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Promoting sustainable urban food systems in Mauritius by enhancing urban and peri-urban agriculture with circular economy approaches

Technical Study

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Table of Contents

List of Tables

List of Figures

List of Boxes

List of Abbreviations

ACF-International	Action Contre la Faim- International
AMB	Agricultural Marketing Board
APAU	Agricultural Policy Analysis Unit
CSO	Civil Society Organisations
DBM	Development Bank of Mauritius
DCAs	District Council Areas
EDB	Economic Development Board

FALCON	Farmers in Agriculture, Livestock, Cooperative Network
FAREI	Food and Agricultural Research and Extension Institute
GDP	Gross Domestic Product
GHG	Greenhouse Gases
Ha	Hectares
HSSP	Health Sector Strategic Plan
HPC	Household and Population Census
IIED	International Institute for Environment and Development
MAA	Mouvement pour L'Autosuffisance Alimentaire
MAIFS	Ministry of Agroindustry and Food Security
MAST	Mauritius Academy of Science and Technology
MCA	Mauritius Chamber of Agriculture
MCAs	Municipal Council Areas
MCB	Mauritius Commercial Bank Ltd
MCCI	Mauritius Chamber of Commerce and Industry
MCCPL	Municipal City Council of Port Louis
MCPL	Municipal Council of Port Louis
MID	Maurice Ile Durable
MOESWMCC	Ministry of Environment Solid Waste Management and Climate Change
MSIRI	Mauritius Sugar Industry Research Institute
MSMEs	Micro, Small and Medium Sized Enterprises
MUR	Mauritian Rupee
MW	Municipal Wards
NDS	National Development Strategy
NSIF	National Social Inclusion Foundation
PAGE	Partnership For Action on Green Economy
PLDI	Port Louis Development Initiative
PTA	Parents Teachers Association
RRA	Rodrigues Regional Assembly
SIDS	Small Island Developing State
SUPA	Sustainable Urban and Peri-Urban Agriculture
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNFSS	United Nations Food Systems Summit
UoM	University of Mauritius
USD	United States Dollar
VCA	Village Council Area
WHO	World Health Organization

Executive Summary

Given global predictions that 80% of food will be consumed in cities by 2050, it becomes critical for national and sub-national governments and urban stakeholders to collaborate closely to promote sustainable urban food systems transformation. Integrated and sustainable models for feeding cities such as, sustainable urban farming and shorter supply chains with a circular economy approach, offer potential to reduce environmental impacts (e.g. food miles, food waste, water and energy use) and enhance green spaces in cities, while benefiting food security and nutrition, as observed in different parts of the world during the COVID-19 pandemic.

As a Small Island Developing State, the Republic of Mauritius faces a number of food related challenges including high dependence on highly processed imported food which poses a threat to the nutrition and health of Mauritian and Rodriguan households (WHO, 2020). The country's food import bill was more than 1.1 billion USD in 2020 with agricultural imports accounting for 26.1% of total imports (Statistics Mauritius, 2022b). With rising fuel, food and input costs linked to the war in Ukraine, there is a need to find sustainable ways to enhance domestic food production. The COVID-19 recovery process provides opportunities for transformation towards more sustainable and resilient food systems at national and urban level, which this study aims to contribute towards. With 41.8% of the Mauritian population living in urban and peri-urban areas, encouraging urban and peri-urban agriculture can make a significant impact on improving household food security.

Study Objectives and Methodology

This study, conducted as part of the UN Partnership for Action on Green Economy (PAGE) in Mauritius with support from the United Nations Environment Programme (UNEP), aims to offer technical support to promote sustainable urban food systems in Mauritius by using cities (urban and peri-urban areas) as drivers of change. The study entailed case studies of the capital of city Port Louis and the town of Vacoas-Phoenix, and a smaller study on the Island of Rodrigues, using a holistic urban food systems assessment approach. It explored the main food systems challenges (environmental, socio-economic, food and nutrition security), the policy framework and interventions that can enhance urban and peri-urban agriculture (UPA) for improved sustainability, circularity and food security.

Quantitative and qualitative data was collected through semi-structured interviews with 22 organizations (44 key informants) including different ministries, parastatal bodies, local government associations and CSOs, from April to June 2022. Primary data on the volume of fresh produce flowing through the Vacoas auction market was also collected. The study also entailed a desk review of policy documents from public and private institutions and relevant literature on urban food systems. Two food systems multi-stakeholder dialogues (including an online session with Rodriguan stakeholders) were organised to validate the findings, prioritize the recommendations and agree on establishing a multi-level, multi-stakeholder mechanism to take forward the prioritized actions. The first dialogue was held on 7th September 2022 focusing on Vacoas-Phoenix, and the second on 9th September 2022 focusing on Port Louis. Both dialogues included a focus on Rodrigues.

Promoting UPA in Mauritius: case studies of Vacoas-Phoenix and Port Louis

Enhancing urban and peri-urban agriculture (UPA) in Mauritius provides an opportunity to reduce transport emissions from food imported from abroad and from across Mauritius, while promoting healthier diets. It is also important to reduce food waste along supply chains which represents about 30% of produce. Food and other landfill waste contributes 26.3% of greenhouse gas emissions in Mauritius. Rodrigues, as an outer island with largely traditional agricultural and agroprocessing activities, could also be encouraged to foster a more circular agrarian economy with less dependence on imported food products from Mauritius.

The case studies on Vacoas-Phoenix and Port Louis showed the disparity between the two urban areas in terms of their food system model. Vacoas-Phoenix is very much engaged in food production, agriculture being the main characteristic of the town compared to other towns and cities. Its food system integrates urban and peri-urban agriculture, reducing food miles and enhancing food self-sufficiency. The town is self-sufficient in fresh vegetables due to peri-urban production. However, its circularity could be further improved to reduce food waste and food miles. The Vacoas-Phoenix Market Fair produces 20-25 tonnes of food waste per week. The sustainability of UPA could also be improved by reducing agrochemical use.

Both Vacoas-Phoenix and Port- Louis have good market infrastructures which ensure regular availability of fresh fruits and vegetables to the citizens. However, Port Louis' food system is more dependent on agricultural produce coming from other regions of the country and from abroad, and needs to be designed to address household food security for the urban poor. In Port Louis, there is little agricultural production due to lack of land, but agricultural production activities take place in some peri-urban areas such as Cité La Cure and Vallée des Prêtres. Limited land is a key challenge to expansion of urban agriculture in Port Louis. There are opportunities for enhancing rooftop and vertical food production, but buildings may need to be adapted for this purpose. Peri-urban agriculture could also be enhanced, to reduce dependence on imported food from abroad (eg. fruits) and pollution from local food transport.

Policies and Governance in Mauritius for sustainable UPA

The Ministry of Agroindustry and Food Security is preparing its new Agro- Strategic Plan 2022-2025 and has set up schemes to promote urban gardens (especially at household level). The National Pathway[1] to Sustainable Food Systems of the UN Food Systems Summit (UNFSS) encourages a diversity crops based on minimum use of chemical inputs and creation of an enabling environment for sustainable production. The Ministry of Housing and Land Use Planning is currently preparing urban development plans, which could include urban agriculture as a way to increase access to food by urban poor households, while promoting sustainable and healthy diets and reducing food waste. Despite initiatives such as the micro-gardening scheme (launched after the first lockdown period of the Covid 19 pandemic), the Food and Agricultural Research and Extension Institute's (FAREI) on-demand training for organic backyard gardening and the Development Bank of Mauritius (DBM) soft loan scheme to promote backyard gardening, there has not been significant uptake of urban agriculture in Port Louis and Vacoas-Phoenix.

[1] https://summitdialogues.org/wp-content/uploads/2021/09/Pathway-final-17-Sept-2021.pdf

There is currently no clear policy at national or urban level to encourage public and private investment to promote green urban agriculture, or land use planning policy that recognizes and supports UPA in Mauritius. Urban agriculture, e.g. roof top planting, is now being implemented in Vacoas, but promoters are reluctant to embark on major projects such as shopping malls since they are not seen as profitable. Stakeholder organizations (mainly from government) are consulted on urban planning and land use policies but there is a lack of interactive participation by different sectors and CSOs on urban agriculture as a potential land use option. There is limited sharing of information/data and interactive communication among the various government entities involved, including the Ministry of Agroindustry and Food Security, Ministry of Housing and Land Use Planning, Ministry of Environment, Solid Waste Management and Climate Change and Ministry of Health and Wellness. Land in urban and peri-urban areas is more often earmarked for construction in Port Louis than for agriculture, despite the potential of UPA to reduce dependence on food imports, and hence improve food security and reduce greenhouse emissions.

Key Recommendations for promoting sustainable UPA in Mauritius

The study identified 5 key recommendations to promote sustainable UPA in Mauritius:

***1. Improving policy coherence and governance*:**
(a) Foster better communication amongst public institutions directly and indirectly related to urban food systems namely the Ministry of Agroindustry and Food Security, Ministry of Environment, Solid Waste Management and Climate Change and Ministry of Health and Wellness, as well as municipal councils, so that UPA is given due consideration in development projects proposed by public institutions and private promoters.
(b) A clear public policy should be introduced to promote sustainable urban agriculture in development projects in cities, as well as fiscal incentives to encourage private promoters to include urban agriculture (eg. rooftop gardening) as an integral part of their construction projects.
(c) Establish a new multi-level governance mechanism to improve consultation and policy coordination and strengthen links between different national and local bodies, including FAREI, the Economic Development Board, Ministry of Agroindustry and Food Security, Ministry of Local Government and Disaster Risk Management, Ministry of Environment, Solid Waste Management and Climate Change, Municipal Councils, and CSOs and urban poor groups.
(d) The dimension of smart food purchase and consumption[2] should be integrated in the Smart City Scheme. This will compel smart city promoters in urban and peri-urban areas to include an urban food system element in their project portfolios and at the same time allow households within the Smart Cities to have some level of food self-sufficiency.
(e) Policies for national food security should address household food security which could be enhanced through encouraging UPA. Given that a number of rural areas are also urbanising in terms of population

[2] The concept of "smart food purchase and consumption" is in line with the underlying principles of sustainable food purchasing and consumption behaviour whereby each individual makes a conscious choice of his/her type of diet and the impact of the latter on sustainability.

size and infrastructure development, there should be a national policy on urban and peri-urban food system.

2. *Encourage ecological backyard gardening and community gardens for household food security*

(a) Encourage Mauritian entrepreneurs to propose low-cost artisanal production systems adapted to backyard gardens such as irrigation systems, DIY gardening kits and seedlings ready to sow. These could easily be adopted by households and reduce dependence on high-tech, expensive production systems that are usually imported and therefore not sustainable.

(b) Backyard gardening and small gardening schemes should be strongly implemented by citizens and can suit Port Louis. Leasing of rooftops would be appropriate for agricultural activities in built up areas, for instance beekeeping, rooftop gardening.

(c) Community gardens should be set up particularly in towns like Vacoas-Phoenix where there is sufficient land even on abandoned or bare land.

(d) Parent-Teacher Association (PTA) funds in colleges and schools could raise money to procure inputs/equipment and smart technologies to boost food production in school gardens. This can help children who participate in school gardening projects to raise awareness at the household level and encourage the uptake of backyard gardening, hence increasing household food sufficiency and security.

(e) In order to re-engage young people in the agricultural sector, the Ministry of Education, Tertiary Education, Science and Technology (METEST) could consider offering agriculture as a main subject at advanced level for secondary schools. This can encourage young students who will leave secondary school with a strong background in agriculture to start an agribusiness or pursue higher studies in agriculture.

3. Promoting food festivals and farmers' markets to link local producers and consumers:

(a) Food and music festivals could be organised to help bring citizens closer to consumption of local food, given that Port Louis is the first city in Eastern Africa to have joined the list of UNESCO Creative Cities Network in October 2021, based on its commitment to place culture and creativity at the heart of its development.

(b) Farmers' markets could be set up whereby urban, peri-urban and even rural farmers could have a dedicated space to sell their local and organic produce (crop, livestock and artisanal products). This could be a weekly event to encourage demand and supply of local produce, while reducing the number of intermediaries in the food supply chain.

(c) A massive sensitisation campaign is needed for urban dwellers on the importance of changing their food purchasing and consumption behaviours to more sustainable ones e.g. by choosing local food produced closer to their residential area, and growing some of their food in their backyard.

4. Including poor and marginalised groups in urban and peri urban agricultural activities:

(a) There should be a study on approaches that could be used by NGOs to empower poor and marginalised communities in urban and peri-urban areas to have more targeted and participatory actions that would be readily taken up by these communities instead of a top-down approach.

(b) A crop production scheme for young graduates should be introduced to promote youth to move back into agriculture. University of Mauritius has a crucial role to play in terms of providing training in agriculture to youth, women entrepreneurs and marginalised people.

(c) A 'jardin partagé' or 'community garden'[3] can be set up in urban areas to provide healthy and sustainable food for poor and vulnerable people. This could be implemented through identification of a green space or abandoned land (with permission of the land owner) in both Port-Louis and Vacoas-Phoenix. Community groups comprising marginalised people/women's clubs could also be established (with the help of National Women Entrepreneur Council) to promote sustainable urban agriculture (backyard gardening, rooftop gardening, balcony gardening). Women in Port Louis and Vacoas-Phoenix should be empowered to carry out urban vegetable and fruit production and livestock rearing, and value addition and marketing for their products both to increase household food security and as a profitable venture for surplus produce.

5. Promoting circular economy approaches and reducing waste

(a) In order to promote sustainable UPA, planters should be encouraged to replace chemical fertilisers and pesticides with bioproducts made from local raw materials and manufactured locally e.g compost made from green waste or poultry litter; biopesticides made from plants etc. The government could subsidise the production of local biofertilisers and biopesticides and encourage agricultural input suppliers to sell these products instead of agrochemicals.

(b) There is a need to decentralise the food distribution system region-wise to reduce the carbon and water footprints of transport and storage of fruits and vegetables. A review of the distribution system for fresh fruits and vegetables to Port Louis could decrease the current impact of transport by goods vehicles in the capital city on GHG emissions and reduce congestion.

(c) Food loss and waste along the food supply chain was identified as a key challenge by key informants. The proposed solution is composting of green waste arising from wet markets and fairs as a way to recycle nutrients back to crop production activities. Urban and peri-urban households should also be sensitised and encouraged to compost kitchen waste.

(d) Encourage urban producers to either add value to their produce through processing or sell the excess produce to agroprocessors.

(e) Explore the 15-minutes city model (Abdelfattah et al, 2022) for all 5 urban areas in Mauritius to ensure citizens can enjoy all the facilities and amenities of the city/town within 15 minutes of their homes by walking or cycling. This entails having commercial outlets and other facilities closer to residential areas. The impact on the environment can be very beneficial in terms of discouraging use of vehicles to travel long distances. It can also encourage local food producers to promote their products and services closer to consumers.

(f) Rodrigues has opportunities to shift towards a more sustainable food system with less reliance on chemical inputs and higher water efficiency by focusing on cultivation of resilient, low-input traditional crops, as well as value-addition to agricultural commodities to develop artisanal products and seafood that are specific to Rodrigues. Promoting UPA in Rodrigues could also lessen reliance on food imports from Mauritius. Other aspects that could be promoted include access to water from rain water harvestors for household gardens; and training women entrepreneurs in best practices for value-addition to raw materials from backyard gardens (eg. agroprocessing and agribusiness management).

[3] Family gardens are cultivated individually in marginal zones at the edge of cities and in peri-urban regions, while community gardens are managed collectively.

Economic Assessment of a Household Gardening Programme

The cost and benefits of implementing a three-year Household Gardening programme were estimated. In Vacoas, the total costs of programme was estimated as MUR 87,453,200 (USD 1,943,404.44) [4] and the revenues saved (from produce grown) at MUR 74,862,333 (USD 1,663,607.4) - hence the overall cost is MUR 12,590,867 (USD 279,797). In Port Louis, the costs of the scheme was estimated at MUR 118,534,575 (USD 2,634,101.7) and the revenue saved at MUR 103,270, 042 (USD 2,294,889.8); hence the overall cost is MUR 15,264,533 (USD 339,211.8). A number of additional economic, social and environmental benefits were identified, which suggests that the overall benefits of the scheme outweigh the costs. The costs of food transport saved amounts to MUR 179,670 (USD 3,992) in Vacoas and MUR 495,696 (USD 11,015.5) in Port Louis. In addition, the CO_2 emissions saved amount to 9,634kg in Vacoas and 26,579kg in Port Louis. The financing of such a programme remains a challenge but also offers opportunities such as for young agri-entrepreneurs to develop innovative household gardening kits adapted to the Mauritian context. In addition, the scheme can be incentivized further through innovative business models, using social media and creation of apps, to market surplus products thus creating employment for distribution of the products. Therefore, providing the right environment for start-ups to emerge is recommended.

