1).** A distinct advantage of many indigenous vegetables is that they can be harvested repeatedly², and most farmers devote a quarter to half an acre to these crops.

² Shorter growing cycles (21 days for leafy crops) and prolonged harvest periods are considered to be quality traits of different indigenous varieties because they ensure higher productivity.

Farming: a new challenge for a Maasai family



All the farmers participating in the SASS focus groups produce both for business and consumption, but they report that some farmers only produce for self-consumption.



Figure 6 - Bucket and sack gardens provide vegetables to households in Arusha (by Paulina Bizzotto Molina, ECDPM).

Indigenous vegetable	Average number of harvests	Yield t/ha (SD)
Amaranth	9.7	12.87 (6.27)
Nightshade	5.3	3.85 (0.79)
Ethiopian mustard	4.5	11.64 (8.05)

Table 1 - Average number of indigenous vegetable harvests per year in Arumeru and their yield per hectare (Weinberger and Msuya, 2004).

Certified seeds from individual farmers or farmer groups can only be sold within the ward where they are produced and need to come from formally registered varieties. Intensification of horticulture in Arusha has led to increased **agrochemical inputs use**, particularly among farms producing exotic vegetables for export and domestic markets, while the use of traditional methods of pest management and knowledge about more sustainable production practices is poor. In the last decades, the region has also recorded a **major shift in favour of irrigated horticultural production**.

In addition, **livestock activities play a key role**, and the region records the highest percentage of households involved exclusively in livestock farming in Tanzania (45.2%). Livestock-based farming systems are affected by recurrent droughts and unpredictable weather conditions, and the fast growth of cattle and goat populations leads to overgrazing, pushing herders to shift to alternative livelihood strategies or migrate to southern and coastal regions.

Policies

The national decentralisation reforms started in the 1990s led local government authorities to become the main providers of public services, including healthcare, education, agricultural extension services and irrigation infrastructure. However, administrative and political power still remain relatively centralised.

Although agriculture is considered a key sector for the Tanzanian economic transformation³, **agricultural and rural policies are inconsistent in terms of both objectives and implementation and scarcely benefit poor rural communities**. Policies aimed at pleasing rural voters often contradict measures intended to serve the business interests of politicians or economic elites, thus generating unproductive relations between rural communities and public representatives. Public investment in agriculture is well below the target of 10% of public spending, and the largest part of the budget is allocated to infrastructure, mechanisation and storage facilities and not in agricultural investments. Also, new regulations on bulk procurement of imported fertilisers and seeds brings concerns around the transparency and coherence of some measures. Input policies and strategies are biased towards chemical input-based production systems and subject to the influence of strong corporations, while **biological inputs are less supported, and the role of ecosystem services and biodiversity is largely neglected**. As in other East African countries, policies have focused mostly on crop agriculture and intensive livestock keeping systems, while neglecting the importance of pastoralism for economic growth, livelihoods and sustainable land practices.

Lastly, despite the historical strong commitment of the government to ending malnutrition in the country, food system diversification and indigenous vegetables are currently ignored by health, extension and food security strategies. A key policy for nutrition is the **National Multisectoral Nutrition Action Plan 2016-2021** (NMNAP), implemented by Multisectoral Nutrition Committees at the village, ward, district and regional level. But the NMNAP does not refer to the im-

3 In 2010, the country signed the Comprehensive Africa Agriculture Development Programme (CAADP), aiming to achieve agricultural transformation, food and nutrition security, and economic growth. It implies ambitious targets such as 6% annual growth in agricultural gross domestic product and an allocation of at least 10% of public expenditures to the sector.

portance of indigenous vegetables in achieving diversified and nutritious diets⁴.

Science and technology

Although a constant increase since the mid-1990s, **mechanisation of Tanzanian agriculture is still poor**. The use of hand-held tools dominates, while the use of animal traction or machinery is low, and only 2.5% of the land in Tanzania is under irrigation. Arusha is the fourth region for irrigated planted area, following Kilimanjaro, Dar es Salaam and Mbeya regions. **In Arusha and Meru districts, most farmers practice irrigation and the main sources are surface water, private or village shallows**. The most common technology is stream channels, while stocking rainwater or employing pumps is less widespread, and drip irrigation much less developed.

Poor storage facilities and lack of vehicles for transport also contribute to post-harvest losses and fresh food safety threats. **In Arusha, food storage systems are inadequate**, thus often forcing farmers to sell their crops immediately after harvest, even when the prices are lowest. Worsening conditions of rural roads and the general lack of transportation make farmers isolated from more urbanised markets. Due to gender bias, women in particular have most difficult access to motorized transport options, mobile phones, and modern technologies.

Social organisations

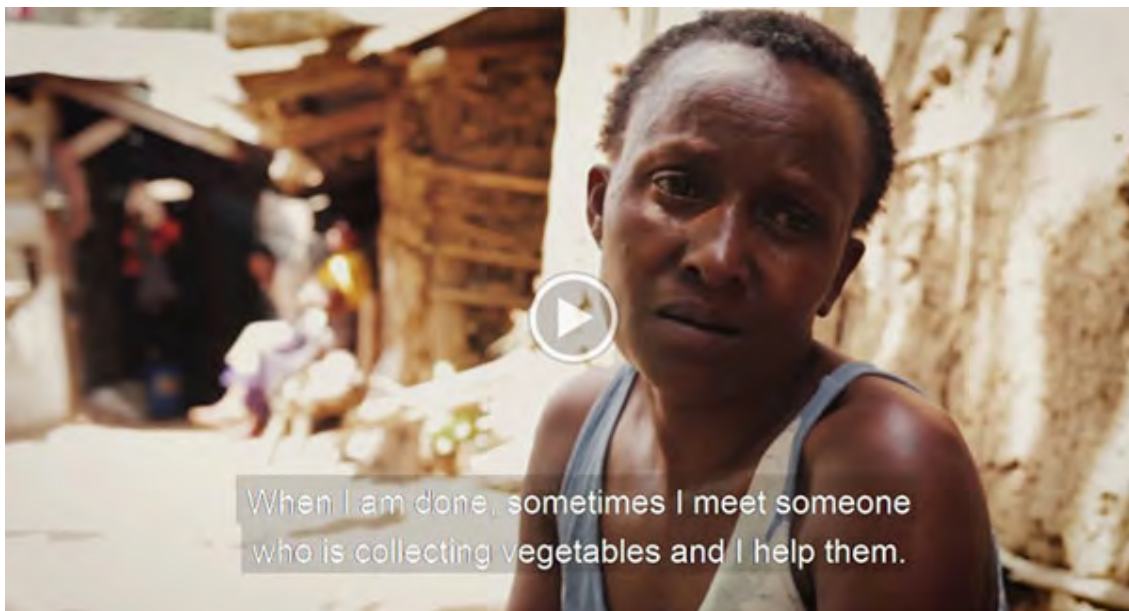
Three major ethnic groups in the study area are Wameru, Warusha and Maasai. The main economic activity of Wameru is small-scale farming. Their response to demographic pressure and the consequent scarcity of land has been the expansion and intensification of agricultural activities around the volcano. Both **the Wameru and Warusha livelihoods are based on complex intercropped farming systems**

⁴ This is different from the case of Kenya, where nutrition policies do refer explicitly to the role of indigenous crops as key nutrient providers.

while, as nomadic pastoralist communities, **livestock is the core sector of the Maasai traditional economy**, although also characterised by occasional subsistence maize cultivation.

With regard to **gender bias**, nearly twice as many women as men aged 20-24 years have had no formal education, and women participate in very few decisions related to their health or household purchases. Also, sexual and domestic violence often goes unpunished. The gender gap is particularly large in the agricultural sector, where women account for nearly half of the workforce (**Figure 4**).

Struggling for the family: Urban farming in Arusha



Women have difficult access to productive assets, finance and formal credit, land and technologies, resulting in lower yields and profits compared to men. Industry employment levels are tiny and male-dominated, while services employment has expanded up to 27% in 2019, with slightly more women than men.



Figure 7 - Vegetable producer participating in a mapping exercise of the indigenous vegetables value chain on the slopes of Mount Meru near Arusha.

Individual factors

The majority of farming households produce both for self-consumption and for the market. **Production for self-consumption mainly consists of maize and represents a key component of livelihoods both in urban and rural contexts.** Tanzania's staple dish is ugali, a porridge produced from grounded or pounded maize, typically consumed with cooked green leafy vegetables. In the last decades, **many farmers started irrigated horticultural production,** leading to higher incomes, intensification of land use, and exacerbation of land and water use conflicts. Other households, in more traditional areas, engaged in rain-fed agriculture using animal traction or tractors and planting maize in former grazing areas, thus increasing their vulnerability to drought.

With regard to urban and peri-urban citizens, research in the Arusha district found that childbearing-age women were deficient for all

micronutrients⁵, **only 16% of women consumed indigenous vegetables, and urban women consumed four times more indigenous vegetables than peri-urban women (Figure 5).**