Summary of Key Recommendations:

Recommendations		**Proposed Lead Implementing Agency & collaborators**
[1] Improving policy coherence and governance for urban and peri-urban agriculture (UPA)	1.1 Foster better communication amongst local public institutions directly and indirectly related to urban food systems	Ministry of Agroindustry and Food Security (MAIFS)
	1.2 Introduce a policy on UPA as a requirement in public and private development projects including fiscal incentives for private promoters	Ministry of Local Government and Disaster Risk Management
	1.3 Produce a land suitability map for urban areas so as to earmark areas that have the potential to be used for UPA	Food and Agricultural Research and Extension Institute (FAREI)
	1.4 Establish a new governance mechanism to improve consultation and policy coordination for sustainable urban food systems and strengthen links between different national bodies and local government and CSOs.	MAIFS
	1.5 Include UPA as part of the national policy on food security to encourage household food security	MAIFS
[2] Encourage ecological backyard	2.1 Organise a massive national sensitisation campaign on ecological backyard gardening for food nutrition and household food security.	University of Mauritius (UoM) (Faculty of Agriculture)

[4] The exchange parity Mauritian Rupee (MUR) to United States Dollar (USD) as at 12 September 2022 was 45. The tendency noted is that MUR is depreciating against the USD.

gardening and community gardens for household food security	2.2 Launch a call for Mauritian entrepreneurs to propose low-cost artisanal production systems adapted to backyard gardens	FAREI
	2.3 Set up a legal framework to encourage citizens in built-up areas to lease their roof tops for UPA activities	Attorney General's Office
	2.4 Issue of Bio-farming certificates to citizens to promote bio-food production as part of UPA.	FAREI
	2.5 Raise funds though Parent Teacher Associations (PTA) in colleges located in urban areas for investment in school gardens with the produce shared back to vulnerable households	Ministry of Education, Tertiary Education, Science and Technology (METEST). Collaborators: MAIFS, , PTA of colleges offering agriculture as a subject.
	2.6 Include Agriculture as a main subject at Advanced level in secondary schools	Ministry of Education, Tertiary Education, Science and Technology (METEST)
[3] Promoting food festivals and farmers' markets in urban areas	3.1 Organize Food and Music festivals to help bring citizens closer to consumption of local food	Municipal Councils (on a rotation basis for the 5 towns). Collaborator: Ministry of Arts and Culture; Port-Louis Development Initiative.
	3.2 Setting up of a weekly Farmers' markets for UPA producers to sell their produce	Municipal Councils
[4] Including poor and marginalised groups in urban and peri urban agricultural activities	4.1 Study on participatory approaches to empower poor and marginalised communities in urban and peri-urban areas to develop more targeted actions that can be readily taken up instead of a top-down approach.	Ministry of Social Integration, Social Security and National Solidarity Collaborator: University of Mauritius; NGOs
	4.2 Set up a scheme to encourage young agricultural graduates to set up agribusinesses for roof-top gardening and other UPA activities.	FAREI
	4.3 Promote community gardens on bare lands in urban and peri-urban areas	Municipal Councils. Collaborator: FAREI
[5] Promoting circular economy approaches and reducing waste	5.1 Set up a scheme to subsidise the production of local biofertilisers and biopesticides and encourage agricultural input suppliers to sell these products instead of agrochemicals. Enhance composting of food waste from large markets.	FAREI, MAIFS, Ministry of Environment, Solid Waste Management and Climate Change
	5.2 Carry out a review of the distribution system of fresh fruits and vegetables to Port Louis to reduce the carbon footprint and congestion.	UoM (FoA)
	5.3 Create a common platform where food outlets (restaurants, hotels and super/hyper-markets) can post daily offers regarding available food products that could be redistributed in the community.	NGOs (Food Wise and FALCON Association)

	5.4 Explore the 15-minutes city model for all 5 urban areas in Mauritius to ensure citizens can enjoy all the facilities and amenities within 15 minutes of their homes by walking or cycling. This entails having commercial outlets and other facilities closer to residential areas.	Ministry of Housing and Land Use Planning

1.0 Introducing the study: Context, rationale and objectives

The Republic of Mauritius (Figure 1) is made up of four tropical islands: Mauritius, Rodrigues, Agalega and St Brandon in the Indian Ocean. Mauritius Island is the mainland and the largest and most densely populated, covering an area of 1,865 km^2 with a population of 1,219,187 (Statistics Mauritius, 2022a). The population is made up of descendants of Indians, Africans, Chinese and Europeans. All the islands are volcanic in origin and are surrounded by coral reefs. Mauritius Island has a small coastal plain, mountains and a central plateau. Native forests which originally covered most of Mauritius have almost completely disappeared except for a few inaccessible areas. Mauritius was elevated by the World Bank to a high-income country for the first time in July 2020 based on 2019 indicators (World Bank, 2020). However, due to the recession caused by the COVID-19 pandemic, it slipped back to upper middle-income status (GNI per capita between USD 4,256 and USD 13, 205) in 2021. The tourism sector is a major source of employment, government revenue and foreign exchange earnings. Tourism accounts for 19.5% of the island's Gross Domestic Product (GDP) in 2019) (Hardowar et al, 2020) but decreased to 4.5% in 2021 (Statistics Mauritius, 2021) due to the restrictions in international travels with the Covid-19 pandemic. Agriculture continues to be an important sector in terms of its share in exports and due to its linkages with other sectors. The Mauritian agricultural sector currently contributes 3.9% to Gross Domestic Product (GDP) with the sugar cane export industry contributing 11.9% (Statistics Mauritius, 2021).

Figure 1: Map of Republic of Mauritius (Source: Hardowar and Chikhuri, 2016)

The second largest island, Rodrigues has a population of 44,427 (Statistics Mauritius, 2022a).It is 17.7 km long and 8.5 km wide covering an area of 109 km². The main economic pillars of Rodrigues are agriculture, fishing, tourism and small-scale industries/cottage (handicrafts) for exports to Mauritius. Poverty is estimated at 37.3% of households against 9.6% for Mauritius (Statistics Mauritius, 2020b). Agriculture is predominantly based on subsistence production of staple crops such as maize, red beans, sweet potato and cassava. Onions, garlic, limes, and chilies are consumed locally and exported to Mauritius. The natural resource base of Rodrigues has been negatively impacted by deforestation, soil erosion, water scarcity, a growing population and increased tourism. Cropland cover is between 2 to 5% of the island while pasture lands cover about 6% (FAO, 2021).

Given predictions that 80% of food will be consumed in cities by 2050 (McArthur Foundation, 2019), it becomes critical for national and sub-national governments and urban stakeholders to collaborate closely to manage the challenges and opportunities offered by urban food systems and promote sustainable food systems transformation. Integrated and sustainable models for feeding cities, for instance, sustainable urban farming and shorter supply chains with a circular economy approach, offer potential to reduce environmental impacts (e.g. food miles, food waste, water and energy use, etc.), and enhance green spaces in cities, while benefiting sustainable food security and nutrition, as observed in different parts of the world during the COVID-19 pandemic.

As a Small Island Developing State (SIDS) the Republic of Mauritius faces a number of food related challenges including scarcity of arable land for domestic food production; high dependence on imported food and vulnerability to external shocks; vulnerability to natural disasters and climate change; and distance from regional and international markets (Ramasawmy and Neetoo, 2021). High dependence on highly processed imported food is a growing threat to the nutrition and health of Mauritian and Rodriguan households (WHO, 2020). At the same time, according to MCB (2019), the carbon footprint of Mauritius (6.83 $MTCO_2e$ in 2019)[5] includes households and business/manufacturing emission and those generated from imported goods out of which imported food products represented 18.5 % of all imports in 2021 (Statistics Mauritius, 2022b). In addition, food distribution channels across the island suffer from a number of inefficiencies such as poor storage and transport conditions for fresh fruits and vegetables leading to food loss along the supply chains (MAIFS, 2016) and food waste at the household level (Nunkoo et al., 2021). It has been estimated that 118, 632 tonnes[6] of food are wasted at household level each year in Mauritius from both urban and rural areas combined (UNEP, 2021). In addition, the total food waste from both domestic and industrial sources (146,662 tonnes in 2019), representing 27% of total waste according to the Ministry of Environment, Solid Waste Management and Climate Change, 2019) needs to be transported to landfills, and contributes, along with other types of waste to 26.3% (1,367.8 Gg CO^2 eq.) of GHG emissions (Figure 2) (PAGE, 2015; Statistics Mauritius, 2020a).

[5] Data available at https://www.climatewatchdata.org/countries/MUS?end_year=2019&start_year=1990#ghg-emissions

[6] This figure represents a **low confidence estimate** of food waste in urban areas extrapolated to rural areas from the Food Waste Index, UNEP (2021).

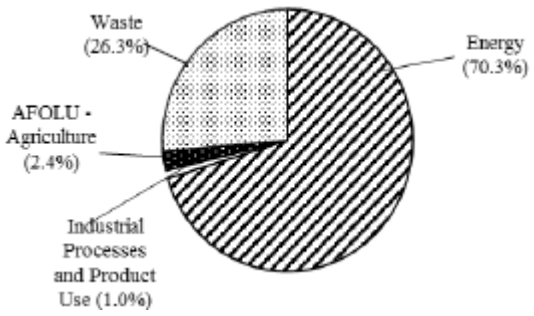

Figure 2: Total Greenhouse gases emissions by sector in 2020 in Mauritius (Source: Statistics Mauritius, 2020a)

There is growing concern for more sustainable and healthier food production and consumption in Mauritius amongst the population in general (Seechurn et al. 2009; Ministry of Environment and Sustainable Development, 2013). This study explores how urban food systems in Mauritius can be made more sustainable through the promotion of urban and peri-urban agriculture (UPA) with emphasis on circular economy approaches, which also enhance food security and self-sufficiency, healthy diets and resilience to shocks. According to Bricas et al (2019), sustainable food systems "protect the environment and biodiversity (…), provide universal access to sufficient, healthy, nutritional and culturally acceptable food (…), rely on an inclusive economic system (…), encourage social cohesion (…) and enable citizens to participate in their development". This transition is all the more urgent in the wake of COVID-19, which has shown the weaknesses of the current food supply chain in Mauritius. With the complete closure and then restricted access to wet markets, fairs and super/hypermarkets, and highly restricted freedom of movement, many Mauritians and especially vulnerable groups had to resort to food aid (WHO, 2020). In addition, the Ukraine-Russia conflict and its impact on fossil fuel and input prices (MCCI, 2022; Muhumuza, 2022) has led to an unparalleled increase in imported food commodity prices and rising inflation. In spite of subsidies on staple foods and certain basic commodities (MCCI, 2021), Mauritians from low-and middle-income groups are finding it increasingly difficult to address household food requirements (Vee, 2022). The COVID-19 recovery process provides opportunities for transformation towards more sustainable and resilient food systems at national and urban level, which this study aims to contribute towards.

Given that cities have limited land for agricultural production, urban and peri-urban agriculture is often not part of cities' urban planning and policy framework. Based on consultations with government bodies[7] such as the Ministry of Agroindustry and Food Security, Ministry of Housing and Land Use Planning, the Food and Agricultural Research and Extension Institute and other stakeholders (eg. FALCON Association, Action for Environmental Action, Port Louis Development Initiative etc. and the private sector) in Mauritius, urban agriculture has been identified as a strategic entry point for promoting sustainable urban food systems. At national level, the Ministry of Agroindustry and Food Security has set-up schemes to promote urban gardens (especially at household level). The Ministry of Housing and Land Use Planning is currently preparing urban development plans to address food insecurity in cities for which urban

[7] The complete list of all consulted stakeholders as part of this study is provided in Annex 1.

agriculture could be explored as an effective solution to increasing access to food by urban poor (eg. in Port Louis) while promoting sustainable and healthy diets and reducing food waste including household food waste which is, estimated at 118,632 tons. The Ministry of Agroindustry and Food Security is preparing its new Agro- Strategic Plan 2022-2025 and has submitted the 1st version of the country's National Pathway for Sustainable Food Systems of the UNFSS, which both offer an opportunity to incorporate urban agriculture with a circular economy approach as part of strategies to promote sustainable urban food systems.

Agriculture in urban or peri-urban areas can take various forms (e.g. home/community gardens, vertical farming, rooftop gardens, hydroponic, etc.) and often requires support in urban development plans (e.g. to use empty spaces in cities, or connect to city infrastructure). If done right, it can benefit multiple sustainability outcomes, and enhance circular economy approaches in cities by closing loops of nutrient cycles, reducing food miles, enhancing farmer-consumer connection, changing consumer's behavior towards food, and addressing food insecurity. Urban agriculture (Figure 3) can help to maintain green spaces and enhance vegetation cover in cities which can have climate adaption and mitigation benefits, helping to control floods, store carbon, and lower heat island effects. Furthermore, it can provide job opportunities and support community development and integration of neglected groups (unemployed, women, disabled people etc.) into economic activities (UNEP, 2022).

However, in urban contexts there is often a need to find a mechanism to coordinate integration of food, and sustainability policies across different levels and agendas of the government, private sector and civil society (Halliday, 2019), and to enhance engagement with urban residents particularly vulnerable groups to promote sustainable urban food systems and improved food security (ACF-International, 2010). In Mauritius and Rodrigues, in spite of public and private initiatives and reports to enhance respect for nature and the environment, policies have traditionally been implemented in a sectoral way without identifying possible cross-sectoral synergies and benefits such as promotion of urban agriculture. This study focuses on two urban food systems in Mauritius namely Port-Louis as the capital coastal city, with very little agricultural production activity, and Vacoas-Phoenix as the second largest town with a very dynamic peri-urban agriculture. The study also offers a short overview of Rodrigues to promote knowledge exchange with Rodrigues, the second biggest island of Mauritius with administrative connections with the Mauritian Government, and provide insights to promote food self-sufficiency and sustainability for the growing Rodriguan population. The findings of this technical study will be used to inform policy decision making in Mauritius and Rodrigues.

Typology	Benefits
Backyard gardens 	***Economic:*** provide fresh, safe and hygienic foods; save income spent on food commodities.
	Social: source of exercise; enhance well-being.
	Environmental: recycling of household organic wastes into compost; reduce pressure on landfills.
Community gardens 	***Economic:*** promote food security for the poor.
	Social: promote intercultural communications; green the city; educate people; strengthen communities.
	Environmental: storm attenuation services; reduce temperature and greenhouse gases.
Allotment gardens 	***Economic:*** enhance self-sufficiency of lower-income residents.
	Social: encourage community participation.
	Environmental: improve biodiversity and ecosystem services.
Rooftop gardens; greenhouses 	***Economic:*** increase organic fruit and vegetable production; create employment opportunities; enhance property value.
	Social: improve aesthetics; provide education; enhance community participation.
	Environmental: increase biodiversity; reduce heat and energy use; recycle organic waste.
Vertical farming 	***Economic:*** reduces energy, packaging and fuel to transport food; turns waste into an asset; offers greater yields; creates jobs.
	Social: improves air quality, the environment and health; supplies fresher local foods; saves time for productive and socially rewarding activities; enhances well-being; encourages higher education and skilled jobs; availability of potable water.
	Environmental: reduces air pollution and need for landfills; requires less space; increases biodiversity; reduces surface water run-off.

Figure 3: Benefits of different types of urban agriculture (Source: UNEP, 2022)

1.1 Objectives of the study

The overarching aim of this study is to support a transition to a more sustainable, resilient and healthy urban food system by using the city of Port Louis and the town of Vacoas-Phoenix as drivers of change in Mauritius. The study aims to identify the main problems faced by urban food systems in Mauritius and propose actionable solutions for sustainable food system transformation, taking into account the contexts of food systems policy and governance in the country. It aims to explore the potential of UPA systems with circular economy approach (e.g. vertical gardens, household gardens, school gardens) to address various food system challenges, including food security (e.g. access to nutritious and sustainable food by urban poor; enhancing livelihoods of farmers), while promoting more resilient and resource-efficient urban development (e.g. urban agriculture as green spaces, reduction of food waste through composting systems, water recycling etc.).

The specific objectives are as follows:

(1) To identify problems faced by urban food systems in Mauritius and explore urban-rural linkages and dynamics in Port Louis, Vacoas-Phoenix and Rodrigues island.
(2) To explore how UPA interventions using a circular economy approach could be a solution for more sustainable urban food systems, reducing resource use, food waste and GHG emissions.
(3) To provide recommendations for UPA interventions, policies and governance measures, that can enhance sustainability, food security and healthy diets.
(4) To carry out a socio-economic analysis of 1-2 proposed recommendations and expected gains from implemented solutions.

1.2. Methodology

The study entailed a holistic urban food systems assessment using a mixed research method entailing collection and analysis of both quantitative and qualitative data. Data was collected on the main food systems challenges (environmental, socio-economic, food security/nutrition, etc.) and governance framework of the 2 city/town in Mauritius (Port Louis and Vacoas-Phoenix); the status of urban and peri-urban agriculture in Mauritius; and interventions that can enhance urban and peri-urban agriculture for improved sustainability, circularity and food security. Primary data was collected through key informant interviews using a semi-structured questionnaire (Annex 2), with Ministries and parastatal bodies including the Ministry of Agro-industry and Food Security, the Agricultural Policy Analysis Unit (APAU), Food and Agricultural Research and Extension Institute (FAREI), the Ministry of Housing and Land Use, Ministry of Environment, Solid Waste Management and Climate Change, municipal councils, local government associations, and Civil Society Organisations (CSOs), including FALCON Association, Action for Environmental Action, Port Louis Development Initiative (PLDI). Some private organisations[8] were also interviewed as per Annex 1. Twenty interviews were conducted from April to June 2022. The study also entailed a desk review of existing policy documents from different public and private institutions and relevant literature on urban food systems.

Given that wet markets account for a significant amount of food waste, data was collected to help provide estimates of waste from Vacoas auction market and an idea of the volume of fresh food available to Vacoas citizens (see Section 6.1.2). Observations were made during several visits to Vacoas auction market over three weeks (June to July 2022) to capture the volume of fruits and vegetables transiting. Discussions were also held with auctioneers licensed to operate on the Vacoas auction market planters, middlemen, traders, associations of planters (small and large), an association of market traders, an association of auctioneers and FAREI Biometry Unit.

The findings and recommendations of the study were discussed at multi-stakeholder dialogues for the Vacoas-Phoenix case study (including a virtual session with Rodrigues) and the Port-Louis case study, on 7th and 9th September 2022 respectively. Different food systems actors have validated the findings and prioritized actions and policy measures to foster UPA and circularity as a means to promote resilient and

[8] Private organisations such as Mauritius Chamber of Agriculture and Business Mauritius play an important role in policy advocacy especially as they represent large producers and corporate sector

sustainable urban food systems. They also agreed on the setting up of a multi-level stakeholder mechanism to take forward the prioritized actions.

1.3 Food systems in Mauritius and Rodrigues

From 1997 to 2020, the contribution of agriculture to GDP decreased from 9.1% to 3.9 % (Statistics Mauritius, 2022d). However, agriculture still contributes to foreign exchange mainly through the export of sugar (MCCI, 2022). Mauritius is a net-food-importer which relies heavily on imported food and raw materials (MCCI, 2022); with food self-sufficiency at 23% and imports at 77% (Statistics Mauritius, 2021). Following the 2008 financial crisis and world food crisis, the government of Mauritius set up a National Food Security Fund to foster local food production and reduce dependence on imported commodities. Both imports of raw materials for local processing and exports have increased significantly in the recent past. Increasing agricultural and food imports contribute to the already wide trade deficit. The country's food import bill was more than 1.1 billion USD in 2020 with agricultural imports accounting for 26.1% of the total imports (Statistics Mauritius, 2022b). Currently, food crop production (106,621 tonnes per year) in Mauritius relies heavily on external inputs such as inorganic fertilizers, pesticides and herbicides as well as irrigation water, and is dominated by small scale farmers (average holding of 0.25 ha) and a few large farms (greater than 10 ha). The livestock sector consists mainly of small-scale farmers breeding cattle, goats, sheep, pigs, deer and poultry. GHG emissions from agricultural production activities have increased from 2% in 2019 to 2.4% in 2020. With a total water utilization in the Republic of Mauritius of 997 $Mm^{3,}$ the agricultural sector accounted for a third (31%) (305 Mm^3) of this (Statistics Mauritius, 2020a).

Mauritius is 100% self-sufficient in poultry and eggs (using imported maize feed), venison and pork, and close to 100% self-sufficient in vegetable production except for sporadic shortages due to natural calamities like cyclones and drought. However, dairy products, meat and fish and their preparations are important items in the import basket (Statistics Mauritius, 2022c). With declining herd sizes, Mauritius is less than 10% self-sufficient in beef and milk production in 2020 (Statistics Mauritius, 2021). A wide range of crops including potatoes, onion, tomatoes, chilies, crucifers (cauliflowers), garlic and ginger are commercially cultivated whereas local fruits mainly come from backyard production (e.g. passion fruit, longan, avocado, bilimbi, etc) except for some commercial production such as pineapple, papaya, banana, watermelon, litchi and mango. Some vegetables such as red cabbage, carrots, cabbage and butternut squash are imported mainly for hotels; while onions, potatoes and garlic are imported during seasons when they cannot be produced in Mauritius. Over the last five years there has been a decline in total vegetable production. The country is not self-sufficient in tropical fruits and relies on imported temperate fruits a lot. Imported fruits include apples, oranges, kiwis, grapes, etc. Imported tropical fruits could be substituted with local fruits from backyard gardens. Local fruit production is estimated at 42,000 tonnes annually over an equivalent of about 3,000 ha of land (Statistics Mauritius, 2021). Staple grains such as rice and wheat (milled into flour locally) are imported as well as maize used for livestock feed. Traditional food crops that could substitute rice and wheat flour in the Mauritian diet, like eddoes, cassava, breadfruit and sweet potatoes are produced in very small quantities. Increasing cultivation of these food crops, exploring the potential for value-additionand sensitization of consumers on the benefits of eating local products could contribute to a decrease in reliance on imported counterparts.

Around 40% of land in Mauritius is covered by sugarcane (Statistics Mauritius, 2021). In light of decreasing sugar prices, a new plan has been adopted to restructure the sector, and encourage diversification of sugarcane lands to food crop production. An attempt is also being made to transform Mauritius into a seafood hub by developing value-added fisheries and seafood-related activities. These diversification strategies at national level require technological inputs as well as associated research. For example, aquaponics production on a commercial scale will lead to the establishment of a value chain with relevant actors including suppliers of equipment and materials for the production activity. The presence of such actors (input suppliers) in the agri-food business sector in Mauritius will facilitate the uptake of small scale aquaponics systems at household level and encourage citizens to explore this type of production activity for some level of self-sufficiency in fresh vegetables. Traditional marketing channels for food crops in Mauritius include farmgate sales; collection of fruits and vegetables by traders (wholesalers) who then sell directly to retailers or though auctioneers.

The productive structure of **Rodrigues** is based on a traditional semi-commercial economy, which depends essentially on agricultural, livestock and fisheries sectors, which are not chemical intensive. The output from these primary products is predominantly for the local market with surplus being exported exclusively to the main island of Mauritius. In addition, handicraft products represent an important source of income for Rodriguans, especially as the tourism sector is gaining importance. The manufacturing sector is limited to a few enterprises and small agro-industries producing primarily for the local market. Key agricultural products from Rodrigues include lime, chilies, red beans, honey, pickles, onions and maize. Natural calamities, such as droughts and frequent cyclones discourage farmers from making good use of their natural resources. Water shortage is the main problem in Rodrigues, as farmers rely on rain to cultivate their land. Cultivation of maize, onion and garlic are mainly done in the valley. Animal rearing is done on the upper plateau where grasses grow abundantly. Irrigation facilities are provided in some areas (Grand Var, Mourouk, Baie Malgache, Mt Plate and Graviers), as well as three water harvesting structures (at Nassola, Riviere Banane and Papayes), which have benefited more than 50 planters. Water user groups have been formed by planters and training organized for them to rationalize the use of water to make it more efficient and equitable.

1.4 Urban food systems in Mauritius

Mainland Mauritius has 1 city (Port-Louis as the business and administrative capital) and 4 towns (Curepipe, Vacoas-Phoenix, Beau-Bassin-Rose-Hill and Quatre-Bornes; while the outer island of Rodrigues has 1 town (Port-Mathurin) which is the business and administrative capital. Port Mathurin is often referred to a village or town but strictly speaking as per Statistics Mauritius (2015), the whole of Rodrigues is referred to as being rural. Mauritius is made up of 9 districts (Rodrigues is referred to as the 10^{th} district) and also divided into administrative regions namely into 5 Municipal Council Areas (MCAs) and 7 District Council Areas (DCAs) (Figure 4). Each MCA represents one urban area (one town) and each DCA represents a rural region (several villages).

Figure 4: The five Municipal Council Areas (in orange boundary) and seven District Council Areas in Mauritius (Source: Kaudeer and Venkannah, 2020)

Table 1 shows the spread of the population over the years 1990 to 2011 for the last three Household and Population Census (HPC) in urban areas. This data will be updated soon with the ongoing HPC for 2022.

Table 1: Population density of urban areas for the last three HPCs (1990 to 2011)

Urban area	Population density (p/km2)		
	1990	2000	2011
Port Louis	3,108	3,265	2,959
Beau Bassin/ Rose Hill	4,547	5,137	5,111
Quatre Bornes	3,303	3,164	3,207
Curepipe	3,068	3,339	2,946
Vacoas/Phoenix	1,890	1,856	1,947

Source: Kaudeer and Venkannah (2020).

With a rise in the number of inhabitants in some villages as well as a better quality of life, it is increasingly complex to demarcate clearly urban and rural areas in Mauritius as per the legal specifications. As per the Health Statistics report of 2020, Table 2 provides a breakdown of the population size in the 5 towns of Mauritius with 41.8% of the total population living in urban areas in 2020.

Table 2: Resident population of Towns in Mauritius (Estimates, 2020)

Municipal Council Area	Population Size
Port Louis	145, 793
Vacoas-Phoenix	105,688
Beau Bassin-Rosehill	103,452
Curepipe	78,256
Quatre Bornes	77,084
Urban Population	510,273 **(41.8 %)**
Rural Population	711,648 **(58.2%)**
Total Population (Mauritius)	**1,221,921**

Source: Health Statistics Report, 2020

An urban food system can be conceptualized as shown in Figure 5, with the pathway linking it to food security.

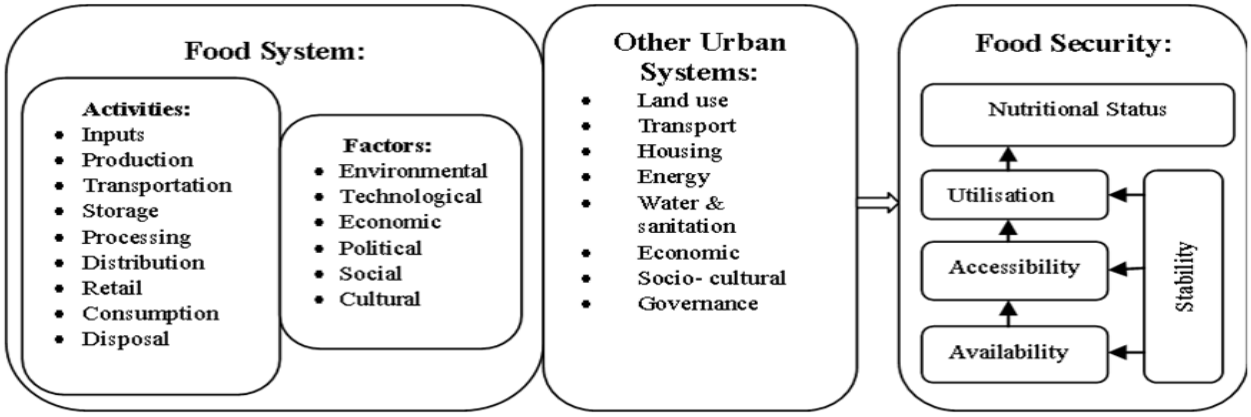

Figure 5: Conceptual framework for urban food system linked to food security (source: Opiyo and Agong, 2020)

In Mauritius, locally cultivated fresh fruits and vegetables and some livestock products such as broiler chicken meat, eggs and other types of meat (beef, pork, venison) are sold at different types of food outlets in urban areas including wet markets, fairs, grocery stores, road stalls and super/hypermarkets. Table 3 shows that as per the HPC of 2011, the majority of households procured their fresh fruits and vegetables from wet markets.

Table 3: Distribution (%) of outlets visited by households for buying fresh vegetables and fresh fruits

Outlet Type	Fresh Vegetables (%)	Fresh Fruits (%)
Wet Market (Bazar)	62.1	57.0
Open Market (La Foire)	22.8	18.8
Supermarkets	6.0	13.4
Street Vendors	5.9	7.4
Shops	2.4	3.2
Vegetable Shops	0.9	0.3

Source: Statistics Mauritius (2015)

Processed food manufactured locally or imported (e.g. pulses, powdered milk, canned meat products, fish and fish products are imported from a range of countries by air or sea freight) are distributed via grocery stores and super/hypermarkets. Agrifood supply chains in urban areas are well established with a number of intermediaries including wholesalers, importers/distributors, retailers and hawkers. Food availability in urban areas is regular and continuous and there is a wide array of food products available. Physical access to food is not a challenge due to short distances between food retail outlets and residential areas and very good public roads. However, the disruption of the food supply chain in Mauritius during the Covid-19 pandemic has highlighted the fragility of the national food system especially at the distribution level (Box 1).

Box 1: Disruption of physical food access during the first lock down period of the Covid-19 pandemic in Mauritius

The restriction on human mobility during the first lockdown period coupled with the closure of all food retail outlets (grocery stores, super/hypermarkets, wet markets and fairs) had a major impact on physical food access in Mauritius in 2020. At the same time, fresh fruits and vegetables traders/distributors could not also sell their produce through the traditional marketing channels and only two resorted to online orders and door to door delivery. In addition, the measures taken to prevent free movement of people had an overall impact on food production. From 19 March 2020, Mauritius was under national containment; lockdown ended on 30 May 2020 while borders were reopened on 15 July 2021. During COVID-19, due to national restrictions on mobility, farmers found it hard to provide fresh farm products to consumers as it was difficult to access fields for harvesting and preparation for cultivation during the first month of lockdown. Similarly, middlemen and truck drivers in agrifood supply chains could not work. Hence, many crops were left abandoned in fields and farmers could not supply their products to hotels which were not operational due to closure of borders. This situation also led to increased levels of food loss (MAST, 2020; Hardowar et al, 2020). There was an 18% decrease in food crop output in the first semester of 2020 compared to the same period in 2019, due to restricted mobility during the Covid-19 lockdown period. During the above period, households resorted to picking local fruits and vegetables from their backyards and/or exchange of fruits and vegetables between neighbours. Immediately after the lift on mobility restrictions after the first lockdown period, a number of households found an increased interest in backyard gardening as they saw the value of having fresh fruits and vegetables at hand.

Urban inhabitants also have access to clean and potable water and all houses are equipped with adequate sanitation for food preparation under good hygienic conditions. There is no recent study on food utilization that is directly linked to the nutrition security of individuals in urban households. However, the National Nutrition Survey 2022 has been launched on 23rd of July 2022 by the Ministry of Health and Wellness in collaboration with international organisations and will study the food consumption patterns and access the nutritional status of the populations to help address nutrition-related health problems and Non-Communicable Diseases (NCDs) in Mauritius.

There has been a shift from traditional and local and low-calorie and nutrient-rich foods such as cassava, eddoes, sweet potato to energy dense and highly processed imported food products in both rural and urban areas (Bhurosy and Jeewon, 2016). Uusitalo et al (2007) identified a “dietary Westernisation” of

young, educated and wealthier adults with consumption of foods such as cakes/pastries, fast foods, burgers and breakfast cereals. This nutrition transition is driven by a number of socio-demographic and economic factors including culture (Pugo Gunsam and Murden, 2007), and increased income (Dunneram and Jeewon, 2013). According to the Health Sector Strategic Plan (HSSP) 2020-2024, unhealthy diet is one of the factors which has led to an increase in NCDs[9] in Mauritius (Ministry of Health and Wellness, 2020). The demand for fresh local tropical fruits and vegetables from urban areas is met mainly from peri-urban and rural farming as well as from imports (especially for temperate fruits, and some vegetables imported mainly for hotels). According to Statistics Mauritius, the country imported some 28,000 tonnes of vegetables in 2019 (including 14,700 tonnes of onion, 8,900 tonnes of potato, 1,800 tonnes of garlic) and some 24,000 tonnes of fruits. In 2018, the imports stood at around 32,300 tonnes and 23,000 tonnes for vegetables and fruits respectively (Statistics Mauritius, 2018).

Harvested fruits and vegetables are usually transported from farms to three auction (wholesale) markets, two of which are located in urban areas (Port Louis and Vacoas) and one in a rural area (Flacq). Fruits (local and imported) and vegetables (local and imported) are then redistributed across the whole island. Official statistics published in 2014 estimate the percentage of vegetables produced locally and sold through auction wholesale market at 70.9%. The figure for fruits is 89.9%. Actual figures gathered from fieldwork (including discussions with stakeholders) are between 60% to 70%. The highest volumes of vegetables are traded in Vacoas and in Port Louis auction markets and this has implications for the sustainability of the supply of fresh fruits and vegetables in urban areas. Firstly, the movement of fresh fruits and vegetables across the island leaves a carbon footprint as it involves a number of trips from the farm to the auction market and to different wet markets and open markets as well as other food retail outlets across the country. Secondly, it is estimated that there is between 10-30% of food loss (Ramma, 2018) along the fruit and vegetable supply chain depending on perishability, type and length of marketing channels, number of intermediaries handling produce, farming practices, climatic conditions, production levels (surplus or shortage) and connectivity with markets. Shorter marketing channels should be promoted as is the case of the “Ti-Bazar” as described in Box 2 below:

Box 2: The “Ti-Bazar”: Example of a shorter marketing channel for fresh fruits and vegetables

A most recent example of an upcoming trend for shorter supply chains has been the setting up of small/average roadside stalls following the two lockdown periods due to the Covid-19 pandemic. These roadside stalls commonly known as “Ti-Bazar” in the local vernacular (meaning small wet market) has become the preferred source of supply of fresh fruits and vegetables for a number of Mauritians who find it easier to stop by on their way back home from work. The fact that these “Ti-Bazar” are also close to residential areas or with direct access on motorways are also attractive to consumers. Over time, the consumers have gained trust and confidence in the roadside sellers as they can see a high turnover of the produce which implies regular procurement and fresh products; and through conversations with the seller, the consumers can also establish that the source of supply of the produce can be trusted.

[10] Available at https://budgetmof.govmu.org/documents/2022_23budgetspeech_english.pdf

2.0 Case studies: Vacoas-Phoenix, Port Louis, and Rodrigues Island

This section analyses urban and peri-urban food systems through three case studies, firstly, the town of Vacoas-Phoenix; secondly, the capital city of Port-Louis; and thirdly the outer island of Rodrigues. It focuses on main food systems sustainability issues related to different stages of the agrifood supply chain from food production, processing, transport and distribution logistics, selling and marketing, consumption behaviours and patterns and food loss and waste.

2.1 Case Study 1: Town of Vacoas-Phoenix

Vacoas-Phoenix (110 km^2), known as 'twin-cities' is located in the District of Plaines Wilhems, between Quatre-Bornes and Curepipe (Figure 6). It is the only town with a peri-urban agglomeration recognised for its agricultural activities, mainly livestock rearing and vegetable production and supplying the main auction market in Vacoas. One of the aims of the Municipal Council of Vacoas-Phoenix is to promote UPA within the administrative area by safeguarding agricultural lands from other uses. A significant proportion of the population of Vacoas-Phoenix is engaged in agriculture and food production. Fruits, vegetables and livestock are abundant in the Vacoas-Phoenix region especially Vacoas, compared to Port Louis. The availability of fresh fruits and vegetables in both urban and peri-urban regions of Vacoas-Phoenix decreases the risk of food insecurity (Source, H. Ramroop, personal communication, 2022). According to the Town and Planning Officer of the Municipal Council of Vacoas-Phoenix, 'Urban Agriculture' is defined as the integration of agriculture within the economic, social, ecological system of urban areas. Urban agricultural practices in the town are located in the upper Plaines-Wilhems. Vacoas-Phoenix has its roots in gardening. The land within the Council administrative area and in its peripheral suburbs are fertile and contribute significantly to the production of food for local residents and the whole island. In Vacoas-Phoenix, the following types of urban agriculture exist: backyard gardening, urban farms, rooftop and balcony gardens, hydroponics, aquaponics, micro vertical gardening, livestock rearing such as hens and goats, and agricultural parks.