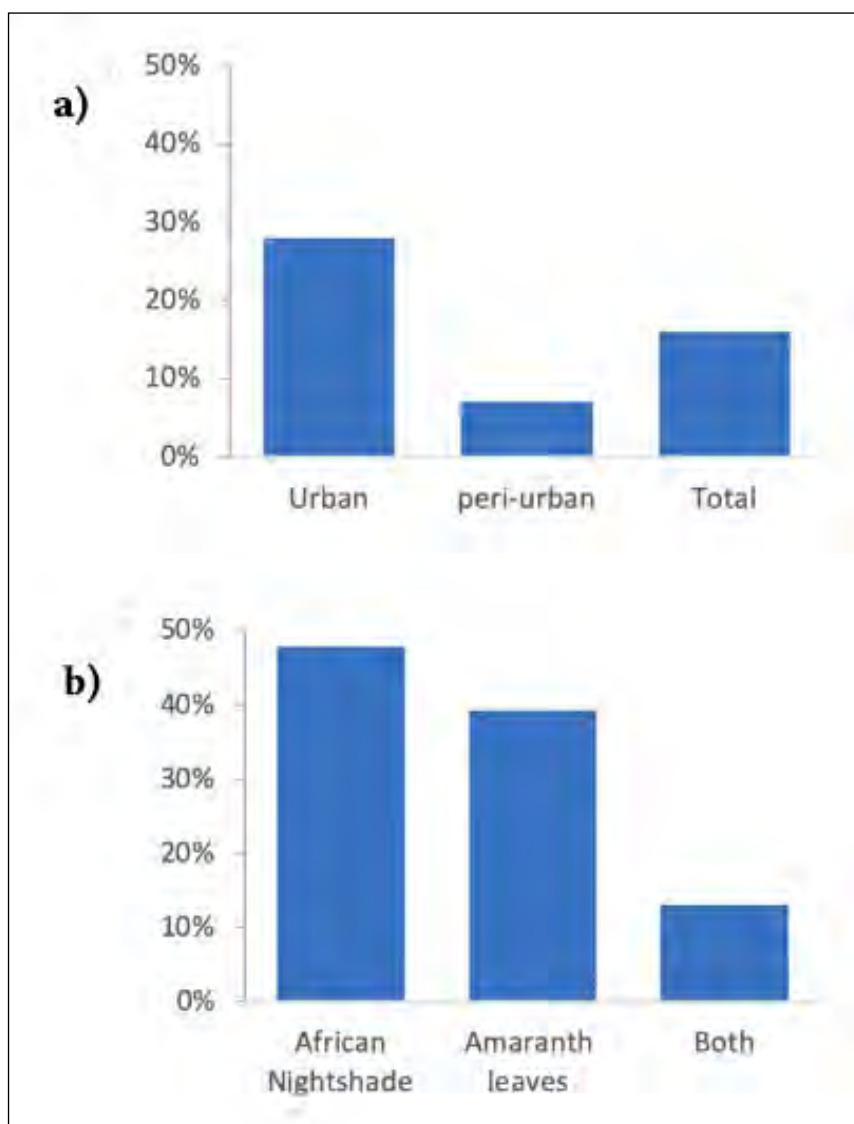


Figure 8 - Consumption of indigenous vegetables among urban and peri-urban women of childbearing age in Arusha district. (UNIPV nutrition team, field research December 2018 - August 2019). (a) Percentage of sample that consumed indigenous vegetables, per area; (b) percentage of indigenous vegetables consumed by sample, per type.

5 Micronutrients include vitamin A, E, C, folate, vitamin B12, calcium, magnesium, iron, and zinc.

1.2. Environmental drivers

According to Van Berkum and colleagues (2018), environmental drivers are defined as natural factors or factors affected by human intervention which directly or indirectly bring about a change in the ecosystem. This section summarises the main environmental drivers that characterise the Arusha region.

Climate

Arusha seasonal pattern includes long rains between March and May (masika) and short rains seasons between October and December (vuli). Mount Meru, by acting as a catchment for rainwater, divides the region into a dryer North and a wetter South. While the higher south-western slopes, where Arusha City is located, receives up to 2,000 mm/year of rain, the northern slopes only record 500-600 mm/year, as to the shadow effect of the mountain. Climate projections indicate an **increase by 1.4°C by the 2030s**, with the West and North-West regions expected to experience faster warming relative to the coastal regions. In particular, **increased rainfall variability** are likely to prolong dry seasons and to **increase the frequency and severity of extreme events**, such as droughts.

Water

Tanzania is officially water-stressed, with agriculture accounting for 89% of Tanzania's water use. Water pollution sources include household waste disposal, particularly in cities, and chemical leakage from agriculture. Water availability becomes less secure due to extreme droughts and flash rains. Recent prolonged droughts (2005 and 2007-09), associated with strong winds, have caused **severe livestock and rain-fed crop losses and repeated food crises**. Considering warming and changes in rainfall, regional predictions suggest that Tanzania may lose 10% of its grain production by 2080, and maize is going to be particularly hard hit. In Arusha, in particular for the

southern region, water is brought by rain and rivers, with distribution shaped by Mount Meru. But its unpredictability acts as a major constraint to agricultural and pastureland productivity. Furthermore, the **water pollution in salt and fluoride coming from households and agriculture** can significantly affect human, animal, and plant health, while **water availability becomes less secure due to droughts**, whose intensity is exacerbated by climate change.

Land and soils

About 46% of Tanzania is suitable for agriculture, translating in 44 million hectares. Much of the arable land is only marginally suitable for agricultural production due to reduced soil fertility, erosion, soil degradation and sensitivity to drought, and only 32% of Tanzania was cultivated in 2014. The cultivated land degrades under high population growth, poor implementation of protection policies, inappropriate use of technologies (e.g. fertiliser use), and poor livestock rearing practices. As a result, **soil erosion and fertility loss are major environmental constraints**.

Arusha's mountain slopes have highly fertile volcanic soils, which are very fragile and prone to soil erosion. At lower altitudes and moving away from Mount Meru, soils become rockier and the layer of fertile soil becomes thinner. In swamps and depressions soils are often unsuitable for agriculture due to bad drainage and very high pH values. **Human exploitation, particularly woodland clear-cutting, threatens the soil capacity to sustain local community development**. High population growth leads to land scarcity and overuse through badly managed intensive agriculture. For example, pesticides (some banned) are widely available but knowledge of proper handling is lacking, resulting in overuse, biodiversity loss, reduced crop diversity, and soil fertility.

Biodiversity

As a part of the Tanzania Safari Northern Circuit, the Arusha region is enriched by the presence of natural parks and conservation areas, such as the Arusha and the Kilimanjaro National parks, the Mount Longido and the Mount Meru Forest Reserves. With regard to main environmental threats, **land-use change, primarily driven by agriculture, forestry, and urbanisation, is the largest driver of biodiversity loss.** Of note, while food systems impact ecosystems, food production is highly dependent on local environmental conditions.



Figure 9 - Tanzanian natural landscape (by Paulina Bizzotto Molina, ECDPM).

Significant impacts on animal and plant biodiversity, soil fertility and functional biodiversity come from different farming practices, including field management, cultivated crops, use of chemicals and technological inputs, and use of livestock antibiotics by agro-pastoralist, that may affect the soil fertility through their impact on the functional biodiversity of soil microbes. Beside the need for a spreading of biological input-based farming systems, **the region includes gardens and horticultural productions areas acting as critical**

ecological corridors for many animal species, supporting biodiversity and ecosystem conservation. Themis Garden is an example of such corridors⁶.

6 Arusha City Council has worked on a City Master Plan for sustainable urban development since 2015, including the creation of many green areas to preserve biodiversity and ecological corridors, mainly along the river stretches crossing Arusha. However, the Plan is still awaiting implementation. Limited central funding, weak local government financial capacity and ineffective revenue collection are outlined as key challenges.

Chapter 2

Activities and governance of the food system

The second Chapter aims at providing the reader with an overview of the main activities involved in the Arusha food system, with a particular focus on indigenous vegetables, and to describe the complex linkages connecting the variety of actors that influence the way food is produced, processed and marketed. Actors include farmers, institutions, agribusinesses, transporters, traders, food industries, wholesalers, retailers, and consumers.

2.1. Activities

In order to better contextualise the actor mapping description, the topic is introduced by the analysis of key factors that help to seize the actors' environment and manoeuvre margin, with reference to enabling environment, food environment, extension services, farmers organisations, and consumption pattern.

Enabling environment

Enabling environments refer to the government coordination, accountability and effective responses power necessary to reach their goals, through regulating bodies, research infrastructure, transport networks and institutional arrangements. Main Tanzanian regulating bodies include regulating and certifying agencies and multi-sectoral working groups on nutrition. Among institutions, the Tanzania Food and Nutrition Centre was established in 1973 to initiate, coordinate and catalyse nutrition activities in the country.

In this video, a worker at the Tanzania Agricultural Research Institute says that proposals for national policies have to come from and reflect the root problems faced by small farmers



However, while food system relevant policies are set by the ministries, local governments still have a significant mandate in policy implementation and budget allocation, with decision-making power vested in the local Councils. However, **the gap between policies and practice in Tanzania is significant**. Trying to face this issue, the Arusha City Council is currently supported by organisations and NGOs such as Rikolto and Trias in the assessment of food safety risks along the vegetable chain. More details about the project are given in **Box 1**.

Box 1: The Arusha Food Safety Initiative

In 2018, the Arusha City Council – supported by the Belgian NGOs Rikolto and Trias, the Dutch NGO Solidaridad, the Tanzania Horticulture Association (TAHA), and the network of local governments ICLEI – drafted an Arusha Food Strategy, aiming at providing healthy food to the consumers in and around Arusha, while increasing market opportunities for farmers. One of the pillars of the Strategy is the Arusha Food Safety Initiative. As part of this Initiative, Rikolto, together with farmers’ groups and the Tropical Pest Research Institute (TPRI), is conducting an assessment of food safety risks (chemical, biological, physical) throughout the fresh fruit and vegetable chain ‘to identify the hotspots for action’. Good storage and safe application of pesticides are key focus areas. **The initiative should work as a pilot to develop and test a national food safety standard to guarantee the production of safe vegetables and fruits.** Training on food safety to vendors and awareness-raising on food safety risks for consumers at food stalls in local markets are important components of the initiative. Main actors in the Tanzanian **national and international research infrastructure** are Sokoine University of Agriculture, the Nelson Mandela African Institute of Science and Technology, and the Tanzania Agricultural Research Institute (TARI). In particular, TARI is made up of different agricultural research institutes with focuses on specific crops (often cash crops such as coffee and cotton, but also staples such as rice and Irish potato) and provides research support to designated zone t the international level, players include the **World Vegetable Center** and a large group of international al local NGOs, and other types of civil society organisations. Lastly, **as a result of poor minor and rural roads maintenance and high transportation costs, many rural areas are remote from markets**, critically reducing farmers’ ability to sell their products. The absence of public transport makes farmers dependent on traders and intermediaries (e.g. entrepreneurs owning

trucks, lorry drivers, porters), that provide transport services from the production areas to the markets⁷.

⁷ Lotter (2014) finds that average distance to market was 11.5 km, taking one hour generally inside a passenger van (48%), a hired truck with covered bed (29%), or bicycle (13%).

Food environment

The food environments shape the constraints and influences on consumers' food choices, including food availability, physical access, affordability, and nutrient quality. **Arusha's food environment has a mixture of traditional and modern markets, with the former dominating the sale of fresh fruit and vegetables**, whose selling activities are female-dominated. Food can be sold in small markets and shops, including wet markets and hawkers, or in large shops and supermarkets. With regard to the large differences in social profiles and kind of products, **Table 2** describes the Arusha's central market – an example of traditional wet market dominance in the fresh fruit and vegetable segment – and Shoppers Plaza – an example of the recent supermarket revolution in Arusha.