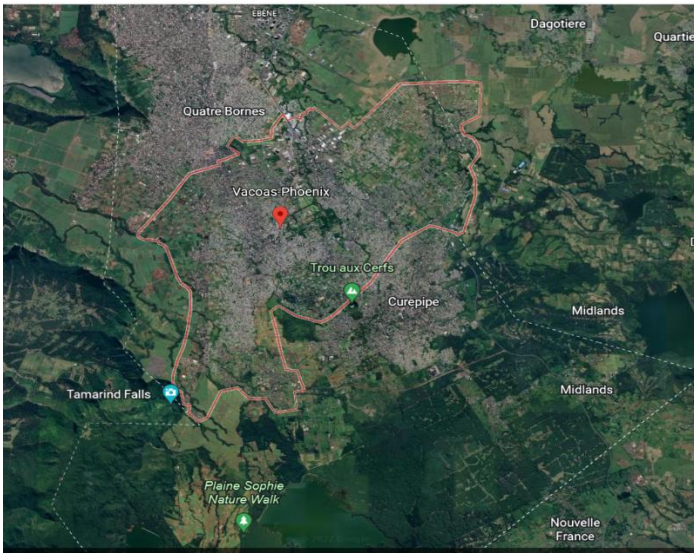

Figure 6: Map showing the town of Vacoas-Phoenix.

Peri-urban regions such as La Marie, Glen Park, Henrietta and Bonne Terre are largely under agriculture including open field cultivation of vegetables, fruit trees and livestock production. There are around 122 progressive growers over a total estimated area of 37164m^2 undertaking hydroponics and sheltered production of salad tomato, sweet pepper, English cucumber, lettuce and ornamentals. However, these growers still rely on chemical inputs. 75% of farmers operate on a full time basis and 25% on a part time basis. Given that Vacoas-Phoenix is located in a humid/superhumid zone with an average monthly rainfall of 72 to 129 mm, most farmers practice mainly rainfed agriculture. However, 75% of 130 hectares in the region of Solferino use sprinklers, mini sprinklers and drip irrigation (R. Gopaul, personal communication, 12 July 2022). Table 4 below shows the zone profile of Vacoas-Phoenix in terms of production of food crops.

Table 4: Zone profile of Vacoas-Phoenix food crop production

Town	Regions	Main crops (full stand)	Acreage (hectare)	No. of farmers	2021 Production Crops (Tonnes)
Vacoas	Solferino	Onion, Potato, Tomato, Chilli, Cabbage, Creepers, greens, spices	130	50	528.43
	Paillotte, Candos	Greens	10.5	22	127.18
	Carreau Laliane	Crucifers, Beans, Chillies, Greens, Salad Crops, Fine herbs, Sweet pepper	25	65	411.42
	GlenPark, Perrier, Bernica	Foodcrops, Orchard	85	47	495.72
	La Marie, La Foret	Foodcrops, ornamental	126	55	581.32
	Hollyrood, Quinze Cantons, Bonne Terre, La Caverne, Route Abattoir	Onion, Potato, Tomato, Chilli, Cabbage, Creepers, greens, spices	8.4	37	53.88
	Plaines Sophie, Mare aux Vacoas, New Beards, De Rauville	Foodcrops, Orchard	200	158	766.53
	Mare Longue	Foodcrops, Orchard	85	38	1167.30
	Closel, Tamarind Falls	Foodcrops, Orchard	127.10	56	289.11
	Henrietta, Camp Roches, Camp Bellin	Foodcrops, Orchard	87.10	43	107.33
	Clairfonds	Crucifers, Greens, Fine herbs, Tomatoes	4.2	14	19.80
	St Paul	Greens, Spices, Creepers, Tomatoes, Squash, Chillies	6	12	67.66

	Belle Terre, Cinq Arpents, Camp Fouquereaux, St Antoine, Highlands, Hermitage, Belle Rive	Potato, Tomato, Cabbage, Creepers, Salad Crops, Ginger	130	50	388.87
Phoenix	Closel, Phoenix, Allee Brillant, Castel, Mesnil	Crucifers, Beans, Chillies, Greens, Salad Crops, Fine herbs, Creepers	18	32	352.426
Total			**1042.3**	**679**	**5356.98**

(Source: Hardowar and Poran, own computation collected from Extension Service, FAREI, July 2022)

Crops and animals produced are consumed directly at the level of farming households and also are marketed through various channels such as directly at farm gate, at the Vacoas auction and retail wet market, on road stalls and in super/hypermarkets. The town is largely self-sufficient in fresh vegetables as the latter are produced in the peri-urban areas of the town. More details on the structure of the wet market in Vacoas can be found in Annex 4. The market infrastructure provided by the Municipal Council of Vacoas-Phoenix allows both auction and retail markets to take place in the same location and makes this wet market a busy centre for trading of fresh fruits and vegetables and attracts a lot of consumers on market days. The number of classified traders in the Vacoas market highlights the importance of this market in the region and encourages peri-urban farmers and intermediaries in fruit and vegetable value chains to continue production and distribution activities. This is important to maintain continual access to fresh fruit and vegetables for urban and peri-urban customers (38,000 households). Consumers usually find fresh vegetables and fruits from the Vacoas wet market fair and other outlets abundant and affordable under normal production conditions, because they are produced in urban and peri-urban regions of Vacoas. The majority of fresh fruits sold in other retail outlets are imported (apples, oranges, kiwis, grapes, citrus, pears, apricots etc.). Some seasonal fruits (mangoes, litchis, watermelons) and local fruits can be found all year round (bananas, pineapples, papayas).

There are short distances between the site of production and the wholesale (auction market) and retail outlets. Fresh fruit and vegetables are transported to the sales outlet for commercial exchanges between buyers and sellers. However, according to auctioneers in the Vacoas auction market, vegetables and fruits produced in other regions of the island are also traded in Vacoas as this enables auctioneers to have the maximum volume of a particular agricultural commodity. Furthermore, the Vacoas auction market and fair generates high levels of food waste - around 25-30 tonnes on a weekly basis (Public Health Inspector, Municipal Council of Vacoas-Phoenix, Pers. Comm.). This waste is not composted and is transported from the Municipal Council of Vacoas-Phoenix to the landfill site at Mare Chicose and contributes to greenhouse gas emissions. However, Ministry of Environment is establishing a compost facility to reduce this waste and related GHG emissions and enhance the supply of compost for sustainable agriculture in Mauritius, given the rising costs of imported fertilizer.

2.1.1 Urban and Peri-Urban agriculture opportunities and benefits in Vacoas-Phoenix

The Municipal Council of Vacoas-Phoenix has been encouraging UPA through a number of measures:

(1) Trade permits for input suppliers: Delivery of trade permits to agricultural inputs and farm implement suppliers who benefit from UPA through sale of their goods. The close geographical proximity of agricultural suppliers to the farming community in Vacoas-Phoenix facilitates agricultural production activities through timely supply of seeds, fertilisers, pesticides, farm tools and implements as well as provision of technical advice to new entrepreneurs. However, the sale of chemical inputs means that the type of UPA promoted is generally not environmentally sustainable.
(2) Food production by citizens: There are opportunities to enhance UPA in Vacoas-Phoenix and for citizens to participate directly in their own food system, while gaining a sense of empowerment and control of the food they consume in terms of types of inputs used (less or no chemicals) with a direct positive impact on their health status. UPA can provide full time employment to local residents through sustainable food production on their own plot of land or at small, medium or large-scale levels. The schemes from the Ministry of Agroindustry and Food Security to encourage backyard gardening, described in Section 7.1, could help to enhance UPA in Vacoas-Phoenix.
(3) Market infrastructure: The renovation and accessibility of the physical infrastructure of the Vacoas auction and retail wet market, now being transformed into the Vacoas urban terminal with the metro light rail, is also an opportunity provided by the town to encourage market exchanges between buyers and sellers of fresh fruits and vegetables.
(4) Land use and planning: The National Physical Development Plan (NPDP) has set out national planning objectives and seeks to implement specific proposal for Vacoas-Phoenix Municipal Council Area (MCA). One of the NPDP objectives is to protect good agricultural land from building development (policy 3.1 on 'protecting agricultural land'). It is desirable to discourage the loss of agricultural land to urban development and other non-agricultural uses as once land is converted, it becomes irreversible reducing land for agricultural production. The existence of undeveloped land areas within the Vacoas-Phoenix Municipal Council Area (MCA) provides a reserve of additional land which could be used for UPA to increase self-sufficiency in certain key commodities, and provides green spaces for carbon sequestration purposes, while helping to retain the spatial identity of nearby villages. Vacoas-Phoenix lies over an important aquifer from which the central water authority extracts potable water from 8 boreholes.

The conurbation of Vacoas-Phoenix has considerable capacity for additional residential development but there are major tracts of lands that are still under rural and agricultural uses. As per the National Forestry Policy, the Ministry of Housing and Land Use Planning does not allocate state-owned lands such as Mare-aux-Vacoas for agricultural activities as it is an upland forest territory located in the major water catchment areas which regulate surface water run-off, floods and ground water recharge, and has been set aside for protection (Ministry of Agroindustry and Fisheries, 2006). All developments (for instance, construction) extend to outside the town of Vacoas-Phoenix. The additional lands especially in the peri-urban regions from forest areas are allocated for agricultural purposes and are often increasingly available in the region of Vacoas-Phoenix. According to the Municipal Council of Vacoas Phoenix, it will be impossible to delocalize planters and farmers of Vacoas-Phoenix.

2.1.2 Challenges for Urban and Peri-Urban agriculture in Vacoas-Phoenix

There are a number of challenges that need to be addressed in order to encourage more sustainable and extensive UPA in Vacoas-Phoenix. The major problems faced by growers in the Centre West of the island, where Vacoas-Phoenix is located, are erratic climatic conditions due to climate change, increased resistance of pests and diseases, shortage and high cost of human labour, high cost of inputs post-COVID and limited land for cultivation which is gradually being converted to residential areas:

(a) Labour shortages: The majority of the labour force are 65 to 75 years old and no young labour force is expected in the coming years. As such, the area under labour-intensive crops such as beans has been reduced for the past two years thereby decreasing supply in the local market. Beans have been constantly fetching a very high price in the market.
(b) Land availability: With more agricultural land being converted in part or fully to residential land, there is less land available as a productive resource for agricultural production activities in peri-urban areas.
(c) Pests and Diseases and use of chemicals: a number of pests and diseases affect vegetable and fruit production, including melon fly pest in creepers, *Helicoverpa armigera* in tomato, leaf miner in various crops, white fly in greens, diamond-black moth in crucifers and mealy bugs, *Stremphyllium* blight in onion, late and early blight in potato and tomato, bacterial diseases in crucifers, didymella in creepers, and new emerging pests namely Fall Army Worm and *Tuta Absoluta.* This has an impact on the yield and quality of vegetables and fruits produced in the Vacoas-Phoenix region and affects the volume of produce that can be traded. In addition, with the use of pesticides to control pests and diseases and chemical fertilizers, the long term sustainability of fruit and vegetable production systems can be questioned as agrochemicals can impact on human health, biodiversity and soil health/quality and pollute water.
(d) Climate change: The prevailing hot weather during certain periods of the year contributes to bolting in summer lettuce varieties. Heavy rainfall leads to broccoli curd rots in several fields in Carreau Laliane and thus number of broccoli producers has significantly decreased. Another challenge to UPA in Vacoas-Phoenix is flooding since the region is prone to heavy rainfall. Climatic factors such as cyclones, flash floods, droughts have a negative impact on yield and therefore on market availability of fresh vegetables and retail prices which fluctuate from low to very high. At high prices, consumers usually reduce their consumption of fresh fruits and vegetables and turn more towards processed (canned or frozen) vegetables which are mostly imported.
(e) Pressure for agricultural land conversion: There is a high demand to convert agricultural land into other uses for example for residential purposes. In some areas, however, the Municipality of Vacoas-Phoenix does not release lands for other uses because of catchment areas for retaining water. UPA are not included in the Municipal Council's development plan, but local government limits the fragmentation of agricultural lands and their premature conversion to non-agricultural uses, especially in areas where agriculture has been identified as a primary land use in the region. Municipal planning policies and tools that promote efficient use of land have been used where appropriate to support this strategy especially for the region of Vacoas.

Currently, there is no national land use planning policy that recognizes and supports UPA in Mauritius and urban development officers do not address urban agriculture through urban development plans (only

green areas). However, this will be considered in future plans. A Master plan exists for the town of Curepipe only. A Master plan for Vacoas is in the pipeline and one for Port Louis will be developed thereafter and these plans will include urban agriculture.

There are also challenges regarding transport of fresh fruits and vegetables and livestock commodities. No scientific study to date has evaluated GHGs emissions from the transport of fresh fruits and vegetables and livestock products to Vacoas auction market. However, the town of Vacoas-Phoenix has come up with a number of measures to reduce traffic congestion by providing parking spaces next to the Vacoas wet auction and retail market. The operation of the metro light rail by the end of December 2022 will also facilitate transport to the wet market and other outlets instead of using private vehicles.

Food waste from municipal markets is significant (900-10,000 tonnes per year) and represents a major environmental challenge and contributing to GHG emissions. In order to address this, a composting plant for green waste from the Vacoas-Phoenix market and auction market as well for other markets will be set up in Henrietta (a peri-urban area of Vacoas-Phoenix). This was announced in the budget 2020/2021 but has still not been implemented due to lack of funds. This is in line with the circular economy model where the principle of three R's will be fully respected namely Reduce, Reuse and Recycle. (R. Bundhoo, personal communication, July 2022). According to the Solid Waste Division of the Ministry of Environment, Solid Waste Management and Climate Change, a major composting project with an investment between MUR 10-12 million, is in preparation and will be completed by 2024 whereby green waste across the island will be composted and sold back to individuals and planters to cater for the demand for compost which amounts to 100 tonnes per year currently being imported. In parallel, there will also be a massive sensitisation and awareness campaign targeting Mauritian citizens on the importance of sorting their household waste. Composter bins will be supplied to each household. In addition, a composting bill is also in preparation and will be completed in 2024 and will help enforcement of sorting of solid waste at the level of individual households as well as businesses.

2.2 Case Study 2: City of Port-Louis

Port Louis is located on the north-west coast of Mauritius in the District of Port Louis and is the only city of the island. It is divided into 8 Municipal Wards (MW) and has a population of 149, 672. According to the poverty mapping study of Statistics Mauritius and the World Bank in 2001-02 and 2006-07, Port Louis had the highest poverty rate in the country ranging from 7% for Ward 1 to 14-15% for Ward 5. Figure 7 provides an overview of the city.

As the main commercial, business and administrative centre of the island, there are around 100,000 to 200,000 people transiting through the city on week-days. The only commercial harbour of the island is located in Port Louis and is a strategic point for importing food and exporting manufactured goods such as sugar. The city also has important public institutions (including the Mauritian Parliament and the Government House and some ministries) and private institutions (e.g. the Mauritius Chamber of Commerce and Industry; the Mauritius Sugar Syndicate etc). Port Louis is a built-up area with some green areas mainly used for leisure and recreational activities (e.g. Jardin de la Compagnie; the Champ de Mars hippodrome etc.). According to the Municipality of Port Louis, there is no large-scale commercial

agricultural production activity within Port Louis due to lack of agricultural land. However, some agricultural production activities take place in a few peri-urban areas such as Cité La Cure and Vallée des Prêtres with a maximum of 30 acres (individual growers) under fruit orchards (litchi, mango) and greenhouse (hydroponics) production of some vegetables. There is also some seedling production in Pointe aux Sables. All the produce is sold in the Port Louis urban wet market. There are also 251 traders dealing in meat and fish products; and 282 traders dealing in cooked food with the raw materials sourced from all over the island. These traders are located in the nine markets and fairs within the administrative area of Port Louis. In addition, the Victoria Urban Terminal (VUT) provides stalls for 72 vegetables/fruits sellers and 75 stalls for sale of cooked/precooked foods (Mr S. Ram, personal communication, 2022). There are 9 urban wet markets (747 traders) in Port Louis for the sale of fruit and vegetables and one main auction market which conducts daily auctions of fruit and vegetables from all over the island. Thus, as a city, Port Louis is not self-sufficient in fresh fruits and vegetables and livestock products.

Figure 7: Map showing the city of Port Louis with orange line showing the delimitation

There is no disaggregated data on reliance on imported food for different regions of the country or on the percentage of imported food consumed in Port Louis. A very large percentage of imported food items transit through Port Louis and are then distributed via wholesalers and retailers to the rest of the island including outer islands like Rodrigues. Although the distances between urban and rural areas in Mauritius are relatively short, the environmental impact of the movement of vehicles from rural areas and some peri-urban areas to Port Louis for the delivery of fresh fruits and vegetables is thought to be quite significant (Box 3).