Name	Description	Social profiles	Products' range
Central market	The Central market consists of stalls under large sheds. The central building hosts shops and bars.	Women dominate the external stands while men trade inside the market. The market benefitted from a 2017 deregulation of retail trading, and an initiative to support female entrepreneurship.	Fresh fruit and vegetables, meat and fish, seeds, very few processed products, and kitchen tools.
Shoppers Plaza	The Shopper is a franchise of Indian origin with supermarkets in Tanzanian regions such as Arusha, Dar es Salaam, and Iringa.	Customers are mostly foreigners, but the number decreased dramatically while the formation of Tanzanian middle class stalled.	The Shopper offers a wide range of mostly foreign goods. Prices are similar to British supermarkets and frequently displayed in both shillings and pounds. The prices are three times the average of traditional markets, which excludes most citizens.

Table 2 - Features of Arusha's central market and Shoppers Plaza (UNISG fieldwork, 2019).

Leafy vegetables follow a slightly different supply chain than other vegetables. While they are sold throughout Arusha, **leafy vegetables are brought straight to the markets, without going through aggregation markets, because of their high perishability.** The main wholesale market for leafy vegetables is, before sunrise, a dedicated area at the **Samunge market**, without any shed or pavement. After sunrise, the area becomes a regular retail market section. Other important markets for leafy vegetables are Kilombero and the Central Market in town, and Tengeru Farmers' market, held in the suburb west of Arusha.

Given its availability and affordability of fresh food, the central market is a key factor for the diet of Arusha's urban citizens as it provides a rich array of nutrients. The market crucially supports rural livelihoods as it connects urban consumers with rural producers (**Figure 10**). However, space is limited and newcomers crowd around the market. Across all social classes, the market is the one-stop for Arusha's citizens buying and selling food. In particular, **the Arusha traditional market, with rich social connections and informal networks, is able to connect urban diets and rural livelihoods.**

Arusha has a higher share of international products compared to Dar es Salaam, and more food processing. In Arusha, there are now **three medium-large supermarket chains**, which are mostly frequented by local elites or foreigners as most individuals and households cannot afford the fresh fruit and vegetable mark-up. **Indigenous vegetables are scarcely sold in Arusha's supermarkets.** This does not reflect a bias against indigenous vegetables but rather **results from the supermarket's limited role in fresh fruit and vegetables** across all social strata. Even if local elites buy some fresh fruit and vegetables at supermarkets, most of their fruit and vegetable needs are met at the wet markets.



Figure 10 - Arusha's central market, women's section (by Carmen Torres Ledezma, ECDPM).

Public services for farmers

Public extension services provide small-scale farmers with information on agricultural technologies, sustainable practices and farm management skills. However, the service is substantially falling. **Most extension advice is skewed towards the use of agrochemicals and improved seeds, crop storage, pest control and inorganic fertilisers, while training on how to convert to organic or conservation agriculture is still very limited.** Also, **the potential of indigenous vegetables production is hardly recognised among extensionists**, as little knowledge or training is provided to them regarding their benefits and optimal production practices and technologies. **Tanzanian farmers have relatively strong access to extension services**, due to the low budget allocated, the small number of officers, and poor working environments, including a lack of reliable means of transport to reach farmers, and limited financial support to carry out field demonstrations. As a result, extension officers at ward

and village level often lack access to training and refreshment courses, resulting in farmers getting information from the private market, such as input suppliers⁸.

Cooperatives and self-help groups

Generally, only a formalised and registered organisation, such as cooperative societies, can access financial support from donors or loans from microfinance and bank institutions or take part in government or NGO development programs. However, **after the long history of top-down state cooperatives, most farmers in Tanzania still mistrust cooperative societies, largely preferring other forms of organisation.** These include various farmers' groups which can be either formally registered with a village or district authority, either loose informal associations of farmers that act collectively to purchase inputs, bring their product to the market, and exchange advice. Also, for specific purposes or target people, **self-help groups and women associations are established among small producers at the grass-root level.** Their establishment is often supported by an external agent, such as an NGO, that provides the initial tools and know-how to help marginalised categories of the community establish stronger social networks.

In Arusha, only a few small-scale producers are organised in formal, market-oriented structures, but most are not. Of the households sampled by UNIMIB sociologists, only about a third belong to a social organisation. The biggest category are women organisations, followed by common interest groups, self-help groups and farmers' organisations. The most common services referes to facilitated access to credit, profit sharing, and access to extension advice, as well as saving account, access to farming inputs and business advice.

8 Biased incentives of private sector actors contribute to maintain the current situation and hinder farmers' decisions to invest in more sustainable practices. For instance, large international input suppliers such as Syngenta and Monsanto invest significantly in extension services and field demonstrations, pushing towards a 'conventional' model of agriculture highly dependent on external inputs.

Consumption patterns

Despite the wide variety of food produced in the country, diets are often monotonous with limited diversity, and generally based on starchy foods with high fibre content such as cereals (maize and sorghum), starchy roots (cassava) and pulses (mainly beans), which supply almost three-quarters of total energy. Consumption of micronutrient dense foods such as animal products and fruits and vegetables is low. **Consumers have a strong preference for maize** over drought-resistant grains like sorghum and millet. Annual per capita consumption of maize is estimated at 135 kg, followed by rice and maize, that is mainly imported. While the staples of the Tanzania central regions are mainly maize and sorghum, the Arusha and Kilimanjaro regions seem to consume mostly plantain. **Wheat is consumed more by wealthier urban households**, usually as flour or through products like pasta, breakfast cereals or chapati. **Rural and pastoralist communities rely more on sorghum and millet.**

Consumption patterns of rural and low-income urban residents depend on seasons and face the seasonal food insecurity by lowering of quantity or frequency of meals⁹. Most food is bought, even in rural areas, and processed. Although Tanzania's obesity is low, **high and middle-income groups increasingly replace traditional vegetables with imported highly processed food** resulted in a 37% increase in adult obesity from 2012. Meanwhile, as a result of poverty, low food knowledge, and socio-cultural factors, the population is dominated by extremely low and low-income households for which dietary inadequacy results in all forms of malnutrition (**Box 2**). Likewise, **the low indigenous vegetables demand originates from a lack of nutrition education**, including a basic misunderstanding of nutritional needs versus hunger, generational norms and misconceptions, low awareness of proper cooking techniques (e.g. cooking vege-

9 While two meals are common in the harvest months, the lean months are often characterised by just one meal a day. Meat and milk consumption are extremely low, being on average once a week or less and, in certain communities, once a month or less.

tables too long to reduce their bitterness or cleanse them from pesticide residues, leading to significant nutrient loss) and cultural perceptions, such as indigenous vegetables perceived as ‘poor people’s plants’, and deep-rooted food taboos concerning the effects of certain vegetables on male reproductive capacity (insert link to video ‘Camba’). In general, indigenous vegetables such as amaranth and Ethiopian mustard are often more affordable options for poorer households.

Box 2: Food and health in Arusha and indigenous vegetables benefits

Although Arusha has a great availability of diverse crops and favourable soil and climate conditions, **about 39% of the region households are food insecure**. Coupled with the high food insecurity is a low dietary diversity: starchy staples, especially maize, provide up to 70% of total energy intake, with limited consumption of meat and vegetables. As a result, **Arusha has slightly higher malnutrition than Tanzania’s average**. It has been argued that Arusha’s food and nutrition challenges stem from poor infant care and feeding practices due to: lacking basic nutrition education, families do not optimise the plentiful nutritious food in Arusha; food waste, due to inexistent post-harvest agro-processing; and health issues, which hamper the biological utilisation of food and nutrients.

As regards the increasing consumption of highly-processed food by the high and middle-income groups at the expense of traditional vegetables, while lowering the risk for undernourishment, this diet can be less nutritionally adequate than the traditional diet.

Diversifying diets with indigenous vegetables is a sustainable way to supply many nutrients while combating micronutrient malnutrition and associated health problems, particularly for poor urban and rural households, by helping undernutrition and overweight, but also for high and middle income groups (for whom obesity, diabetes and cardiovascular diseases are increas-

ing). **Traditional vegetables are a vitally important source of micronutrients, fibre, vitamins and minerals and are essential components of a balanced and healthy diet.** In addition, indigenous vegetables can be better adapted to the environment than standard vegetables, and thus can provide low-cost quality nutrition to a large population segment.

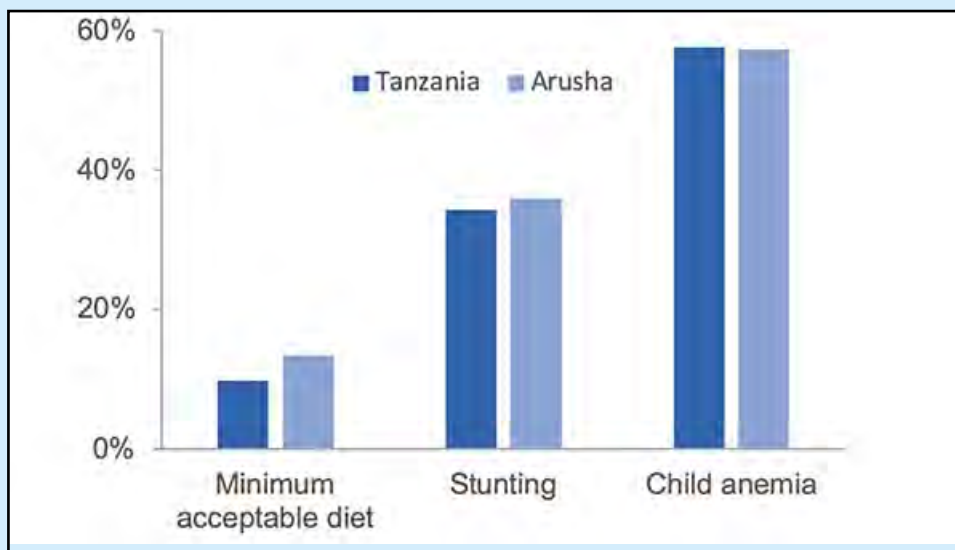


Figure 11 - Child nutrition in Tanzania and Arusha through stunting (6-23 months), minimum acceptable diet (6-23 months) and child anaemia (6.59 months). (2015-16 Demographic and Health Survey and Malaria Indicator Survey).

2.2. Food system governance

An important component of the research into the governance dynamics of the food system entails mapping the main actors and understanding their connections. Each actor engages in a variety of practices and relationships that, consciously or unconsciously, regulate how the food system functions, ultimately determining its outcomes in terms of economic, social and environmental sustainability. Our objective is to identify key entry points to catalyse change in the food system outcomes by, for example, strengthening weak linkages or addressing gaps in the system. An overview of main actors involved in the Arusha food system is given in **Figure 12**.

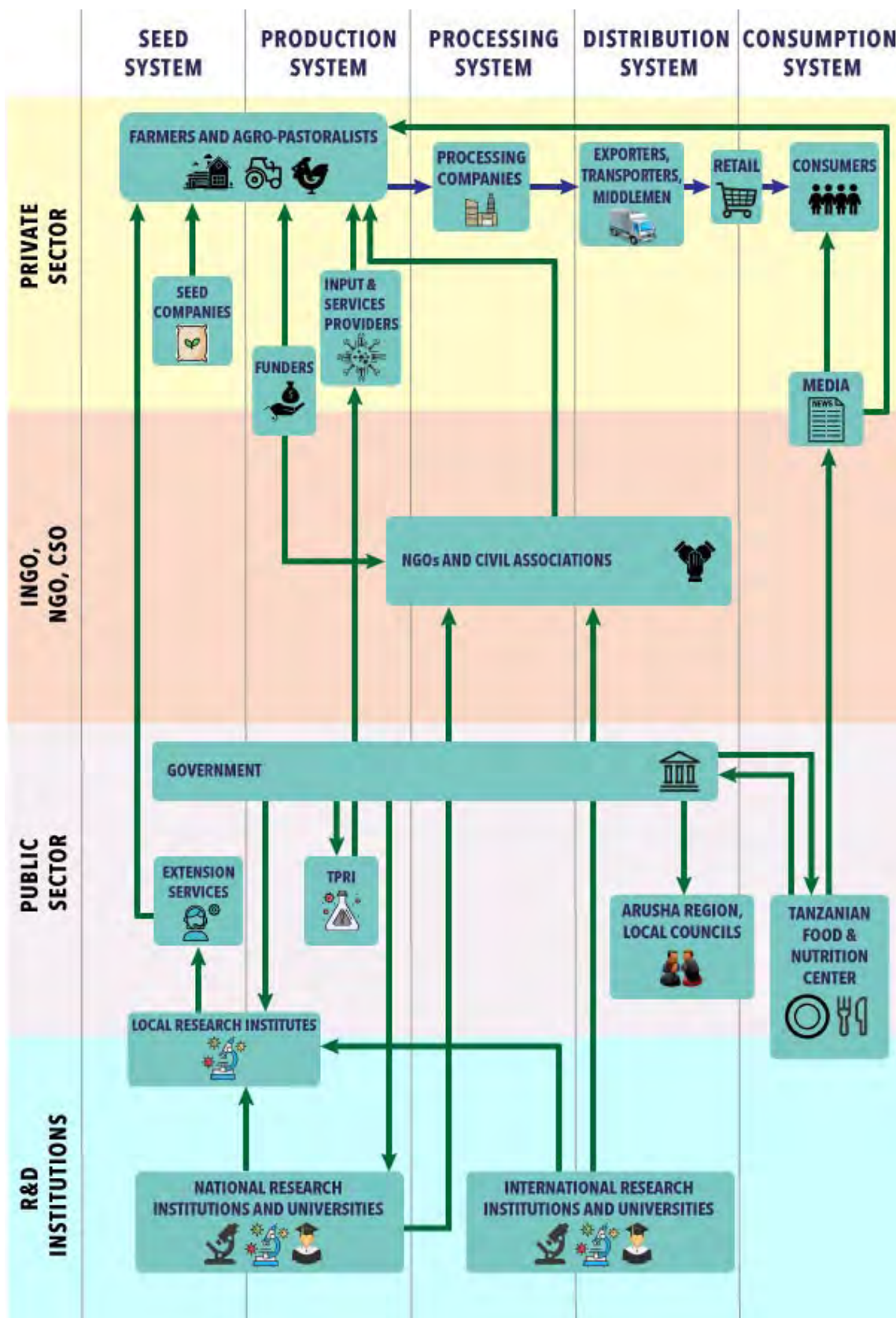


Figure 12 - Overview of the main actors in the Arusha food system and their interlinkages with reference to decision making, financial and knowledge flows (INGO: International Non-Governmental Organisation; CSO: Civil Society Organisations).

(i) The seed system – Around fifty-four **seed companies** operate in Tanzania, and thirty of them are involved in vegetable seeds. Many companies target Tanzania as an outlet market as for the huge number of smallholders, rather than to invest in agricultural production straight. Currently, twelve companies active in Arusha also produce or sell seeds for indigenous vegetables, and three companies export to Europe. Some of them are also involved in initiatives to develop the vegetable value chain and vegetable seed production value chain in Tanzania and Arusha Region, such as **RijkZwaan** and **East-West Seeds**. Many of the improved varieties of indigenous vegetables grown in Arusha have been developed by the **World Vegetable Centre**, an international research centre with programmes on seed breeding, vegetable value chain, healthy diets and impact assessments.

Currently, as for most crops in Tanzania, **informal seed networks are the major source of indigenous vegetable seeds, but they are often unable to provide reliable, good quality cultivars**. This is due to a lack of information about optimal production methods, limited availability of improved varieties, and insufficient support systems. **The formal market**, on the other hand, **seems to play an increasingly important role** as a source of affordable certified quality seed of indigenous vegetables. SASS researchers found that, while in 2004 there were only three companies in the indigenous vegetables seeds sector in Tanzania, the market has grown dramatically since then, with at least twelve companies mapped at present.

(ii) The production system – The Tanzanian horticultural sector is dominated by **small-scale producers** with plots smaller than two hectares, and by less than thirty **large-scale producers** that active in the country. Medium-scale farms are on the rise, occupying five times as much farmland than large-scale farms and almost as much as all the small-scale farms considered together. In general, both at a national and regional level there is a low level of farmer organisation, although some cooperatives, self-help groups and marketing associations are active in the Arusha region.

Competition amongst large horticulture companies exporting fresh vegetables is high, as fertile land is scarce and businesses compete in sourcing from the few small-scale producers able to meet the high standards required in terms of quality, quantity and consistency. **More companies are active in the horticulture sector** targeting export markets, and **input providers and agro-dealers** supply the sector with a range of pesticides, fungicides and fertilisers. The Tropical Pesticides Research Institute (TPRI) is mandated to enforce proper use and handling of chemical inputs through routine inspections, while in practice it is mostly agricultural extension officers and agro-vet dealers that provide information to farmers on how to use agrochemicals. In general, knowledge of the proper handling is lacking, leading to both environmental and human health risks for producers and consumers¹⁰. There is also a lack of improved organic inputs in the market, which pushes even organic farmers to resort to chemical inputs. **The principles of organic and/or conservation agriculture are disseminated mainly in the context of NGO or development agencies funded projects**, such as the **Mesula network** (described below in **Box 3**) or by farmers' groups.

In general, small-scale farmers in Tanzania often have **weak power positions** and linkages in the value chain. They depend on input and credit providers and effective extension support to start the planting season. Then, during the harvesting period, they depend on traders to commercialise their production, as they are often scattered and removed from the main output markets. **Producers in Arusha are poorly coordinated and supported by weak alliances among themselves as well, thus being ultimately driven by the agendas**

10 Chemicals' misuse is significant and mainly due to limited knowledge of safe application rules (e.g. failure to understand container labels or instructions regarding the use of protective gear). Products are often used without any direction and control and mixed among them disregarding compatibility. Spraying is frequently done in the wrong weather conditions, without wearing any protective clothing or caring for the proximity of people or animals. Applicators are cleaned in water channels and empty containers sometimes re-utilised (Istituto Oikos, 2011).

of the rest of the actors in the value chain, particularly input providers and middlemen.

(iii) **The processing system** – Arusha has a **well-established food processing and transformation industry** compared to national standards. However, there is a significant difference between urban and rural areas in terms of the level of activities. Relevant for the horticulture sector is **Darsh Industries**, the biggest tomato processor in Tanzania, producing several consumer products such as ketchup and tomato paste. They work with out-growers in and around Arusha, who are facilitated to grow hybrid tomato varieties, supplying improved seeds and inputs to the farmers, working together with local seed companies.



Figure 13 - Women selling fresh vegetables at the market (by Cecilia d'Alessandro, ECDPM).

Despite drying indigenous vegetables requires feasible simple solar techniques, **drying activities are not widespread**, and mostly at the

household level for direct home consumption. In general, **indigenous vegetables are sold fresh and loose at the market (Figure 13)**, sellers have no access to refrigeration means, and seem not to be interested in such technologies (**Box 3**). At a larger scale, there are some farmer groups that are active in drying indigenous vegetables to sell in Kingori, their nearby village west of Arusha. **MACE Foods**, a Kenya-based company processing dried spices and vegetables for the East African and diaspora market, is starting to source indigenous vegetables from producers from the Arusha area.

Box 3: Processing and value addition in the indigenous vegetables chain

Proper handling and processing of indigenous leafy vegetables in Arusha is very limited, and most vegetables are sold fresh, loose, and without packaging. Farmgate buyers harvest indigenous vegetables themselves and bear the costs of harvesting and packing. Most retailers and some wholesalers divide the vegetables purchased into small bundles tied with plastic rope or banana plant fibre. Most vegetables received are packed in polyethylene bags of around 50 kgs. Value addition is absent and indigenous vegetables are mainly handled and sold fresh, loose and not sorted, particularly amaranths and African nightshade. Harvesting is carried out in the late afternoon to prepare the vegetables for early morning transport to the market. Of the growers sampled, 60% did not wash the produce, while others washed with tap or drinkable water, or used non-drinkable flowing water from streams and irrigation canals. Culling with one sellable grade was done only by 31%, the remainder cull in the field by selective harvesting of desired plants. The majority of the sellers/producers bundled the indigenous vegetables with a fibre tie, while the remainder was sold loose. Packaging for transport generally consisted of nylon-reinforced plastic bags with a small percentage using the same type of bag inside a basket. Pre-transport storage averaged

8.6 hours (overnight). **None of the sellers had access to refrigerated storage, which generally does not exist in Tanzania's public markets.** When asked how much they would pay for each half-day of refrigerated storage for 5 kg of produce, 70% of sellers could not answer or were not interested, and this percentage rose to 100% in Arusha. In terms of value addition, 40% of sellers did no processing. Some slicing, crushing and sun-drying processing was reported for cowpeas, pumpkin and sweet potato leaves.