Box 3: Movement of goods vehicles in Port-Louis and environmental impact

Port-Louis is the network hub at the centre of the 5 urban areas in Mauritius (Rahman et al, 2012). The transport sector contributes about 25% of CO_2 emissions (Rahman et al, 2012) and the latter represented about 70.3% of all GHG emissions in Mauritius in 2020. An average of 50 goods vehicles/ lorries bring fruits and vegetables on a daily basis. Five goods vehicles are involved daily in transporting fruit and vegetables from auction sale sites to different regions of Port Louis covering an average of 5 km each in food miles. Around 5 trips per vehicle are performed daily for delivery and/or distribution. Two goods vehicles are involved in transportation of fresh vegetables and fruits to the hotels and resorts (one trip per day). An average of 20 small vehicles such as pick-up vans, cars and light good vehicles are also involved in movement of goods by intermediaries and/or vegetables and fruits sellers. In order to avoid any traffic congestion during daylight peak hours, the operation of the auction sales starts from 23h00 and ends at 6h00 in the morning.

Source: Mr S. Ram, Personal Communication, 2022

With goods vehicles representing 27% and 33% of inbound (morning) and outbound (afternoon) traffic into Port Louis during peak hours on a daily basis, it would be more sustainable to decrease the movement of goods vehicles bringing fruits and vegetables into Port Louis from across the island, and encourage procurement from closer sources including peri-urban areas of Port Louis. This would also help to reduce the number of intermediaries in the food supply chain, bring down food costs, and reduce food loss and waste along the supply chain. In addition, it would allow consumers to have a closer connection with farmers/growers, and increase the traceability of produce and the level of trust this can bring for both buyers and sellers.

Traders operating in the Port Louis urban markets are under the control and supervision of the Municipal City Council of Port Louis (MCCPL) to ensure they abide by the Mauritian Food Act as well as other regulations. Health Inspectors employed by the MCCPL have the responsibility to supervise and control the sale of fresh and processed food in wet markets, fairs and premises where cooked food is sold. The food should be of quality and fit for human consumption. There is also a control on the cleaning of food outlets and handling of the food waste generated. Currently all the food waste from Port-Louis wet markets and fairs and non-food (garden) waste generated are transported in municipal trucks to the main landfill area of Mauritius at Mare Chicose. A composting project was initiated 3 years ago by the Government of Mauritius but has not been implemented yet due to lack of funds. However, infrastructure facilities and legal frameworks are under preparation.

2.2.1 Urban and peri-urban agriculture (UPA) opportunities and benefits in Port-Louis

UPA in Port Louis can reduce some of the environmental impacts noted above, by reducing reliance on food imported from abroad and from other parts of Mauritius, thus reducing transport emissions and waste, while enhancing access to fresh fruit and vegetables. The following types of UPA could be considered:

1) Rooftop gardening**:** According to the Municipal City Council of Port Louis, there is little bare or abandoned land in the city centre, but there is some land in the region of Pailles (peri-urban area) which could be used for agricultural production. Rooftop gardening within the city center could be an option for food production given the number of commercial and residential buildings. The potential of rooftop gardening on selected buildings was corroborated by two key informants - FAREI and the President of Port Louis Development Initiative. However, according to FAREI, rooftop gardening remains challenging for the following reasons: official approval is needed to access public or private buildings during office hours and at odd hours given the nature of agricultural production activities, and this can represent a security issue; physical access to the buildings may need to be engineered as buildings are not specifically designed for rooftop gardening; rooftop gardening would require use of equipment and materials including substrates and/or soil and irrigation, which can pose a risk to the structural stability of buildings. However, according to the President of the Port Louis Development Initiative, about 50% of buildings in the city center could be rented by entrepreneurs for rooftop gardening. Even Port-Louis residents in private residential buildings could explore this type of activity with the help of institutions like FAREI. He refers to the example of urban vertical farming in buildings in the Netherlands, which use less water, energy and transportation than conventional agricultural systems. In addition, the green areas created on rooftops can help in carbon sequestration and create a better and less polluted environment in the city center. However, integrating rooftop gardening into buildings in Port Louis is likely to require a proper rooftop water pipeline system given the dry climatic conditions.

2) Encouraging household gardening: household gardening could be encouraged to produce fruits and vegetables which can make households less reliant on purchasing these from the wet markets and fairs. The President of PDI also referred to the example of community gardens which are on the rise in the United Kingdom, creating a common space for volunteers to work together to grow fruits and vegetables that can be shared with the community. There is potential for promoting awareness of the importance of community gardens/micro-gardens to Port-Louis citizens through television programmes. Peripheral areas such as Cite la Cure, Valley des Prêtres of Port Louis are not currently under cultivation and farming except for a few orchards. Citizens in those areas could be encouraged to establish fruit orchards as an income generating activity.

3) Agricultural education to empower youth: Education plays a pivotal part in empowering the youth of tomorrow to have a successful career in agriculture. There are opportunities to include UPA in college courses in Mauritius and especially in Port Louis and in Vacoas-Phoenix (Tilloo, pers. Comm. 2022). There are examples of good practices by colleges in Mauritius which try to empower the youth to engage in urban agriculture through agricultural education and training (Box 4).

Box 4: Agricultural Education and Training at London College in Port-Louis

Agriculture forms part of the academic curriculum in colleges especially at the London College in the City of Port Louis. Crop production is the core subject in the agriculture syllabus. Training sessions about agricultural practices are carried out three to four times a year. Aquaponics, a food production system that couples aquaculture with growing of vegetables under a hydroponics system, is not being prioritized in the agricultural course, but could help the community and students to sustain food production as it is a food production system that could be easily implemented in backyards. The main challenge faced by students in Mauritius is that the academic curriculum does not include agriculture as a main subject at grades 12 and 13 (the last two years in secondary school) and therefore students are not exposed to this subject and not encouraged to pursue it further.

Roof top gardening is practised by the college as part of the curriculum but there are major challenges such as poor maintenance and shortage of labour. Vegetables grown on roof tops include spices and horticultural products. Growing vegetables and horticultural products provides a source of food for students and staff but is not a lucrative business for the college since the amount produced is too minimal to generate surplus production to be sold outside the school. The vegetables are sold to the administration section and the money collected is reinvested in upcoming projects or given to other departments.

London College has its own farm where it practices aquaponics, hydroponics, protected sheltered farming and low cost vertical farming with decorative plants. Vegetable production at the college farm situated at Pointe aux Sables, La Tour Koenig in the peri-urban region of Port Louis provides sustainable food for college subsistence but its contribution to wider food security of the region of Port Louis is minimal. Animal husbandry such as cattle, rabbit, and cow rearing is no longer practised at the farm of London College. Since 1980 until 2010, rearing of chicken and goat meat as well as rabbit production were possible. Seeds, seedlings and fertilisers are procured from Vacoas-Phoenix, Port Louis and Curepipe. Organic fertilisers and horse manure are bought from the northern region. The inputs are no longer procured from Port-Louis region owing to their exorbitant costs. Organic composting is also being carried out at the farm level at London College. The college has its own compost bins and composters and is engaging in organic production with the help of a NGO. The college is actively engaged in circular economy since it promotes composting to reduce food waste. Students are allowed to bring their own compost and are engaged in bottle sorting for recycling. Blood donation campaigns are carried out regularly at the London College and blood donors are each given one fruit tree or vegetable seedling. Plants were also distributed during the covid-19 pandemic. This could be replicated in other colleges not only in Port Louis but across the island.

The college faces challenges in the implementation of projects to promote food security and self-sufficiency. Financial resources and labour shrinkage are emerging issues which hinder the production of vegetables. It is recommended that the Parent-Teachers Association funds should raise money to procure more inputs/equipment to boost food production, hence increasing self-sufficiency and food security. Through the support of the PTA, the community could engage better with the college through purchase of agricultural products provided production can increase to a larger scale. (Source: M. Tilloo, pers. Comm., July 2022)

4) Establishing community gardens: "Action for Environment Protection" is a registered NGO under the National Social Inclusion Foundation (NSIF) founded in 2019. It has set up a community garden in Tranquebar, a peri-urban region of Port Louis in collaboration with the non-profit organisation, Caritas and local citizens. This initiative germinated during the first COVID-19 pandemic confinement in Mauritius especially when many families could not buy foodstuffs. The objectives of the NGO are to produce fruits and vegetables through agroecological methods without the use of chemical pesticides or fertilizers, and create employment for women from disadvantaged pockets of the community. The NGO also focuses on reducing waste and practices organic composting. It uses a protected nursery, aquaponics, planting beds, and apiculture practices (bee keeping) for its own food security and self-sufficiency and practices worm farming in planting beds. The burrowing of earthworms makes soil more porous and improves aeration. Vegetables grown by the NGO are sold to the community on Tuesdays and Thursdays. The NGO fosters agroecological practices among the community in close collaboration with Forma Terra, an institution based in Reunion Island, in the Indian Ocean. All these sustainable practices could be replicated by other NGOs and institutions in Port Louis.

5) Empowering the urban poor: Fam-Unie Foundation is a newly formed NGO which aims to empower vulnerable groups like women and youth. It is currently supporting 50 women from the poverty-stricken region of Port Louis and providing professional, holistic, creative and life skills training and courses such as personal grooming, pastry, cooking, fitness classes, sustainable agriculture, soap production and informatics. Monthly talks on health, well-being, agriculture, child abuse, nutrition and food preservation are organised. This initiative will enable these women to create micro-businesses that will improve their earnings and livelihoods, and hence food security. Fam-Unie Foundation empowers women living in extreme poverty in the underprivileged peri-urban region of Paul and Virginie at Cite La Cure, who mainly come from Rodrigues. These women are equipped with entrepreneurial skills, encouraging them to become financially independent through small-scale sustainable agriculture and artisan soap making under women's community-based initiatives. The women rely on slum livestock agriculture to support their livelihoods, but are not land owners, have limited resources and access to information and scarce access to markets, which limit their capacity to scale up and create small-scale community enterprises. This project will help them ease their household cost burden as they can get their own fresh supply of vegetables from backyard cultivation. These empowered women will also be instrumental in helping other vulnerable families as they grow and sell fresh vegetables, fruits, aromatic, and medicinal plants, which will be put on sale at a preferential price in their ghetto during weekly bazaars. This underprivileged group of women will be provided a monthly stipend as an incentive and can benefit from employment on completion of their training program. They can take up part-time jobs such as small-scale planters while also working in their community-based garden and earning a monthly salary. Surplus vegetables can be supplied to wholesalers like 'Les Vergers de Labourdonnais' situated in the northern region of the island. As this women's community-based project and capacity program becomes sustainable with the support of the NGO, it can be replicated for other vulnerable groups.

2.2.2 Challenges of Urban and Peri-Urban Agriculture in Port-Louis

Land availability is a key challenge for UPA in Port-Louis. The city centre is mainly a built-up area which means that the only way to implement urban agriculture is through roof top gardening. However, this can be challenging due to structural risks, access and security issues and the hot climate. Land in peri-urban areas offers greater potential for production for the Port Louis market. Unfortunately, the aspects of smart food purchasing and consumption behaviour have not been included in the Smart City Scheme but are now being taken care of in other schemes under the aegis of the Economic Development Board (EDB), such as the Integrated Modern Agricultural Morcellement Scheme that was announced in the National Budget Speech of 2021-2022 which gives owners of land less than 2 acres the possibility to convert 15% of this land for agricultural activities. As fresh food is easily available in different retail outlets (wet market, open fairs, street hawkers), the challenge will be to change the food consumption habits of Port-Louis city dwellers and commuters to more sustainable ones by sensitising them on the impact of their current consumption behaviour on the environment, and on food security and health.

2.3 Case Study 3: Rodrigues

Rodrigues' economy is largely dependent on a subsistence and agroecological type of agriculture and fishing. 38% of the Rodriguan population was involved in agricultural, forestry and fisheries activities in 2016 (Republic of Mauritius, 2016). The agriculture and agro-processing sector, consisting almost exclusively of micro, small and medium enterprises (MSMEs), constitutes the main pillar of the economy and employs, together with the fisheries sector, about one third of the labour force. Rodrigues is considered mainly rural with the capital Port Mathurin as administrative town. In the early 19th century, traders bought fish and agricultural products and sold them to Mauritius Island and brought back food supplies from Mauritius to sell. Rodrigues imports food from Mauritius, mostly processed food imported by Mauritius (Statistics Mauritius, 2021). Agriculture in Rodrigues consists essentially of the production of fresh vegetables and staple foods, i.e. maize, onion, sweet potato, red bean, and garlic. Other important food crops include cabbage, tomatoes and creepers, including chayote, zucchini, cucumber and pumpkins. The main fruits are lime, banana, sweetsop, mandarine, mangoes, coconut, pineapple, grapefruit and pawpaw. About 11% of the population is involved in fishing activities. There are 1162 registered fishermen (Statistics Mauritius, 2021). The fishing sector is dominated by inner lagoon artisanal fishing in small boats.

Octopus, being the main seafood product, is mainly exported to Mauritius. Key products mainly exported unprocessed to Mauritius Island, in addition to livestock, are limes, small chilies, onion, red beans, honey and octopus, which also represent products with good potential for value addition. In 2012, 1,104 units of cattle, 3,366 units of goats, 1,442 units of sheep, 25 units of pigs, and 7,550 units of poultry were exported to Mauritius representing the surplus after local consumption (Switch Africa Green, Oct 2016). The island has developed a unique agricultural identity specializing in products such as limes, chilies and red beans and enjoys an established reputation for its traditional agro-processed products, notably pickles, sweet-and-sour chutney, candied fruits and chili pastes. Mostly women are engaged in agro-processing activities, producing primarily for the local market, and once local subsistence requirements are met, the surplus is exported to Mauritius. Small volumes of traditionally-processed food items, such as pickled fruits, chutney and chili pastes are also exported to Mauritius. Traditional agro-processed

products such as pickles and sweet-and-sour chutney are generally produced in small quantities by individuals, mainly women, using their own kitchen. A proportion of planters also sell their produce to cooperatives which then develop value-added products (Figure 9, Annex 4). Processed products are mainly sold on the local market, either directly to consumers or to tourists, and through small-scale retailers. A small portion of the local production of processed food is shipped to Mauritius through Mauritian wholesalers or re-sellers. The products are then sold either directly to the consumers or through supermarkets.

Similarly, fresh products, if not consumed locally are directly sold by producers on the local market, including tourists. For specific specialty products including lime, onions and small chilies, collectors and exporters also purchase them directly from farmers to be sold in the Mauritian market. Local collectors then sell the products either to Mauritian exporters or through a network of small re-sellers in Mauritius. On the other hand, registered (as opposed to informal) exporters work with Mauritian wholesalers to reach HORECA (Hotel/Restaurant/Café) companies and supermarkets. The main actors involved in the agricultural value-chain are smallholder planters and producers and producer associations. Another important actor in the agricultural value chain is the Agricultural Marketing Board (AMB). With a view to enhancing the income of planters in Rodrigues, the AMB purchases the whole surplus production of onions, garlic, saffron, ginger and red beans at guaranteed prices for the Mauritian market.

2.3.2 Challenges and opportunities for Rodriguan agriculture

Rodrigues faces some food security and sustainability challenges, namely:

(1) Availability of land due to 'urbanisation'. The area under cultivation for food crops has decreased from 336 ha in 2017 to 173 ha in 2021 (Statistics Rodrigues, 2021). There is no law for the protection of agricultural land, and water scarcity. In the last few years, forested areas in Port Mathurin are decreasing to provide space for construction of concrete buildings for commercial purposes.
(2) Rain water harvesting. Each household in Rodrigues is equipped with rainwater harvesting. However, rainwater harvesting is targeted for domestic purpose only. Water is bought at Rs 2200-2500 per lorry during periods of drought. There are four desalination stations in Rodrigues for domestic purposes only and not for irrigation. Some hotels are equipped with their own desalination units.
(3) Technology: There is reliance on traditional agricultural practices and limited access to modern and mechanised equipment. This will be taken care of in the new agro strategic plan.
(4) Standards: The agro-processing products at cottage level do not meet standards. This could be attributed to limited access to good quality water.
(5) Knowledge gaps: There is a lack of know-how on food preservation techniques, packaging, good agricultural practices, record-keeping and agribusiness management skills.
(6) Lack of awareness of Rodrigues value-added products in Mauritius and abroad.
(7) Outbreak of pests and diseases affecting livestock leading to banning of exports to Mauritius penalises livestock breeders.
(8) Pests and disease problems arising from food waste left in Port Mathurin wet market.
(9) Port Mathurin, being the main harbour of the island, is therefore the main transit area for imported goods from Mauritius. This leads to potential sources of imported pests and diseases.

(10) Port Mathurin is a reclaimed area and the soil is therefore sandy. The town is also prone to floods and has suffered from the latter in the past years. This discourages urban dwellers from growing vegetables in their backyard, instead they favour mostly fruit trees especially mango.

(11) With rising sea levels, Port Mathurin's soil has a high salinity and leads to poor yield of food crops.

(12) Port Mathurin is plagued by fruit flies during the fruiting season of mangos and this is discouraging Port Mathuring inhabitants to grow fruit trees.

(13) There is little or no livestock production activity in Port Mathurin except for a few households with free range chicken and ducks but no goats, sheep or cattle.

There are a number of opportunities to address food systems challenges in Rodrigues. Rodriguan agriculture is gradually moving from a traditional sustainable mixed system to a more intensive commercial food system which takes into account sustained soil fertility and sustainable irrigation water use (KPMG, 2009), in order to increase production of food crops. The Rodrigues Regional Assembly (RRA) boosts the development of the agricultural and agro-processing sector. The latter has been identified as having potential for creating jobs, generating income, and providing scope for increasing value-addition of Rodriguan agricultural produce. Furthermore, agro-processing can contribute towards food security, nutrition and health and indirectly contribute to enhance the social and cultural wellbeing of the inhabitants. Agro-processing activities exist predominantly at cottage level and involve the manufacture of a wide range of traditional food products like pickled lime, pickled chillies, sweet and sour lime, honey, processed pork products such as ham and sausages, dried octopus and salted fish. All these products are manufactured from locally produced agricultural raw materials and are mainly sold to visitors in the island. Globalisation and the opening up of new niche markets internationally as well as the tourist sector in Rodrigues for speciality horticultural, ethnic and organic products provide an added impetus for revitalising the sector, through export to regional and international markets (Goburdhun et al, 2010). According to the new agro strategic plan of Rodrigues (2022-2023), the RRA will adopt a filiere (value chain approach) from seed to market. It will also boost the Rodrigues agriculture by providing incentives to farmers such as mechanical land preparation, family drip irrigation system, sheltered farming, increasing honey production by expanding cultivation of melliferous plants and consolidating the agroprocessing sector (Ravina, pers comm, 2022).

There are no community gardens in Rodrigues and only one small vertical farm at Roseau. This could be an opportunity to tap. There is only one rooftop garden as well as one aquaponics system in Port-Mathuring. However, greens are produced in some kitchen gardens and small plots and sold to hotels. Rodrigues is adopting a circular economy and there is less food waste in Rodrigues than in Mauritius Island since excess food is fed to cattle and pigs. Composting is also practised. The sustainability of exported Rodriguan products can be improved by ensuring that organic raw materials are used to produce processed products. Processors should make sure that the foods and raw materials used for processing come from producers who use certified ECOCERT products or have applied biofertilisers on their farms. Food is outsourced island-wise and distributed to the Port Mathurin wet market. Decentralisation could contribute to lower levels of GHGs emissions across the country.

3.0. Policy framework and initiatives for UPA in Mauritius

This section briefly identifies policies and programmes that are linked to the goal of promoting urban and peri-urban agriculture (UPA) in order to enhance sustainability in food production and consumption, as well as household and national food security.

3.1 National policy context for UPA

Although there is currently no national policy specifically focusing on UPA in Mauritius, the sectoral policies of different government institutions contribute directly or indirectly to UPA. For example the Ministry of Agroindustry and Food Security has policies to boost food production and reduce food loss and waste through further processing (value-added products) as well as recycling (composting); the Ministry of Environment, Solid Waste Management and Climate Change has policies to mitigate the impact of agricultural production activities on the natural ecosystem; the Ministry of Commerce and Consumer Protection has policies to ensure fair price of food products on the market etc.

With the rise in the price of fossil fuels and imported food products, the Government of Mauritius is coming up with new strategies to encourage maximum local food production and has introduced measures to counter the increase in agricultural prices. The recent national budget (2022/2023)[10] has allocated 3 billion rupees (approximately 7 million USD) to the agricultural sector and contains some bold measures. For instance, supporting sheltered farming schemes through a grant of 50% on investment costs up to a maximum of MUR 500,000 (approximately 11000 USD) for the purchase of sheltered farms for hydroponics, as a measure to attract the youth back to the agricultural sector; increasing subsidies for onion, potato, garlic and beans seeds; bringing back abandoned land under cultivation; and creating an agro-processing park at Henrietta peri-urban region of Vacoas. The focus is not presently on urban agriculture as a priority. However, the Ministry of Agroindustry and Food Security together with the Municipality of Port Louis has introduced measures to promote urban gardens, green spaces, hanging gardens and community gardens in Port Louis. Community gardens are being created at Citadelle and Les Salines, Port Louis (Gunputh[11], Personal Communication, 2022).

Past and present governments have put forward strategic plans (Ministry of Agroindustry and Fisheries, 2008; MAIFS, 2016) to reduce dependence on imported food by promoting domestic cultivation of crops, including local neglected and underutilised species, using sustainable practices, including superfoods (such as papaya, moringa) and establish agro-processing to add value to these crops with MUR 200 million (approximately 4.4 million USD) earmarked in the national budget 2022-2023 for an agro-processing park. The strategic plan of the Ministry of Agroindustry and Fisheries (2008) mentions the term urban agriculture to encourage Mauritian consumers to take “initiatives at household level in terms of kitchen and roof gardening, urban agriculture, and diminishing food wastage”. The strategic plan of the Ministry of Agroindustry and Food Security (2016) refers to “community supported gardens” as a more direct marketing channel for fresh fruits and vegetables with no mention at all in the document regarding “urban

[10] Available at https://budgetmof.govmu.org/documents/2022_23budgetspeech_english.pdf
[11] Senior Chief Executive, Ministry of Agroindustry and Food Security

agriculture". The new strategic plan (expected in 2022) being prepared by the Ministry of Agroindustry and Food Security provides an opportunity to include urban agriculture as a means to improve household food and nutrition security in urban areas and reduce dependence on rural areas and imported food.

In line with the comprehensive National Agri-Food Development Programme announced in the national budget speech 2020-2021[12] to promote the Farm to Fork concept, ensure food security and reduce the dependence of Mauritius on imports, more land will need to be brought under cultivation. This measure has been reinforced in the recent national budget speech 2022-2023[13] whereby a "Crop Replantation Fund", to be managed by the Development Bank of Mauritius (DBM) at an annual preferential rate of 2.5%, has been earmarked to encourage growers to bring back abandoned land under cultivation.
A National Development Strategy (NDS)[14] was developed by the Ministry of Housing and Lands in 2003 to propose a package of plans, policies, guidelines and mechanisms that will help the government in collaboration with the private sector and the community to take on board the challenges of sustainable development and ensure a win-win situation for all parties involved. A new NDS which builds on key principles of the previous plan will be prepared soon in 2022/2023 for the next 20 years. Urban renaissance zones and rural regeneration zones will form the basis of the new NDS. Urban renaissance in cities and towns as well as peri-urban regions will focus on public and private sector initiatives and comprise major employment-generating activities including agribusiness and trading activities.

The Land use and Planning department of the Ministry of Housing and Land Use Planning has the responsibility to promote development of land in harmony with provisions of the Planning Policy, Guidance, Outline Planning Scheme, Local Government Act 2011, Town and Planning Act, the Planning Development Act 2004 and the Building Control Act 2012. It is national policy that the best quality agricultural land is safeguarded from development wherever possible. Class I and Class II good agricultural lands within Municipal Council Areas (MCA) are classified in the agricultural land map of November 1992 prepared by the Ministry of Agroindustry and Food Security. The urban policy and planning context for UPA is further explored in section 4 on governance.

3.2 Current initiatives for UPA: Backyard gardening

There are currently three government initiatives that have addressed household food security in both urban and rural areas in Mauritius through backyard gardening. Their aim was to encourage households to venture into backyard kitchen gardening to have some form of self-sufficiency in terms of fresh vegetables and fruits; to recycle household food waste into compost and use it in kitchen gardens; and to reduce dependence on wet markets and fairs. Currently backyard gardening can include container farming, rooftop gardening and balcony gardening, depending on the space available at the household level. In many cases, households use recycled containers to grow fine herbs, or even dwarf fruit trees. Use of rooftops depends on accessibility to enable daily watering and other production activities; and balcony

[12] Available at https://mof.govmu.org/Documents/budget2021_22/2021_22budgetspeech_english.pdf
[13] Available at https://budgetmof.govmu.org/documents/2022_23budgetspeech_english.pdf
[14] https://housing.govmu.org/Documents/Planning/nds.pdf

gardening is used in cases where the rooftop is not appropriate or the person lives in a flat. The three initiatives are as follows:

1) FAREI set up a micro-garden household gardening scheme following the first Covid-19 lockdown period in 2020. This one-off scheme provided MUR 15,000 to interested persons to set up a mini-sheltered production unit, backyard garden or rooftop garden. It has been able to target 600 persons and is now closed as the funds allocated have been spent. There is no current data on the impacts of this scheme or formal monitoring and evaluation indicators that could be used to establish whether this scheme has been successful and whether the beneficiaries have continued their backyard gardening.
2) FAREI provides an on-demand training course of ten half days in organic backyard gardening in women's clubs as well as community centers in both urban and rural areas. Starter kits (seeds, watering can, garden tools and seed trays) are provided to trainees. The aim is to encourage households to grow fine herbs, leafy vegetables and salad crops and be less dependent on wet markets and fairs.
3) The Development Bank of Mauritius provides a loan of up to MUR 100,000 for backyard gardening to any household, with a low interest rate of 0.5% per annum and a moratorium on loan repayments for a period of 6 months. This type of scheme encourages both urban and rural inhabitants to invest in backyard gardening for improved household food security.
4) A very recent scheme (August 2022) has been set up by the Economic Development Board (EDB) and is called the Integrated Modern Agricultural Morcellement Scheme (IMAMS). The objective of an IMAM Scheme is to encourage modern and innovative agricultural practices through the development of an integrated agricultural facility. The Integrated agricultural facility will comprise of a mix of an agricultural morcellement, residential and commercial facilities which may include, amongst others, warehousing, processing, packaging and sale facilities. The promotor benefits from a number of fiscal incentives such as exemption on land conversion tax (for a maximum of 15% of the land to be converted); an income tax holiday for 8 years so long as the promotor is deriving income from an innovative agricultural activity; and a registration duty exemption for the land transfer so long as the land is being used for innovative agricultural practices. This IMAM scheme could be a trigger for promotors in urban areas to take on board agricultural activities as part of their development project with the aim of contributing to urban food security.

Table 6 below shows the extent of kitchen gardening in Mauritius across the different districts from the Household and Population Census of 2011 (Vacoas is part of the district of Plaines Wilhems). The table shows that Port Louis has the lowest number of households taking up kitchen gardening at just 593, while the district of Plaines Wilhems (where the town of Vacoas-Phoenix is located) has the highest at 11,916. There is only one household in Port Louis with 5 perches (0.118 hectare) of land under backyard gardening whilst most of the kitchen gardens in Mauritius are less than 1 perche (0.023692 hectare) which is negligible. The next Household Population Census is being carried out since May 2022 and it would be interesting to see how the kitchen gardens have evolved, especially since the lockdown periods due to the Covid-19 pandemic.

Table 6: Geographical distribution of housing units by size of kitchen garden, Republic of Mauritius

Size of kitchen garden	Number of housing units											
	Port Louis	Pamplemousses	Riviere du Rempart	Flacq	Grand Port	Savanne	Plaines Wilhems	Moka	Black River	**Island of Mauritius**	Island of Rodrigues	**Republic of Mauritius**
Less than 1 perche	526	1,951	1,343	2,519	2,430	1,932	9,473	2,842	1,122	**24,138**	1,854	**25,992**
1 perche and less than 2 perches	51	550	367	1,053	689	535	1,384	1,039	120	**5,788**	1,222	**7,010**
2 perches and less than 3 perches	5	195	142	399	220	208	491	361	40	**2,061**	659	**2,720**
3 perches and less than 4 perches	6	81	61	176	89	112	186	157	12	**880**	456	**1,336**
4 perches and less than 5 perches	4	73	63	170	97	83	173	106	13	**782**	502	**1,284**
5 perches or more	1	102	62	219	117	128	209	93	6	**937**	837	**1,774**
All size	**593**	**2,952**	**2,038**	**4,536**	**3,642**	**2,998**	**11,916**	**4,598**	**1,313**	**34,586**	**5,530**	**40,116**

Source: 2011 Housing Census

Note: 1 perche = 0.023692 hectare Source: Statistics Mauritius (2015)

4.0 Governance framework for UPA in Mauritius

An urban food system (Figure 5) is made of a number of sub-systems including the governance sub-system (Cifuentes et al, 2021). According to Hospes and Brons (2016), urban governance can be described as "the collaborative efforts of citizens, civil society organizations and municipality governments in governing local food systems." Fostering a collaborative governance mechanism can help actors in urban food systems to work together through the "integration of related public policies in a coordinated and holistic way" (UNEP, 2022). Effective urban food systems governance can enable cities to effectively address food system problems through local solutions that promote food security with a circularity perspective (Tefft et al 2020).

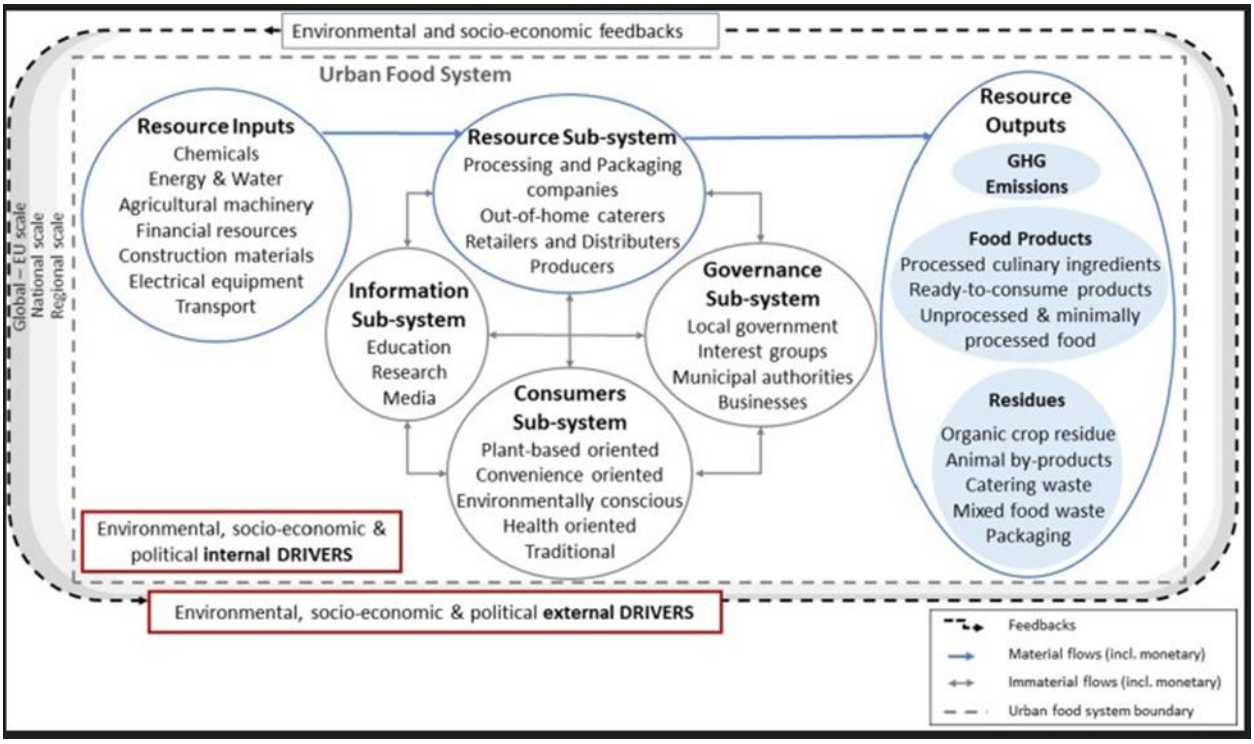

Figure 8: Urban food system and its subsystems. Source: Cifuentes et al. (2021)

In Mauritius, the national food system governance that is directly linked to sustainable food consumption and production and food security, including in urban areas, is made up of different Ministries. These include the Ministry of Agroindustry and Food Security, the Ministry of Finance and Economic Development, the Ministry of Health and Wellness, the Ministry of Commerce and Consumer Protection, and the Ministry of Environment, Solid Waste Management and Climate Change, as well as the private sector and civil society actors. All of them are aware of the challenges of food security in Mauritius especially with respect to food availability, given dependence on imported food products, and food access, leading to rising food prices. Ideally, these different bodies should work together with the same goal of strengthening food self-sufficiency and sustainability and food and nutrition security through UPA.

However, in practice, ministries tend to operate in silos, and there is currently no coordinating mechanism that links different ministries, local authorities (Municipal Councils) and urban citizens to promote integrated solutions. Presently the onus for promoting UPA lies at the level of the Ministry of Agroindustry and Food Security. When major public infrastructure development projects are discussed, different ministries concerned usually participate in intersectoral committees on urban development, but promotion of urban food systems does not seem to be a priority that is integrated in the policy agenda. Food security and sustainability issues are currently dealt with more at a national rather than urban or rural level given the small size of the island.

Municipal Councils, such as Vacoas-Phoenix, deal with land use issues including preservation of agricultural land and economic issues. The Council, in line with the Ministry of Housing and Land Use Planning together with the Ministry of Agroindustry and Food Security, applies planning regulations in

safeguarding agricultural land for local food production. A Master Plan is currently being developed for Vacoas which identifies the need for urban agriculture in collaboration with the Ministry of Housing and Land Use Planning, the Ministry of Agroindustry and Food Security, the Ministry of Local Government and the Municipal Council of Vacoas-Phoenix. The Ministry of Housing and Land Use Planning is supporting the development of urban development plans to address food insecurity in cities of Mauritius, for which urban agriculture could be explored as an effective solution for increasing access to food by urban poor, promoting sustainable and healthy diets and reducing food waste.

Peri-urban agricultural activities are monitored by a number of authorities including the Ministry of Agroindustry and Food Security for award of lease agreement, FAREI for technical advice, and Municipal Councils that provide trade licenses. Application for access to a water resources for agricultural purposes is done at the level of the Irrigation Authority, a parastatal body operating under the Ministry of Agroindustry and Food Security. Table 7 provides an indication of the role of different stakeholders in urban food systems governance in Mauritius.