(iv) The distribution system – Distribution and trade in the Arusha food system is mostly characterised by **informal traders**. Nearly two-thirds of Tanzanian farmers sell their produce at farm-gate rather than carrying it to a nearby market, and generally **small-scale traders** aggregate, produce and bring it to markets. Often, establishing formal organisations of informal actors is difficult to achieve. Only a few traders' associations offer a platform for more informal traders at the market level. The **Tanzania Chamber of Commerce, Industry and Agriculture** represents formalised traders and shopkeepers in Arusha, with the goal to stimulate the local government to take into account the interest of small-scale entrepreneurs, by supporting people in issues around registration, taxation, and rules around import. In the case of maize, an important role is played by the **National Food Reserve Agency**, which enters the market during major harvest periods to buy maize. The Kibaigwa market near Dodoma is the main physical maize market in Tanzania, while the main source of fresh fruit and vegetables for rich and poor households in the city of Arusha are small-scale **vendors** and wet markets. In Arusha, Samunge is the main wholesale market for leafy vegetables, counting some 3,500 traders of which three quarters mostly sell horticultural products. Bigger marketplaces such as the Central market and Samunge are managed by **market authorities** together with **traders' associations**. **Supermarket managers** are currently deciding not to stock indigenous vegetables.

An important ‘homegrown’ player catering for the horticultural sector geared towards export is **TAHA Fresh**, providing logistics services to companies, by facilitating clearance, air and sea freight and trucking to different export markets offering a ‘one-stop-shop’. Rare initiatives in Arusha trying to develop the market for products in the region of Arusha include **Mesula (Mount Meru Sustainable Land)**, a network of producers started from a partnership between **Oikos East Africa** and **Istituto Oikos**, whose initiatives are described in **Box 4**.

Box 4: Mesula network initiative and Participatory Guarantee Systems

Mesula (Mount Meru Sustainable Land) is a network of producers initiated by Oikos East Africa and Istituto Oikos and two Italian funders. **Oikos East Africa** is a Tanzanian NGO with Italian roots working closely with **Istituto Oikos**, based in Milan. The Mesula initiative started as a social enterprise, contracting farmers that have been trained by the company itself in organic horticulture and linking them to consumers and the hospitality sector (mostly expatriates and high-end consumers).

In Arusha, the Mesula organic farmers’ network has achieved organic certification through **Participatory Guarantee Systems (PGS)**, that are certification systems for organic products based on trust mechanisms and the active engagement of stakeholders, particularly the producers, who participate directly in the development and implementation of standards and control mechanisms. They are **mostly designed for small-scale farmers relying primarily on local markets and direct selling relations**. Besides providing a credible guarantee for the organic quality of food, PGSs contribute to expand local markets for organic products, encouraging a closer interaction between producers and consumers and guaranteeing a fair return to producers.

Due to the increase in fiscal rules and regulations and the unpredictability their enforcement, the institutional set up of Mesula has fundamentally changed. Thus, Mesula is no longer a company, but in practice has become the brand name for the network of farmers that have achieved organic certification through the project. An entrepreneur now buys and sells the produce of Mesula farmers as an independent trader and hosts the monthly Arusha Farmers Market, still at the grounds of Oikos East Africa.

Leafy vegetables, which are **highly perishable and generally sold unprocessed**, are characterised by short value chains, with most trade happening at farm-gate and in retail and wholesale open-air markets. Critical factors include **unpredictable supply and demand**, and the **volatility of the market price**. The leafy vegetables chain lacks cold transport and thus long-distance trade is rare. Most trade in indigenous vegetables is informal. While formal standards and registration for market access of indigenous vegetables exist, enforcement by the relevant authorities is low and so is compliance. In general, the **vertical linkages between farmers and traders are hampered by information deficits, market weaknesses, and infrastructure challenges**. Also, horizontal linkages between traders are scarce, but, compared to farmers, they are a more self-aware and organised category, and this helps them get better deals on the market.

(v) **The consumption system – Tanzanian diets are characterised by high levels of starchy foods**, while fruit and vegetable consumption is deemed insufficient to provide adequate nutrient intake. Together with the lack of nutritional education, another barrier to increased consumption of fruits and vegetables is the widespread concern for food safety hazards, particularly high levels of pesticide residues, which spur Tanzanians to not eat raw vegetables from the market. The risk of biological contamination is also significant, due

to the **absence of suitable storage facilities and scarce hygienic conditions provided by market infrastructure**. As regards affordability, fruits and vegetables are often more expensive per calorie as compared to starchy staples and do not provide the same perception of satiety as high-protein sources or fats.

In this video, a woman shows how she chooses to cook mostly maize porridge for the family due to its high nutritional values



The existing demand for indigenous vegetables is still low. The evidence available indicates that the low daily use and consumption of indigenous vegetables is largely a problem of low consumer awareness about their importance for nutrient provision, rather than insufficient availability.

In Arusha there are **no consumer organisations** playing a role in safeguarding consumer interests. Community health workers play an important role in nutrition awareness. Social and behavioural change are part of the **Mboga na Matunda** NGO program and other Feed the Future programs such as **NAFAKA** (grain in Swahili). The former is the fruit and vegetable value chain programme part of USAID's global Feed the Future Initiative¹¹, mostly targeting small-scale producers and other actors in the value chain, and NAFKA is the program focused on staple crops in Tanzania. The programs in support of the

¹¹ USAID, United States Agency for International Development.

vegetable value chain development include **Vegetables for All project**, a Dutch funded project that is currently focused on behaviour change related to the consumption of fruit and vegetables in the north of Tanzania, with the aim to improve the availability, affordability and consumption of nutritious foods by families.

Among news channels, press and local audiovisual media report on food safety scandals. **Local radios** are often linked to **religious communities**, and religious and community radio stations have considerable reach and impact in awareness around food safety, nutrition and even agricultural and environmental issues. Increasingly, **social media platforms** play a role in informing consumers about health and food safety. The Swahili forum is an example of a new information channel that can be relevant to reach households and individuals. The World Vegetable Centre has used **community radio** successfully to raise awareness of the nutritional value of indigenous vegetables. Local newspapers are an important source of information, but mostly for urban, middle-class consumers, while they have much less reach in the rural areas around Arusha city.

Chapter 3

Outcomes of the food system

In this section we summarise the SASS analysis of the the food system performance in Arusha with respect to the main sustainable development dimensions, namely Economic, Social and Environmental sustainability (see **Figure 1**), and the Food quality, availability and access.

3.1. Economic sustainability

Agriculture is a key economic sector in the Arusha and vegetables target both the domestic and the export market. The larger horticulture companies provide jobs through direct employment and contract farming. Arusha also has a well-established food processing industry, an important tourist flow, and the region acts as a crucial trade hub for Kenya and East African Community. These **favourable conditions contribute to a lower level of poverty than in the rest of Tanzania**. However, **policies still fail to effectively benefits poor rural populations or the agri-business environment**, also affected by many factors such as bad road infrastructures and scarce economic financing. Moreover, the heavy reliance on rain-fed crop production systems increases the risks faced from precipitation changes,

highlighting the reality of **climate change as a major threat to agri-business**, especially for smallholders' livelihoods.

3.2. Social sustainability

Positive social factors in the region include the lack of open conflicts and a higher life expectancy than country average but, although significant gains occurred in recent years, **quality of health care system and level of education are still low**. Diet diversity is poor, and **high level of malnourishment** remains a serious problem, especially among women and children. The situation gains even more value considering the young age structure of the Arusha population and that women are now accounting for the majority of the horticulture labour force. Together with high fertility rates, these factors put structural pressure on job markets and social service delivery. Social sustainability is threatened by **strong gender disparities**, with higher unemployment rates and lower incomes among women, small-scale farmers' poverty, and by **persisting regional disparities and gaps between urban and rural areas** in terms of access to basic services.

3.3. Environmental sustainability

While favoured by **fertile mountain slopes and relatively constant water availability** and embellished by precious natural areas, Arusha environment is under several threats. Demographic growth, urbanisation and agriculture activities are putting pressure on land, soil and water resources. Water availability is endangered by the progressive **effects of climate change and increased rainfall variability**, and increased productivity from chemical input-based production systems comes at the expense of natural resources availability and quality, leading to **biodiversity loss, reduced crop diversity and soil fertility**. For instance, **fertiliser and pesticide use**, in the absence of preliminary soil tests and capacity building of farmers and extension workers, contributed to environmental degradation. Lastly,

with regard to the impact on biodiversity, strengthening of green area and urban garden is planned to support urban biodiversity conservation.

3.4. Food quality, availability and access

Low dietary diversity, increased population pressure and gender biases threaten the sustainability of Arusha's food system. The **inappropriate use of agrochemicals in horticulture, the spreading of irrigated horticulture and low adaptation to climate change** are particularly dangerous for medium to long-term sustainability. **Food safety standards and regulations suffer from a lack of regulatory enforcement and coordination for implementation**, especially regarding the use of pesticides. **Predicted climate changes will significantly impact food production** as well: warming and changes in rainfall will diminish water availability for crops, shorten the growing season, and increase crop losses due to weeds, pests and diseases, a consequence of increased temperatures. Grain production, and maize in particular, are expected to be particularly hard hit in the next decades, thus putting the Arusha livelihood at serious risk.

In this video, an agriculture extensionist specialist explains how creating more awareness about the nutritive values of traditional vegetables can help spread these overlooked vegetables, which have proved to be very resilient to different climates



In general, **the economic, social and environmental sustainability of the Arusha food system seems to be poor.** Seen the weakness of interlinkages among several food system actors, the smallholder farmers' fragility and isolation from markets and governance, social inequalities, and the current absence of innovative strong coalitions and diversification of agri-business, moderate advantages of the region in terms of environmental and economic resources cannot work out enough to face future global and local challenges, such as the impact of demographic growth and the effects of climate change.

Chapter 4

Pathways towards a more sustainable food system

As described in the previous chapters, the efficiency and safety of the Arusha food system is currently undermined by several interconnected factors across different actors and activities. A comparison of the main mechanisms and characteristics between conventional horticulture and indigenous vegetables in the Arusha region is summarised in **Figure 14**.

Based on our analysis, here we suggest and discuss four preliminary “pathways to solutions” with the aim to suggest possible solutions to overcome main drawbacks of the current Arusha agriculture system towards a more sustainable food system in the region. Based on the analysis of the current food system, four promising entry points were developed into pathways for solutions, that are categorised by governance, production, distribution, and consumption domain.