Table 7: Role of stakeholders in the Mauritian urban food systems governance

Stakeholder	Link to UPA	Link to Urban Food Systems
FAREI	Capacity building of planters and breeders through provision of technical advice and extension activities (field visits, group meetings, field days etc.) Training of citizens for backyard gardening	Capacity building of planters through provision of technical advice and extension activities (field visits, group meetings, field days etc) Provision of training on marketing of agricultural commodities to planters and breeders
Irrigation Authority	Implementation of irrigation projects in every irrigation area and undertaking research into the optimum use of water.	Provision of training to planters on the optimum use of water
Ministry of Agroindustry and Food Security	Participate in intersectoral committees on urban development projects with respect to land use allocation	Formulate of national policies on food security
Ministry of Health and Wellness	Nil	Formulation of national policies on nutrition Promotion of good health and nutrition in schools and communities
Ministry of Environment, Solid Waste Management and Climate Change	Participate in intersectoral committees on urban development projects with respect to land use allocation, drainage, waste management	Formulation of national policies on solid waste management
Ministry of Local Government and Disaster Risk Management	Participate in intersectoral committees on urban development projects with respect to land use allocation, waste management	Formulation of policies and strategies for development of urban infrastructural projects (e.g. urban terminals for the metro light rail) Strategies for the enforcement of conveyance of municipal solid waste

Municipal Councils	Provide permits for urban development projects in line with the prudent use and stewardship of local community resources such as agricultural land	
University of Mauritius (Faculty of Agriculture)	Research on different types of urban and peri-urban agriculture applied in the Mauritian and Rodriguan contexts	Capacity building of students as future technicians/agronomists and agricultural scientists
Farmers Associations	Represents rights of farmers Represents interest of farmers to government	
Agricultural Marketing Board		Provide seeds at subsidized rates to planters Provide marketing and storage facilities to potato and onion planters
CSOs (including NGOs)	Encourage UPA for vulnerable households to improve food security	

5.0 Key findings and recommendations for promoting UPA in Mauritius

Mauritius has a high dependence of more than 77% of its domestic requirements on imported foods, and diets are becoming more westernised leading to increased consumption of highly processed foods and a rise in Non-Communicable Diseases (NCDs). Recent shocks of Covid-19 and the conflict between Russia and Ukraine have significantly increased food prices and highlighted the need to enhance food self-sufficiency. Waste from wet markets is high (900-10,000 tonnes per year) and household food waste is quite high, estimated at 118,632 tons per year, both contributing to GHG emissions. Agriculture is largely unsustainable, with significant use of agrochemicals. UPA provides opportunities to reduce dependence on food imports and related GHG emissions, through ecological production of fresh fruit and vegetables, and improve circularity through composting further reducing emissions. The three case studies have provided insights on current UPA initiatives in Mauritius and Rodrigues, associated challenges and potential solutions to improve urban food systems for enhanced household food security and sustainability. This section summarises the main findings and challenges relating to urban food systems and UPA in Mauritius and Rodrigues and explores options and recommendations for UPA interventions. It analyses possible business models and governance reforms and the gains that would be achieved. It recommends ways to improve city-national food systems integration and policy coordination, and urban food systems governance, including policy coherence across sectors, institutional coordination and local implementation.

5.1. Summary of Key findings and challenges for UPA in Vacoas-Phoenix, Port-Louis and Rodrigues

1) The concept of 'urban food systems' is not clearly defined or prioritised in the master plan/strategic plans of the town of Vacoas-Phoenix and the city of Port Louis.

2) Backyard gardening, balcony gardening, rooftop gardening and sheltered farming in urban areas can contribute to enhancing household food security. There is growing interest in urban agriculture amongst urban dwellers in Mauritius since Covid-19, to ensure access to fruits and vegetables.
3) Land in urban and peri-urban areas is more often earmarked for construction purposes (for national economic interest) than for agriculture, despite the potential of UPA to reduce dependence on imports, and hence improve food security and reduce greenhouse gas emissions. Port Louis, being an administrative and business centre, is densely crowded with buildings and has traditionally left agricultural activities to peri-urban areas and other regions of Mauritius. On the other hand, Vacoas-Phoenix, due to its favourable agroclimatic conditions, has significant agricultural production activities in both urban and peri-urban areas.
4) Vacoas-Phoenix has an advantage over Port-Louis in terms of its supply of fresh local fruits and vegetables which originate mainly from its peri-urban areas. As a result Vacoas-Phoenix is largely self-sufficient in fresh local fruits and vegetables and has no challenges with two dimensions of food security - food availability under normal conditions (absence of climate shocks and pandemic restrictions), and physical food access as food production areas are close to the urban residential areas. Economic food access remains a challenge for urban poor in Port Louis and even for middle-income households following the rise in food prices during the Covid-19 pandemic and the Russo-Ukrainian conflict. The third dimension of food security namely food utilisation remains to be unpacked in terms of how urban households allocate their food budget; and food stability which relates to the stability of the first three dimensions is also quite fragile.
5) Due to short distances between agricultural production sites and food retail outlets in Vacoas-Phoenix, the environmental footprint of its urban food system is relatively low as compared to Port Louis. However, a high proportion of the food consumed and available in grocery stores, super and hypermarkets is also imported and this therefore has a major environmental footprint.
6) In Port-Louis, urban agriculture is very limited and there is very little peri-urban agricultural production. Port-Louis therefore relies on fresh food supplies from different regions of the island and imported food commodities.
7) The current fresh fruits and vegetables supply chain is dominated by a few large distributors who transport the fruits and vegetables across the island to the three main auction markets for wholesale activities and the same fruits and vegetables can travel back to other parts of the island with the consequence of the impact of transport on GHG emission while a smaller circuit from production to consumption could have decreased the GHG emissions.
8) Current food production in Mauritius, in urban, peri-urban and rural areas is not sustainable due to heavy reliance on external inputs such as chemical fertilisers and pesticides; and use of irrigation systems that are not water efficient such as sprinklers.
9) Food systems in Rodrigues are still relatively less input intensive than in Mauritius although the main challenge of water scarcity needs to be more effectively addressed.
10) Limited land is a key challenge to expansion of urban agriculture in Port Louis. There are opportunities for enhancing rooftop and vertical food production, but buildings may need to be adapted for this purpose. Although some urban poor households are food insecure, physical food accessibility is generally not an issue in Mauritius given the small size of the island. However, given the concentration of residential

zones and commercial buildings, there is definitely more agricultural land available for production activities in peri-urban and rural areas.
11) There is no clear policy at national or urban level, or land use planning policy, to encourage public and private investment to promote green UPA in Mauritius. Urban agriculture, e.g. roof top planting, is now being implemented in Vacoas, but promoters are reluctant to embark on major projects such as roof top gardens in shopping malls since the profitability of such ventures has not yet been established.
12) Organizations such as National and local authorities are consulted on urban planning and policies but interactive stakeholder participation and involvement regarding urban agriculture does not take place as this is not part of the mandate of these organizations.
13) There is a lack of coordination among the various bodies (e.g. the Ministry of Agroindustry and Food Security and the Ministry of Housing and Land Use planning) concerned with urban food systems and very often duplication of activities resulting in waste of resources. The Ministry of Housing and Land Use planning has as mandate the allocation of lands, whereas it is up to the Ministry of Agroindustry and Food Security to decide on the type of plantation. The land division unit of the Ministry of Agroindustry and Food Security manages land allocations for agricultural purposes. In addition, there is limited sharing of information/data and interactive communication among the various government entities and civil society stakeholders involved and no mechanism for coordination between them.

5.2 Recommendations for sustainable urban and peri-urban agriculture in Mauritius

The recommendations below are based on the three case studies carried out as well as the interviews with different government agencies and CSOs conducted as part of the study. These recommendations identify actions that can enhance the sustainability of urban food systems, and contribute to food security and healthier diets. They have been divided into five different areas for intervention:

***1. Improving policy coherence and governance*:**
(a) Communications should be improved amongst public institutions directly and indirectly related to urban food systems, namely the Ministry of Agroindustry and Food Security, Ministry of Environment, Solid Waste Management and Climate Change and Ministry of Health and Wellness and local Municipal Councils so that UPA is given due consideration in development projects proposed by public institutions and private promoters. A new governance mechanism should be established to improve consultation and policy coordination for sustainable urban food systems and strengthen links between different national bodies and local government, including FAREI, Economic Development Board, Agricultural Policy Analysis Unit, Ministry of Agroindustry and Food Security, Ministry of Local Government and Disaster Risk Management, Ministry of Environment, Solid Waste Management and Climate Change, Ministry of Health and Wellness, Municipal councils, CSOs and urban groups.
(b) A clear public policy should be introduced to promote sustainable UPA in development projects in cities, as well as fiscal incentives to encourage private promoters to include urban agriculture (rooftop gardening or allocation of part of their land) as an integral part of their construction projects. For example, promoters of shopping malls could include vertical gardens on the rooftops since the inception of the project with the intention to use the fresh produce for sale to the different food outlets that would be

part of the food court in the mall. Besides, the use of green roof technology has the potential to alleviate some of the problems associated with urban agriculture (e.g. by cooling the atmosphere), without adversely affecting the benefits provided by urban agriculture. These approaches can also facilitate the formation of formal space and water use agreements and enable redistribution of ground-level resources among urban farmers. The soil suitability map produced by the Mauritius Sugar Industry Research Institute (MSIRI) should be extended to urban areas so as to earmark areas that have the potential to be used for UPA.

(c) The dimension of smart food purchase and consumption could be added in the Smart City Scheme. This will compel smart city promoters in urban and peri-urban areas to include an urban food system element in their project portfolios and at the same time allow households within the Smart Cities to have some level of food self-sufficiency. In 2015, the government introduced the Smart City Scheme, managed by the Economic Development Board, with the aim to create working, living and leisure space that will be environment-friendly; aim at generating its own resources in terms of energy and water; provide for state of the art connectivity; provide smart modern transportation; and reduce traffic congestion (EDB, 2020). There are presently 12 smart city projects that have been approved by EDB out of which 75% are located in rural areas. The Smart City Scheme, however, does not include sustainable food systems as one of the criteria.

d) Given that a number of rural areas are also urbanising in terms of population size and infrastructure development, there should be a national policy on urban and peri-urban food systems and UPA. Policies for national food security should address household food security which could be enhanced through encouraging UPA.

2. *Encourage ecological backyard gardening and community gardens for household food security*

(a) There should be a massive national sensitisation campaign on ecological backyard gardening for food nutrition and household food security. For examples, cultivation of dwarf varieties of local fruits in containers is also a good way for consumers to substitute imported fruits with local fruits. Although local authorities from both Port Louis and Vacoas-Phoenix are encouraging backyard gardening for household food security, only a small percentage of the urban population have invested time and resources in this. This may be because food is easily accessible in wet markets, fairs, super and hypermarkets and due to lack of awareness of the need to enhance household food self-sufficiency instead of 100% dependence on commercial food outlets.

(b) Mauritian entrepreneurs should be encouraged to propose low-cost artisanal production systems adapted to backyard gardens such as irrigation systems; DIY gardening kits; seedlings ready to sow etc. These could be easily adopted by households and reduce dependence on high-tech, expensive production systems that are usually imported and therefore not sustainable.

(c) Backyard gardening and small gardening schemes should be strongly implemented by citizens and can suit Port Louis. Leasing of rooftops would be appropriate for agricultural activities in built up areas, for instance beekeeping, rooftop gardening.

(d) Bio-farming certificates should be provided to citizens of Port-Louis and Vacoas- Phoenix to promote bio-food production. Citizens, using the training facilities offered by FAREI should be encouraged to adopt bio-farming (eg. use of neem mixture; no use of pesticides/fertilisers), hence promoting the maintenance of the long term soil fertility by enhancing soil microbial life, soil organic carbon and nutrient recycling. In

addition, existing Support schemes should be reviewed for the purchase of equipment and materials to support bio-farming.

(e) Community gardens should be set up particularly in towns like Vacoas-Phoenix where there is sufficient land even on abandoned or bare land. As is done in Bristol in England by the Mayor once a month, all produce from the different backyard and community gardens could be brought to a common area in the city and sold to the citizens whilst at the same time creating a leisure activity in the community.

(f) Parents Teachers Association (PTA) funds in colleges and schools could raise money to procure more inputs/equipment and smart technologies to boost food production in school gardens. This can help children who participate in school gardening projects to bring back the knowledge at the household level and encourage the uptake of backyard gardening hence increasing household food sufficiency and security. Through the support of the PTA, the community could engage better with the college. The government could investigate how public schools and institutions like prisons and hospitals could procure their fresh fruits and vegetables from sustainable urban and peri-urban agricultural activities to reduce dependence on imported counterparts.

(g) Grade 12 and 13 students should be trained in agriculture to encourage young people to view agriculture as a career opportunity with the aim of encouraging new methods and approaches based on technology that could in parallel promote UPA. Online training through a modular approach should also be explored, starting with the identification of a core set of contents on UPA. Potential targets include audiences such as schools, retired people and households - but their availability to participate in such programmes differs. Thus, an asynchronous access and interaction with small online modules, designed to share knowledge, and skills and promote behaviour change would be advisable. People from different backgrounds can also be brought to interact with the contents in cohorts, just as MOOCs (Massive Open Online Courses) are organised, and online badges provided for those who have achieved a level of understanding and f application of the contents.

(h) There is a need to develop a sense of a shared economy in Mauritius - enabling people to share and access resources through a shared economy approach. For example, through rental of pooled agricultural equipment such as wood and leaf shredding to prepare materials for composting. A similar approach can be applied to the process of identifying and managing a community garden.

3. Promoting food festivals and farmers' markets in urban areas:

(a) Food is a bridging element between humans and has a hedonic and artistic function as well. Food Festivals could be organised with locally produced fresh fruits and vegetables with activities such as culinary contests, sharing of traditional recipes etc. that can help renew interest of Mauritians in buying local food and curb the nutrition transition towards more westernised diets and dependence on imported food. This type of event should be done across the country in the five municipal areas (Port Louis, Vacoas-Phoenix, Beau-Bassin/Rosehill, Curepipe and Quatre Bornes). The urban population could be encouraged to showcase their products from their kitchen garden to recognise the importance of their investment of time, energy and money. Local chefs can also propose innovative and simple recipes to promote Mauritian gastronomy using fresh locally sourced produce. Given that Port Louis is the first city in Eastern Africa to have joined in October 2021 the list of UNESCO Creative Cities Network based on its commitment to place culture and creativity at the heart of its development, the organisation of Food and Music festivals could help bring citizens closer to consumption of local food.

(b) Setting up of Farmers' markets whereby urban, peri-urban and even rural farmers could have a dedicated space (with parking facilities and other amenities) to sell their local and organic produce (crops, livestock and processed local and artisanal products). This can be a weekly event which will then encourage both demand and supply of the local produce and at the same time reduce the number of intermediaries in the food supply chain. This closer connection between the producer and the consumer will build trust in the long term. This will also encourage producers as they will receive a better price for their products and also reassure the consumer on the traceability of the goods purchased.. The "Ti-Bazar" (Box 2) illustrates an example of shorter marketing channels.

(c) A massive sensitisation campaign is needed for urban dwellers on the importance of changing their food purchasing and consumption behaviours to more sustainable ones e.g. by choosing food produced closer to their residential area; by growing some of their food in the backyard etc.

4. Including poor and marginalised groups in urban and peri urban agricultural activities

(a) A study should be conducted on approaches that could be used to empower poor and marginalised communities in urban and peri-urban areas to have more targeted and participatory actions that would be readily taken up by these communities instead of a top-down approach. Poor and marginalised people in urban areas are included in agricultural activities mainly through NGOs such as the Mouvement pour l'Autosuffisance Alimentaire (MAA), the Farmers in Agriculture, Livestock, Cooperative, Organic Network (FALCON) Association which implement projects such as donation of egg laying hens, training on growing fruits and vegetables in backyards etc. FALCON Association has a project called *Anou Planter* (Let's farm) which targets poor and marginalised communities. However, it is observed that there may be some cultural barriers for poor and marginalised people to accept help which may hinder inclusiveness of the NGO approach.

(b) A crop production scheme for young graduates should be introduced to promote youth to move back into agriculture. University of Mauritius has a crucial role to play in terms of providing training in agriculture to youth/ women entrepreneurs/marginalised people. People should be encouraged to get involved in UPA through access to favourable financial schemes that can help them start their agribusiness.

(c) A 'jardin partagé' also defined as community garden[15] can be set up in urban areas for poor and vulnerable people to provide healthy and sustainable food. 'Jardins partagés' were a success in the Lille and Paris regions in the late 1990s. This new urban space-sharing draws inspiration from New York and Montreal 'community gardens'. The Municipal program of Paris so-called 'Main Verte' (equivalent to Green Thumb in New York) was created to encourage community gardening, social engagement and education. This can easily be done by both the Municipal authorities and NGOs in towns in Mauritius where land is available.

(d) Community groups comprising marginalised people/women's clubs could be established (with the help of National Women Entrepreneur Council) to promote sustainable urban agriculture (backyard gardening, rooftop gardening, balcony gardening). Women in the city of Port Louis and town of Vacoas-Phoenix

[15] Family gardens are cultivated individually in marginal zones at the edge of cities and in peri-urban regions, community gardens are managed collectively.

should be empowered to carry out urban vegetable production and livestock rearing, and to bring about value addition and marketing for their vegetable/crop/ fruits/livestock products as a profitable venture.

5. Promoting circular economy approaches and reducing waste

(a) In order to promote sustainable UPA, planters should be encouraged to replace chemical fertilisers and pesticides with bioproducts made from local raw materials and manufactured locally e.g compost made from green wastes or poultry litter; biopesticides made from plants etc. The government could subsidise the production of local biofertilisers and biopesticides and encourage agricultural input suppliers to sell these products instead of agrochemicals.

(b) There is a need to decentralise the food distribution system region-wise and therefore reduce the carbon and water footprints of transport and storage of fruits and vegetables.

A review of the distribution system of fresh fruits and vegetables to Port Louis could decrease the current impact of transport by goods vehicles in the capital city on GHG emissions and reduce congestion.

(c) Food loss and waste along the food supply chain was identified as a key challenge by key informants. The proposed solution is composting of green waste arising from wet markets and fairs as a way to recycle nutrients back to crop production activities. Urban and peri-urban households should also be sensitised and encouraged to compost kitchen waste and use the compost in their backyard gardens.