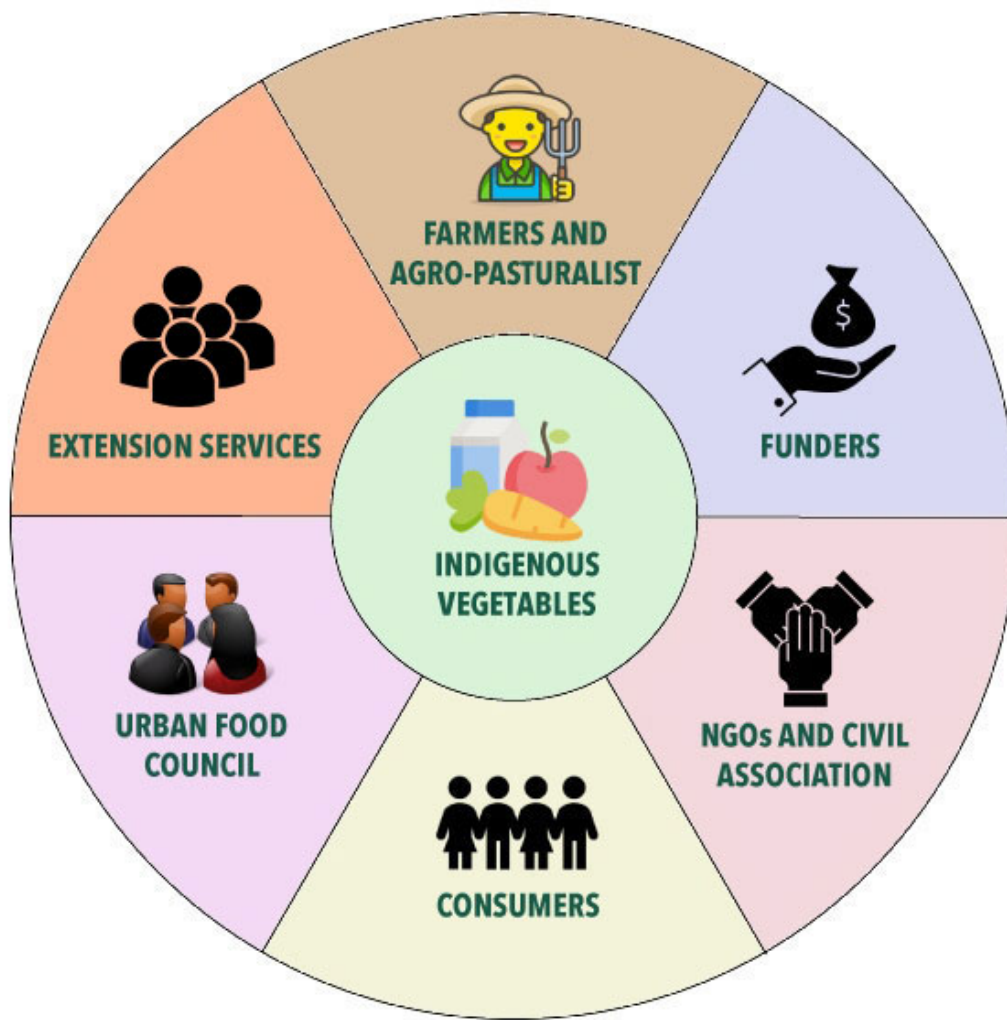


Figure 14: Main actors proposed for coalitions targeting stronger support for indigenous vegetables and efficient local value chain in the Arusha region

4.1. Improving the indigenous vegetables value chain

Pathway 1 - Governance: Multi-stakeholder platform for stronger chain governance

The integration of indigenous vegetables in Arusha’s food system is hindered by several factors concerning the weak internal and external governance of the value chain. In order to overcome the conflicting in-terest between political and economic elites, the general inconsistency of policies and biases, and to favour dialogue and trust among chain stakeholders and with external partners, a **dedicated multi-stake-holder platform can serve as the main governance body of the indigenous vegetable chain.** Bringing together stakeholders, **an Arusha multi-stakeholder platform for the indigenous vege-table chain can facilitate stronger chain governance and learn**

from, or build upon, existing multi-stakeholder initiatives, such as Arusha’s urban food council¹². The platform could start by drawing from the lessons of the signed Milan Urban Food Policy Pact and the Vegetable for All Project, by facilitating access to inclusive and responsive financial and extension services, timely and high-quality inputs and reliable markets.

Key stakeholders for the platform include local facilitators, knowledge generators and fundraisers, financial institutions, smallholder farmers associations, local government officials, champion farmers, traders and processors, partners involved in existing sustainability projects and in horticultural export chains, local traders’ organisations or networks, and consumer advocates. SASS project can facilitate the platform by **favouring multi-stakeholder engagement, dialogue and consensus, supporting the creation of shared solutions** and actionable plans, and **helping to connect the platform to national and international initiatives**¹³.

Pathway 2 - Production: Informed choice through extension support

Extension officers are a main source of production expertise for small-scale farmers, but their importance for technical knowledge declined under budget cuts, resulting in farmers getting more and more technical information from the private market, such as input suppliers. Also, current indigenous vegetable production is hampered by insufficient support which results in less production, lower yields, and under-served commercialisation opportunities. Recognised the crucial role of intermediaries between agricultural policy and farmers, we suggest **developing an indigenous vegetable-sensitive curriculum for extension officers can promote indigenous vegetable produc-**

12 Arusha, which joined the Milan Urban Food Policy Pact in 2015, has an eleven-member council that works on food safety, market linkages, and application of good practices in Arusha City.

13 Such as GAIN’s Marketplace for Nutritious Foods or Tanzania’s National Multisectoral Nutrition Action Plan.

tion, decrease production risks and spread sustainable production practices.

Arusha and Meru District agricultural officers are the main actors in this pathway as they disseminate the information about indigenous vegetable production practices. Other stakeholders can help in forming the new curriculum, monitoring its process and helping in communicating its message, such as ministries, organisations that test sustainable production techniques, scientific and technical providers. SASS can contribute by **supporting a coalition to lobby the integration of sustainable indigenous vegetables production practices** in extension officers' curriculums, and by **informing farmers about sustainable production techniques of indigenous vegetables** based on the farms' soil health.

Pathway 3 - Distribution: Improved food safety along the chain

Unsafe food along the indigenous vegetable chain is due to **weak enforcement and coordination combined with insufficient technical support and infrastructure, and a lack of incentives for investments in safer practices at farm and market level.** Adopting safer practices - such as improved hygiene at market places or integrated pest management - entails costs that need to be borne by various stakeholders, such as producers, traders, market authorities and regulating institutions. The transition towards less chemical-intensive agriculture could lead to yields declining before sustainable cropping practices start paying off. Bridging this time lag can be a hurdle difficult to finance. Moreover, consumers buying fruits and vegetables in most markets in Arusha do not have a way to differentiate between good quality and safe food from unsafe foods. A price premium for quality assurance can be used to finance the necessary investments.

Currently, **Arusha's City Council is debating food safety initiatives in partnership with Rikolto and Trias.** Rather than working in parallel, the multi-stakeholder platform described for the Pathway

1 can support this process. In designing and implementing the food safety plans, input can be sought from the TPRI as knowledge providers, and from Mboga na Matunda and Vegetables for All, due to their work on good agricultural practices and linkages with processors. Community radios can bring food safety communication messages to consumers, as risk communication is part of effective risk management. SASS can support the design of food safety programming by facilitating the inclusion of a wide range of stakeholders and can lobby to embed the platform's food safety task force with Arusha's City Council and its food strategy, helping the monitoring mechanisms' set up as well. SASS can also connect the task force with outside financial service providers.

Pathway 4 - Consumption: Information campaign for greater food knowledge

Strengthening of consumer food knowledge regarding indigenous vegetables, including benefits and proper cooking techniques, could improve consumers' choice and help to tackle the problem of malnutrition. Increased awareness of the benefits of indigenous vegetables could lead to dietary adequacy improvements and communicating tips on producing indigenous vegetables might increase production in home gardens and small, urban plots.

Possible ways to provide nutritional information include national food-based dietary guideline, local programs for schools, specific cooking techniques in workshops, and local campaigns tackling cultural practices that limit dietary diversity. Among specific groups, pregnant or breastfeeding women require special attention. On the farm, with the support of the Pathway 2, farmers should have access to the knowledge necessary to grow nutritious crops to diversify their self-consumption. As radio is the most important communication channel for Tanzanian female farmers, we suggest **community radio spots can be combined with poster distribution, cooking workshops, and school nutrition class**, possibly starting from the already existing

several programs working on improving food knowledge and expanding informed consumer choices in Tanzania and Arusha.

Cultivating small, smart and organic: A woman teaches how to use a small area with a small amount water to cultivate nutritious plants which can also be used for medicinal purposes



SASS research team can foster campaigns that cater to childbearing-age women needs, and the Sokoine University of Agriculture additional knowledge could support nutrition programs on community radio.

4.2. Pathways' overview

Currently, Arusha's food system suffers from widespread malnourishment, high poverty, and ecosystem degradation. For these reasons, we formulated and discussed four pathways for stronger integration of indigenous vegetables in Arusha's food system, that are: a multi-stakeholder platform serving as the main governance body of the indigenous vegetable chain (Pathway 1), the inclusion of indigenous vegetables in extension officers' curriculum (Pathway 2), a food safety unit within the platform (Pathway 3), and a nutrition campaign that enhances informed consumers' choices (Pathway 4). These pathways could foster the creation of preliminary coalitions targeting the stronger support for indigenous vegetables and efficient local value

chain, by improving the strength of vertical and horizontal linkages between actors.

With reference to SASS suggestions, the four pathways will be further discussed, amended, and validated at a later stage with relevant local stakeholders. The analysis of current food system performance and possible outcome from the pathways implementation is summarised in Table 3.

Notably, implementation of any pathway alone would not fundamentally alter Arusha's food system, but incrementally improve its economic, social, and environmental sustainability.

	Characteristics	Social sustainability	Environmental sustainability	Economic sustainability
Current food system	High population growth; Dominance of small-scale farming; High degree of informal food distribution.	+ Low obesity; + Lack of open conflicts; + Higher life expectancy than country average. - High malnutrition, esp. < 5 years; - Low dietary diversity, particularly vegetables; - Low food knowledge; - Small-scale farmers' poverty; - Gender bias; - Large urban-rural gap.	+ Fertile mountain slopes; + Water availability. - Low diversification; - Fragile mountain slopes; - Pressure on water resources; - Pressure on available land; - Declining soil fertility; - Insufficient pesticide management.	+ Trade hub for Kenya and EAC; + Lower poverty levels than country average; + Irrigation. - Low yields; - Higher poverty than global; - Bad road infrastructure.
Diversification pathway assumptions and outcomes	Stronger support for indigenous vegetables; Efficient local value chains; Policy environment conducive for indigenous seeds and production; Extension services support for smallholders.	+ Improved nutrition; + Increased support for farmers organisations; + Increased seed autonomy; + Female economic empowerment. - More vegetables do not reduce undernourishment; - Costs of diets might increase; - Gender-related tensions in households.	+ Increased resilience; + Increased soil fertility; + Agro-biodiversity enhancement. - Unlikely to stop encroachment on Mount Meru.	+ New economic opportunities for smallholders, esp. women; + Diversification decreases risk-profile. - Lower crop output; - Vulnerability to local market conditions.

Table 3: Summary of the current food system performance and possible implications of the various pathways, with positive (+) and negative (-) sustainability dynamics (authors' elaboration based on own research)

Chapter 5

The way forward

This report analyses the economic, social and environmental sustainability of rural and urban Arusha, with a focus on the potential role of diversification and indigenous vegetables to advance sustainability of the Arusha food system. Based on a political economy analysis and discussions with local stakeholders, **we developed four promising entry points into pathways** for a better integration of indigenous vegetables, also outlining the potential roles of the SASS consortium in supporting these pathways.

As with the Naivasha case study,¹⁴ our research shows that stronger integration of indigenous vegetables can increase the adequacy of diets **in Arusha, with particular benefits for children under five and childbearing-age women. As indigenous vegetables have a short shelf-life, more integration would also benefit urban-rural linkages. Environmentally,** stronger integration of indigenous vegetables can increase resilience to climate change, improve soil fertility, and safeguard agro-biodiversity. **Economically,**

¹⁴ See the SASS e-book “Sustainable food systems and indigenous vegetables - The Naivasha case”, [click here to download](#).

indigenous vegetables integration opens new economic opportunities for smallholders, **especially women, while market diversification decreases dependency on a single crop. To reach these targets,** integrated strategies taking into account the complex interlinkages, interests and incentives of the different actors in the food system are needed.

In this report, we highlighted **several bottlenecks** pertaining to governance, production, distribution, and consumption hamper households, policymakers and businesses in Arusha in moving towards a more diverse and inclusive food system. **Considering the weak vertical and horizontal linkages among value chain actors,** we believe that **building coalitions towards change will be crucial.**

As highlighted during the **Final Workshop of the SASS Project held on November 19, 2020 in Arusha,** the pathways towards a more sustainable food system align very well with the on-going initiatives of Food Safety Food Smart Cities of Arusha. As with the Nai-vasha case study.¹⁵

In particular, the Food Smart Cities Arusha multi-actor platform could be a good starting point to promote participative and effective governance of the food system in Arusha, and the pathways should be incorporated within the working groups of the Food Safety initiative.

According to the participants at the Final Workshop and in line with Food Smart Cities Arusha, **a major pathway should also be implemented to address logistics and city infrastructures issues,** with particular reference to food transport and distribution roads, market and storage facilities. The workshop also emphasized the crucial impor-

15 Food Smart Cities Arusha is a recent initiative on Food Safety that took place in Arusha in 2018. Most of the organisations represented in the workshop are stakeholders of this initiative, that created an innovative multi-actor partnership platform structured around a working group composed of TAHA, Rikolto, Arusha City Council, Tanzania Bureau of Standards, Agri-profocus, TRIAS, TPRI, Coleacp, Solidaridad and MUVIKIHO. While the actual working of the platform is still at an infancy stage, the plan is to structure it to provide solution-focused interventions through creation of High-Level Steering Group, and to be organised around six Working Groups, including: Consumer sensitization / consumption of safe food, Participatory Guarantee Scheme, Safe Production Food, Safety Standard, Youth Incubator, and Logistics / City Infrastructure.

tance of **awareness campaigns through a multimedia approach**, with the aim of supporting both the willingness of stakeholders to cooperate in the governance task and sustainable food consumption.

Each food system has different characteristics and therefore different pathway can lead towards sustainability. Unearthing the characteristics and trade-offs of sustainability pathways in food systems needs interdisciplinary research. Context-specific programs and policies should be developed in partnership with and owned by local actors. In Arusha, **we showed that stronger integration of indigenous vegetables could be particularly beneficial for Arusha's food system sustainability**. We hope that this report provides a first step towards a more sustainable food system in Arusha.

Bibliography

- Abrahms, M. Z. and Nelia P. S. 2011. Diet and Mortality Rates in Sub-Saharan Africa: Stages in the Nutrition Transition. *BMC Public Health*, 11(801): 1-12.
- Access to Seeds Index*. 2018. Identifying Leading Seed Companies in Eastern and Southern Africa. *Amsterdam: Access to Seeds Index*.
- Baldermann, S., Blagojević, L., Frede, K., Klopsch, R., Neugart, S., Neumann, A., Ngwene, B., Norkewit, J., Schröter, D., Schröter, A. and Schweigert, F.J. 2016. Are neglected plants the food for the future?. *Critical Reviews in Plant Sciences*, 35(2): 106-119.
- Bartow, C. and D.M. Zocchi. 2018. The Ark of Taste in Kenya. Food, Knowledge, and Stories of Gastronomic Heritage. *Bra, Italy: Slow Food*.
- Borrelli, N. and M. Benegiamo. *Forthcoming 2019*. Small farmers in Sub-Saharan Africa for a place based and sustainable food system transition - Evidence from Kenya. *Bologna: Rassegna Italiana di Sociologia*.
- Borrelli, N., Benegiamo M. and G. Corti. 2019. *Small farmers' Food Production as heritage. Evidences from a Survey in Kenya*. Conference proceedings, WORLD HERITAGE and LEGACY Culture | Creativity | Contamination, Gangemi Editore.

- Boulanger, P., Dudu, H., Ferrari, E., Mainar Causapé, A.J., Balié, J. and Battaglia, L. 2018. *Policy Options to Support the Agriculture Sector Growth and Transformation Strategy in Kenya. A CGE Analysis*. Luxembourg: Publication Office of the European Union.
- Carter, R., Ferdinand, T. and C. Chan. 2018. Transforming Agriculture for Climate Resilience: A Framework for Systemic Change. Working Paper. Washington: World Resources Institute (WRI).
- Cena, H. 2018. Warning for Young Women Diet in Sub-Saharan Area: The Key Role of Local Biodiversity, Responsible Research and Innovation Strategy. *Presentation at the SASS workshop, 3 May. Pavia: University of Pavia*.
- Checkland, P. B. and J. Scholes. 1990. *Soft Systems Methodology in Action*. Chicester: John Wiley & Sons Ltd.
- Chivenge, P., Mabhaudhi, T., Modi, A. and Mafongoya, P. 2015. The potential role of neglected and underutilised crop species as future crops under water scarce conditions in Sub-Saharan Africa. *International journal of environmental research and public health*, 12(6): 5685-5711.
- Corvo, P. and Fontefrancesco, M. F. 2018. *Sotto il cielo della Rift Valley. Sviluppo rurale e cibo tradizionale nella contea di Nakuru, Kenya*. Pollenzo: dell'Università degli Studi di Scienze Gastronomiche.
- EAC. 2007. The Treaty for the Establishment of the East African Community. *Arusha: East African Community*.
- FAO and UNDP. 2017. Integrating Agriculture in National Adaptation Plans: Kenya Case Study. *Rome: FAO*.
- FAO. n.d. *Staple foods: What do people eat?* Accessed 04 July 2019 at <http://www.fao.org/3/u8480e/u8480e07.htm>.
- FAO. 2015. Food and Agriculture Policy Decision Analysis (FAPDA): Country fact sheet on food and agriculture policy trends. *Rome: FAO*.
- FAO. 2018. *NADHALI 2018*. Draft Report [forthcoming]. Rome: Food and Agriculture Organisation of the United Nations (FAO).
- Fontefrancesco, M.F. 2018. The Slow Food Model: A Road for Small-Scale Productions in a Globalised Market. *International Journal of Agricultural Management and Development*, 8(1): 17-23.

BIBLIOGRAPHY

- Government of Kenya. 2011. *National Food and Nutrition Security Policy*. Nairobi: Agricultural Sector Coordination Unit.
- Government of Kenya. 2010a. A Medium-Term Investment Plan for Kenya's Agricultural Sector: 2010-2015. Nairobi: Republic of Kenya.
- Government of Kenya. 2010b. *The Kenya CAADP Compact*. Nairobi: Republic of Kenya.
- NCLR. 2012. The Land Act, 2012. Nairobi: National Council for Law Reporting.
- Government of Kenya. n.d. *Kenya Vision 2030*. Accessed, 05 July 2019 at <https://vision2030.go.ke/>
- Goyal, A. and Nash, J. 2017. Reaping Richer Returns: Public Spending Priorities for African Agriculture Productivity Growth. *Washington, DC: World Bank*.
- Hivos, IIED and KRC. 2016. Uganda Food Change Lab: Planning for the Future Food System of Kabarole District. *The Hague: HIVOS*.
- HIVOS. 2018a. Report for baseline study on sustainable diets for all in Kenya. *The Hague: HIVOS*.
- HIVOS. 2018b. *Scoping Study*. Internal document: not published.
- Imarisha Naivasha. 2012. Lake Naivasha Sustainable Development Action Plan. First Action Plan (2012- 2017). *Nakuru: Imarisha Naivasha*.
- IPES-Food. 2016. From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems. *Louvain-la-Neuve: IPES-Food*.
- Jayne, T. S., Mason, N. M., Burke, W. J. and Ariga, J. 2018. Taking stock of Africa's second-generation agricultural input subsidy programs. *Food policy*, 75: 1-14.
- Jayne, T.S. and Muyanga, M. 2012. Land constraints in Kenya's densely populated rural areas: implications for food policy and institutional reform. *Food Security*, 4(3): 399-421.
- Jayne, T.S., Chamberlin, J. and Headey, D.D. 2014. Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. *Food policy*, 48: 1-17.

- Kebaso, B. M. 2015. The effects of hydrological characteristics of river Nyakomisaro on the water supply of Kisii Municipality, Kenya. Doctoral Dissertation. Nairobi: Kenyatta University.*
- Kiambi, D. and Mugo, L. 2016. Seed Systems and Value Chains in Kenya: Case Study on Sorghum and Cowpeas. Wageningen: ISSD Africa.*
- Kimenju, S.C. and Tschirley, D.L. 2008. Agriculture and livelihood diversification in Kenyan rural households. Nairobi: Tegemeo Institute of Agricultural Policy and Development.*
- Kimiywe, J., Waudu, J. and Mbithe, D. 2008. Utilisation and Medical Value of Indigenous Leafy Vegetables Consumed in Urban and Peri-Urban Nairobi. Paper presented at the Developing African leafy vegetables for improved nutrition workshop, Nairobi, 6-9 December 2005. Nairobi: Rural Outreach Program.*
- Kingdom of the Netherlands. 2017. Horticulture Study - Phase 1: Mapping of Production of Fruits and Vegetables in Kenya. Nairobi: Embassy of the Kingdom of the Netherlands.*
- Kirimi, L., Sitko, N.J., Jayne, T.S., Karin, F., Muyanga, M., Sheahan, M., Flock, J. and Bor, G. 2011. A farm gate-to-consumer value chain analysis of Kenya's maize marketing system. MSU International Development Working Paper No. 111. Michigan: Department of Economics.*
- Knaepen H. 2018. Making Markets Work for Indigenous Vegetables - Towards a Sustainable Food System in the Lake Naivasha Basin, Kenya. ECDPM Discussion Paper 230. Maastricht: ECDPM.*
- MACE Foods. 2018. Final Project Report: African Indigenous Vegetable systems for better livelihoods in Kenya. Available at <https://knowledge4food.net/research-project/arf1-vegetable-systems-kenya/>.*
- Maengwe, K. W. 2017. Effects of Land Subdivisions to Food Security - Case Study: Kaputiei North-Kajiado County. Master Thesis submitted for the Degree of Master of Science in Geographical Information Systems. Nairobi: University of Nairobi, Department of Geospatial and Space Technology.<*
- Marson, M. and Vaggi, G. 2019. Sustainable Value Chains in Agriculture. The African Indigenous Vegetables in Southern Nakuru Coun-*

BIBLIOGRAPHY

- ty, Kenya. A Policy Paper prepared for the SASS Research Project. [Draft February 2019 - not yet published].
- Mason, N. M., Wineman, A., Kirimi, L. and Mather, D. 2015. *The effects of Kenya's 'smarter' input subsidy program on crop production, incomes, and poverty*. Policy Brief No. 11. Nairobi: Tegemeo Institute of Agricultural Policy and Development.
- Programme on Smallholder Behaviour and Incomes: Do Different Quasi-experimental Approaches Lead
- Mason, N. M., Wineman, A., Kirimi, L. and Mather, D. 2017. The Effects of Kenya's 'Smarter' Input Subsidy to the Same Conclusions? *Journal of Agricultural Economics*, 68(1): 45-69.
- MoALF. 2016. Climate Risk Profile for Nakuru. Kenya County Climate Risk Profile Series. *Nairobi: Ministry of Agriculture, Livestock and Fisheries*.
- MoITC. 2017. National Trade Policy: Transforming Kenya into a Competitive Export-Led and Efficient Domestic Economy. *Nairobi: MoITC*.
- Mulatu, D. W., Van der Veen, A. and Van Oel, P. R. 2014. Farm households' preferences for collective and individual actions to improve water-related ecosystem services: The Lake Naivasha basin, Kenya. *Ecosystem Services* 7: 22-33.
- Mulatu, D. W., Van der Veen, A., Becht, R., Van Oel, P. R. and Bekalo, D. J. 2013. Accounting for Spatial Non-Stationarity to Estimate Population Distribution Using Land Use/Cover. Case Study: the Lake Naivasha Basin, Kenya. *Journal of Settlements and Spatial Planning*, 4(1): 33-44.
- Munyi, P. and De Jonge, B. 2015. Seed Systems Support in Kenya: Consideration for an Integrated Seed Sector Development Approach. *Journal of Sustainable Development*, 8(2): 161.
- NCPD. 2017. *2015 Kenya National Adolescent and Youth Survey (NAYS) - Nakuru County*. Nairobi, Kenya: National Council for Population and Development.

- Ndabibi Environmental Conservation Centre. 2015. *Farmlands/Jo-spat Macharia's NECC*. Video. 27 July. <https://www.youtube.com/watch?v=Ilz4QE3TBsA>
- Odongo, V.O., Mulatu, D.W., Muthoni, F.K., van Oel, P.R., Meins, F.M., van der Tol, C., Skidmore, A.K., Groen, T.A., Becht, R., Onyando, J.O. and van der Veen, A. 2014. Coupling socio-economic factors and eco-hydrological processes using a cascade-modeling approach. *Journal of Hydrology*, 518: 49-59.
- Odongo, V.O., van der Tol, C., van Oel, P.R., Meins, F.M., Becht, R., Onyando J. and Zhongbo, Su. 2015. Characterisation of hydroclimatological trends and variability in the Lake Naivasha basin, Kenya. *Hydrological Processes*, 29: 3276-3293.
- Oniang'o, R., Grum, M. and Obel-Lawson, E. 2007. Developing African leafy vegetables for improved nutrition. *The African Journal of Food, Agriculture, Nutrition and Development*, 7(3-4).
- Padulosi, S., Thompson, J. and Rudebjer, P. 2013. Fighting poverty, hunger and malnutrition with neglected and underutilized species (NUS): needs, challenges and the way forward. *Rome: Bioversity International*.
- Paustian, K., Lehmann, J., Ogle, S., Reay, D., Robertson, G.P. and Smith, P. 2016. Climate-smart Soils. *Nature*, 532(7597): 49-57.
- Perez-Rea, D. and R. Antezana-Gomez. 2018. The Functionality of Pseudocereal Starches. In Sjöö, M. and Nillson, L., *Starch in Food*, 509-542. Cambridge: Woodhead Publishing.
- Poultron, C. 2010. *Agricultural Services and Decentralisation in Kenya*. Policy Brief 035. Brighton: Future Agricultures.
- Pretty, J., Toulmin, C. and Williams, S. 2008. Sustainable Intensification in African Agriculture. *International Journal of Agricultural Sustainability*, 9(5): 5-24.
- Rapsomanikis, G. 2015. *The Economic Lives of Smallholder Farmers: An Analysis Based on Household Data from Nine Countries*. Rome: FAO.
- Röling, N. 1997. The Soft Side of Land: Socio-Economic Sustainability of Land Use Systems. *ITC Journal*, 3(4): 248-262.

BIBLIOGRAPHY

- Rudebjer, P., Meldrum, G., Padulosi, S., Hall, R. and Hermanowicz, E. 2014. *Realizing the promise of neglected and underutilized species*. Rome: Biodiversity International
- Sassi, M. and Zucchini, E. 2018. *Food Insecurity in the Rural Lake Naivasha Basin: Evidence and Policy Implications*. International Working Paper Series, No. 18/01. Pavia: University of Pavia.
- SDSN. 2015. Indicators and a Monitoring Framework for the Sustainable Development Goals. *New York: SDSN*
- Sheahan, M., Black, R. and Jayne, T.S. 2013. Are Kenyan farmers under-utilizing fertilizer? Implications for input intensification strategies and research. *Food Policy*, 41: 39-52.
- Stein, C. and Barron, J. 2017. Mapping Actors along Value Chains: Integrating Visual Network Research and Participatory Statistics into Value Chain Analysis. Colombo: IWMI.
- tilgoe, J., Owen, R. and Macnaghten, P. 2013. Developing a Framework for Responsible Innovation. *Research Policy*, 42(9): 1568-1580.
- Stirling, A. and Mayer, S. 1999. Rethinking Risk: a pilot multicriteria mapping of a genetically modified crop in agricultural systems in the UK. Unset: University of Sussex.
- Stirling, A., Lobstein, T. and Millstone, E. 2007. Methodology for obtaining stakeholder assessments of obesity policy options in the PorGrow project. *Obesity Review*, 8(2), 17–27.
- Thomas, G. W. 1982. *Exchangeable cations*. In: Page, A. L., Miller, R. H. and Keeney, D. R. (Eds), *Methods of Soil Analysis*, part 2, 159-166. Vancouver: American Society of Agronomists.
- Tittonell, P., Vanlauwe, B., De Ridder, N. and Giller, K.E. 2007. Heterogeneity of crop productivity and resource use efficiency within smallholder Kenyan farms: Soil fertility gradients or management intensity gradients? *Agricultural systems*, 94(2): 376-390.
- UNDP. 2017. *Income Inequality Trends in sub-Saharan Africa*. New York: UNDP.
- USAID, 2010. *Staple Foods Value Chain Analysis: Country Report – Kenya*. Washington: United States Agency for International Development.

- USAID. 2011. Feed the Future Kenya 2011-2015 Multi-Year Strategy. Washington, DC: Feed the Future.
- Van Berkum, S., Dengerink, J. and Ruben, R. 2018. *The food systems approach: sustainable solutions for a sufficient supply of healthy food*. Wageningen: Wageningen Economic Research.
- van Etten, J., López Noriega, I., Fadda, C. and Thomas, E. 2017. *The contribution of seed systems to crop and tree diversity in sustainable food systems*. In: Mainstreaming agrobiodiversity in sustainable food systems: Scientific foundations for an agrobiodiversity index. Rome: Bioversity International.
- van Oel, P.R., Mulatu, D.W., Odongo, V.O., Meins, F.M., Hogeboom, R.J., Becht, R., Stein A., Onyando, J.O. and van der Veen, A. 2013. The effects of groundwater and surface water use on total water availability and implications for water management: the case of Lake Naivasha, Kenya. *Water Resources Management*, 27(9): 3477–3492.
- Wambugu, P.W. and Muthamia, Z.K. 2009. *The State of Plant Genetic Resources for Food and Agriculture in Kenya*. Nairobi: Republic of Kenya.
- Wanjala, S. W. 2018. *Inferences of Land Use, Socio-Economic and Demographic Trends on Food Stability - A Case Study of Land Use and Food Systems around Naivasha*. (Unpublished Master Thesis). Pavia: University of Pavia.
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., ... Murray, C. J. L. 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393(10170), 447–492.
- World Bank and CIAT. 2015. *Climate-Smart Agriculture in Kenya. CSA Country Profiles for Africa, Asia, and Latin America and the Caribbean Series*. Washington, D.C.: World Bank.
- World Bank. 2018. Kenya Economic Update, April 2018, No. 17: Policy Options to Advance the Big 4. Nairobi: World Bank.
- WWF. 2012. Shared Risk and Opportunity in Water Resources: Seeking a Sustainable Future for Lake Naivasha. Gland: WWF.
- Yunus, M. 1999. The Grameen Bank. *Scientific American*, 281(5): 114-119.

Project description

The “Sustainable Agrifood Systems Strategies (SASS)” multidisciplinary programme, funded by the Italian Ministry of Research, aims to build knowledge, policy dialogue and partnerships contributing to sustainable food systems at national, regional and international levels, based on three research locations in Kenya and Tanzania. The SASS programme is a consortium initiative by the European Centre for Development Policy Management (ECDPM), the University of Milano-Bicocca (UNIMIB), the University Cattolica del Sacro Cuore (UNICATT), the University of Pavia (UNIPV) and the University of Gastronomic Sciences (UNISG). The aim of the present e-book is to introduce the preliminary research results from SASS, between 2017 and 2019, about the food system in the southern Nakuru area in Kenya.

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