(d) Regarding food that is still fit for consumption, there are two NGOs, Food Wise (https://foodwise.io/) and Manzer Partazer (FALCON Association) (https://www.facebook.com/manzerpartazerorg/) which are collecting and redistributing unwanted food to poor and marginalised communities. There is a need to create a common platform where it is possible for food outlets (restaurants, hotels and super/hypermarkets) to post daily offers regarding available food products that could be redistributed in the community. However, this would also require strict control procedures with respect to the food hygiene and safety aspects to avoid any health related issues.

(e) Encourage urban producers to either add value to their produce through processing or sell the excess produce to agroprocessors. For example, there are periods of the year where some vegetables and/or fruits are in abundance. These fruits and vegetables could be preserved in different forms (pickled in brine, fruits pastes, jams etc) and sold as local produce to consumers. This is a way of upcycling the excess fruits and vegetables instead of either let them rot in the field or flood the market and obtain a low price. Urban residents could also be encouraged to grow superfoods and underutilised crops such as breadfruit, papayas, jackfruit as part of backyard gardening and eventually as part of community gardens (Goolaub, Pers Comm., 2022).

(f) Better management and use of natural resources such as solar energy. Agrovoltaism could be encouraged such as the setting up of greenhouses using photovoltaic panels for solar energy production. Also use of rain water harvesting for use of rain water for irrigation purposes. FALCON Association is already involved in agrovoltaism and rainwater harvesting and could spearhead the use of these two environmental friendly technologies by training young agro-entrepreneurs.

(g) Explore the 15-minutes city model (Abdelfattah et al, 2022) for all 5 urban areas in Mauritius to ensure citizens can enjoy all the facilities and amenities of the city/town within 15 minutes of their place of residence whether by walking or cycling. This entails having commercial outlets and other facilities closer to residential areas. The impact on the environment can be very beneficial in terms of discouraging use of

vehicles to travel long distances. It can also encourage local food producers to propose their products and services closer to the consumers.

5.3. Recommendations for UPA in Rodrigues

Rodrigues has opportunities to shift towards a more sustainable food system with low reliance on chemical inputs and higher water efficiency by focusing on cultivation of resilient, low-input traditional crops, as well as value-addition to agricultural commodities and seafood that are specific to Rodrigues. Promoting UPA in Rodrigues could also lessen reliance on food imports from Mauritius. Given the different context and challenges for Rodrigues, recommendations have been provided separately:

(a) A scheme should be established to encourage rain water harvesting to help households to cater for the irrigation of their backyard gardens.

(b) Training should be provided in agro-processing and agribusiness for women entrepreneurs using sustainable/organic raw materials from backyard gardens to develop value-added products, including on food hygiene and food safety, use of standards, agribusiness management, product certification etc.. Short training courses could be provided by the Faculty of Agriculture of the University of Mauritius.

5.4 Economic analysis of establishing a Household Gardening Programme

One recommendation of the study is to design and implement a Household Gardening programme to promote sustainable urban food system. The proposed programme builds on an existing scheme run by the Ministry of Agro Industry and Food Security. This section presents an economic analysis of the costs and benefits of implementing the programme over three years in Vacoas-Phoenix and Port-Louis. It also assesses the related social and environmental benefits of the scheme. The economic analysis was presented at the two multi-stakeholder dialogues on urban food systems held as part of this study in September 2022. The municipalities of Vacoas-Phoenix and Port Louis have proposed that the lead agency for the scheme should be either the MAIFS or FAREI or both**.** MAIFS could devise the scheme and FAREI could lead its implementation. The Municipalities should be part of national steering committees and sub-committees to implement the scheme.

The proposed components of the scheme are as follows:

(i) Sensitization and awareness to be conducted by the Municipality in collaboration with MAIFS/FAREI coupled with social media campaigns to promote the scheme

(ii) Provision of subsidized household gardening kits to inhabitants of Vacoas/ Phoenix and Port Louis

(iii) Award for best household garden designated on a yearly basis

(i) Sensitization and awareness on home gardening

Prior to the launch of the programme and during the implementation phase, urban dwellers of Vacoas and Port Louis should be made aware of the programme to stimulate interest in the concept of home gardening. The multi-stakeholder dialogues on urban food systems indicated the need to educate urban dwellers, including young people and children, not only to be able to grow and harvest their own food

crops but also to appreciate the benefits of home gardening. The COVID-19 pandemic was an opportunity for many to start gardening as a coping mechanism during lockdowns when food availability was limited. Those who were involved in home gardening found therapeutic and psychological benefits. Home gardening is an opportunity for city dwellers to spend some time outdoors doing mild physical activity, improving overall health and lowering stress.

(ii) Provision of subsidized household gardening kits

The programme will provide subsidized kits to inhabitants of Vacoas and Port Louis. The mode of operation proposed is as follows:

- Recruitment of a Programme Coordinator and a Monitoring and Evaluation Officer: The Coordinator will be responsible for the implementation of the programme. Currently, the municipalities do not have a department that promotes urban farming. Therefore, on a pilot basis, this programme will fund for the position of a coordinator for three years. An important component of the programme will be to assess the effectiveness of the household gardening scheme. A Monitoring and Evaluation Officer should be recruited to assess the impacts of the scheme and provide feedback on its status and implementation.
- Establishing a committee to administer the scheme: A committee should be set up with Ministry of Local Government, Ministry of Agro Industry and Food Security, representatives from municiapalities, FAREI, relevant NGOs, Development Bank of Mauritius, and National Social Inclusion Foundation to implement and monitor the programme. The mandate of the committee will include setting eligibility criteria for households applying for the scheme, screening of applications received, issuance of vouchers and registration of suppliers of household gardening kits.
- Provision of training in home gardening to selected households: Training modules will be developed and provided by FAREI. A support mechanism will also be available for any issues that households may face. Short training videos and clips will developed and available on social media.

(iii) Yearly Award for Best Home Gardens

The programme will have a Best Home Garden Award on a yearly basis to encourage home gardeners to improve on the designs of their home gardens. This is also a means to have innovative ideas for home gardens that can be disseminated in households in the future.

Estimating the costs of the 3-year programme for municipalities

The tables below present the number of expected beneficiaries, costs of the components of the programme and the total costs in each municipality. The total costs of the programme were estimated as MUR 87,453,200 in Vacoas and MUR 118,534,575 in Port Louis.

1. Number of beneficiaries and costs of programme components

	Municipality of Vacoas	**Municipality of Port Louis**
Estimated number of households	26422	36448

Percentage of households targeted over three years	20	20
Number of beneficiaries	5284	7290
Grant per kit	Up to MUR 15,000	Up to MUR 15,000
Training cost per beneficiary	MUR500/ beneficiary	MUR500/ beneficiary
Best Award	MUR 25,000/ award	MUR 25,000/ award

2. Total costs of the Programme in Vacoas and Port Louis

	Vacoas	**Port Louis**
Staff Costs for Programme Coordinator and Monitoring and Evaluation Officer	2,470,000	2,470,000
Vouchers for HHG kit	79,266,000	109,344,750
Training Costs	2,642,000	3,644,825
Sensitization	3,000,000	3,000,000
Awards	75,000	75,000
TOTAL Costs (MUR)	**87,453,200**	**118,534,575**

Benefits of the programme in Vacoas and Port Louis

The tables below present the benefits of the programme, based on the revenue saved from scheme and other non-monetary benefits. The revenue saved from the three year programme is estimated as MUR MUR 74,862,333 in Vacoas and MUR 103,270,042 in Port Louis.

Estimation of revenue saved from the three-year programme	**Vacoas**	**Port Louis**
Number of lettuce (or any equivalent green leafy veg/ herb at an average of MUR 25.00/unit) per meter squared	10	10
Size of HHG kit in meter squared	10	10
Approximate number of cycles in year 1 (assuming 45 days per cycle and some failures)	4	4
Approximate number of cycles in years 2 & 3	6	6
Number of beneficiaries in year 1	881	1215
Number of beneficiaries in year 2 & year 3	2202	3037
Volume of products home-grown over 3 years (units)	2,994,493	4,130,802
Average cost of one lettuce (MUR)	25	25
Additional cost per household for a MUR25000 HHG kit	10,000	10000
Value of home grown vegetables over 3-year programme	**74,862,333**	**103,270,042**

A number of economic, social and environmental benefits were identified as shown in the table below:

ECONOMIC	SOCIAL	ENVIRONMENT
Money saved from growing own food	Healthy, nutritious, safe food grown	Transport saved from not moving product from farm to retail and then to home - *CO2 emissions saved over three-year programme*
Food security of household	Pleasure derived from growing, harvesting and eating own food	
Possible income generation	Educational benefit to children	
Cost saved from not having to go to the market	Creation of green jobs (direct and indirect) for locally designed HHG kits	

The transport costs and CO2 emissions saved from the programme were estimated as follows:

Estimation of Transport cost saved by home gardening	Vacoas	Port Louis
Volume of Lettuce grown in 3 years	2,994,493	4,130,802
Number of Households	5284	7290
Average Distance from Field to Market and back in the vicinity o(in km)	6	10
Cost of transport in a truck: MUR 5 per km	5	5
One trip in a 4WD truck: 500 lettuce	500	500
Number of trips saved for lettuce home grown	5989	8262
Distance covered (in km)	35934	99139
CO2 emssions per l of diesel (kg/l)	*2.681*	*2.681*
CO2 emissions saved over three-year programme (in kg)	***9634***	***26579***
Cost of trips saved over three-year programme (in MUR)	**179,670**	**495,696**

Overall Economic Assessment

In Vacoas, the total costs of the three year programme was estimated as MUR 87,453,200 and the revenues saved (from produce grown) was estimated at MUR 74,862,333. Hence the overall cost of the

scheme in Vacoas is MUR 12,590,867. In Port Louis, the costs of the scheme is MUR 118,534,575 and the revenue saved is estimated at MUR 103,270, 042; hence the overall cost of the scheme is MUR 15,264,533. Furthermore, a number of additional economic, social and environmental benefits were identified, which suggests that the overall benefits of the scheme outweigh the costs. The costs of food transport saved amounts to MUR 179,670 in Vacoas and MUR 495,696 in Port Louis. In addition, the CO2 emissions saved amount to 9,634kg in Vacoas and 26,579kg in Port Louis.

One issue raised during the dialogues was the financing of such a programme. Different modalities were discussed, for instance, finance can be raised through environmental compensation of private companies where half of the budget originates from the private sector and the other half from the government. Development partners may also be interested to contribute to such programmes. Another opportunity that could be explored is to seek green climate funds.

This scheme provides for opportunities to create green jobs where young agri-entrepreneurs can develop innovative household gardening kits adapted to the Mauritian context. A suggestion was made to have innovative technology included in the kits that would attract younger generation into gardening. In addition, the scheme can be incentivized further through innovative business models, using social media for instance and creation of apps for marketing of surplus household garden products, thus creating employment for distribution of the products. Therefore, providing the right enabling environment for start-ups to emerge is one recommendation to encourage sustainable urban food systems.

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Annex 1: List of Public and Private Organisations interviewed for Key Informant Surveys

	Name and address of organisation	Contact Persons	Position
1.	Agricultural Policy Analysis Unit (APAU), Ministry of Agro-Industry and Food Security Renganaden Seeneevassen Building Port-Louis	Dr Nitin Chikuri Dr Orlando Felicité (Rodriguan) Mr Bahadoor	Policy Officers
2.	Ministry of Agro Industry & Food Security Levels 8 & 9 Renganaden Seeneevassen Building, Cnr Jules Koenig & Maillard Streets, Port Louis	Mr M. Gunputh	Senior Chief Executive
		Mrs S.S. Soborun	Deputy Permanent Secretary
3.	Ministry of Agro Industry & Food Security Land Use Division, Reduit	Mrs K. D Mohabeer	Principal Scientific Officer
4.	Food and Agricultural Research and Extension Institute (FAREI), HQ Réduit and St Pierre, Vacoas	Mr Prakash Goolaub Mr Dev Bheemah Mr Raj Ramnauth Ms Mactoobah Mr Rajiv Shimadry Mr Roopesh Gopaul Mrs Sawaram Mr Keshav Ramheet	Acting Director Principal Extension Officer (Crops) Chief Biometrician Biometrician Principal Extension Officer (Livestock) Extension Officers/Senior Extension Officers
5.	SME Mauritius Ltd Pope Hennessy St, Port Louis Ministry of Industrial Development, SMEs and Cooperatives 16th Floor, Newton Tower, Sir William Newton St, Port Louis	Mrs Leevana Kisten	Senior Business Support Executive
6.	Development Bank of Mauritius	Mr Pandoo	CEO
7.	Municipal Council of Vacoas Phoenix	Ms Hema Ramroop Mr Bundhoo Ramsahad	Planning and Development officer Principal Health Inspector
8.	Municipal Council of Port-Louis	Mr Sailesh Kumar Ram	Principal Health Inspector

9.	Ministry of Housing and Land use planning	Mr Bedeu Mr Gunnoo Mr Sookoowa Mr Hauradhun.	Chief Cartographer Principal Urban Planner Town Planner Acting Administrative Manager
10.	Action for Environmental Action NGO Le Thabor	Mr Pascal Laroulette	Director
11.	FAM-Unie, NGO, Port Louis	Mrs Chantal Espitalier Noel Mrs Vidya Persand Mr Khemraj Persand	Director Collaborators
12.	Farmers in Agriculture, Livestock, Cooperative, Organic Network (FALCON) Association Bois Pignolet, Terre-Rouge	Mr Manoj Seeborun Ms Khousbou Singh Sewraj	President Project Coordinator
13.	Port Louis Development Initiative (PLDI)	Mr Gaetan Siew	Chairperson Architect and Urbanist
14.	Mauritius Chamber of Agriculture	Mrs Jacqueline Sauzier	General Secretary
15.	Statistics Mauritius	Mrs Chandranee Rughoobur Mrs R. Pemsing	Statistician, Social Analysis
16.	College Terre Rouge	Mrs L Speville	Headmistress
17.	Rodrigues Regional Assembly (RRA)	Mr Perrine	Commissioner of Agriculture
18.	London College	Mr Mahen Tilloo	Agricultural Teacher
19.	SKC Surat Co. Ltd	Mrs Hemlata Seechurn	Administrative Manager
20.	Agricultural Marketing Board	Mr Sookun Rishi Mrs Badree Yantee	Seeds Officers
21	Solid Waste Division, Ministry of Environment, Solid Waste Management and Climate Change	Mr Beerajee	Director
22	Rodrigues Agricultural Research and Extension Services	Mr Jerome Felicite	Assistant Manager , Commission for Agriculture

Annex 2: Key Informant Questionnaire

Government Agencies :

Part A: Personal Information

Name:…….

Job title:……..

Organisation……

Telephone no:……

Email-address:……

Part B: Established, effective institutions for urban food / Institutions

1. What are the main food systems challenges facing [Port Louis/Vacoas/Rodrigues] in terms of the environment and food security? (eg. access to food and nutrition for poor groups, dependence on imported food, food waste generating greenhouse gas emissions, insufficient composting).
2. What do understand by the term 'urban agriculture'? What types of urban agricultural practices exist in the city of Port Louis?
3. What urban agricultural practices exist in the town of Vacoas-Phoenix?
4. How can urban and peri urban agriculture in the city of Port Louis be enhanced to address sustainability and food security challenges?
5. How can urban agriculture in the town of Vacoas-Phoenix be enhanced to address environmental and food security challenges?
6. What are the main challenges to enhancing urban agriculture in the city of Port Louis?
7. What are the main challenges to enhancing urban agriculture in the town of Vacoas-Phoenix?
8. With rapid urbanization, can we say that food insecurity is shifting to urban areas?
9. How do you see UA in cities? Do you find it a solution to poverty, joblessness, urban vulnerability and food insecurity? Or do you see it as a low-value and ineffective use of urban spaee?
10. How are urban food systems challenges (environmental and social), urban and peri urban agriculture and urban-rural linkages, addressed in the Municipal Council's development plan?
11. Does your Ministry have a clear mandate exist to work on urban food systems?
12. What are the key food strategies /programs/projects related to the promotion of urban food systems implemented or supported by the MOAFS?
13. How can urban/peri-urban agriculture promote a circular economy approach? (eg reduction of food waste and GHGs).
14. For major projects for eg Victoria Train Stations, are there consultations with MOAFS for setting up of community gardens, vertical farming etc?
15. The MOAFS has come up with sheltered farming schemes. Will this be extended to charitable institutions, primary schools and colleges in the 2 towns/cities?
16. As far as green spaces and empty spaces are concerned, is there provision for leasing of these spaces to self-groups (women, marginalized, poor)?
17. The MOAFS has set up the household gardening schemes. Do we have an update on the number of recipients of the scheme in PL and Vacoas?
18. Is food production and distribution part of Mauritian cities'/towns' urban planning and policy framework? (more policy support)
19. What are your views on the new agro-strategic plan of the MOAFS and the country food systems pathways for the UN food systems summit (UNFSS) offering opportunities for urban agriculture with circular economy to promote urban food systems?
20. Is there provision in the new strategic plan for incentives for the youth (for eg allocation of lands) to start their enterprises in the two regions?
21. How does the new agro-strategic plan of the MOAFS promote sustainability, resilience and circularity?

<u>Policies and regulations</u>

22.Is the term ‘’urban food system’’ integrated in national agriculture and food policy, legislation or regulations?

23.Are urban food issues incorporated in other sector policies?

24. Are institutional structures and processes conducive to the development of urban food policies, regulations and programs?
25. What mechanisms have authorities and stakeholders established to mobilize funding for urban food interventions?
26. What are the urban food budget legislation and allocation?
27. Are there policy, legislation, incentives to mobilise private capital for urban food investments?
28. How can the current food systems in Mauritius (eg policy coherence across sectors, institutional coordination, local implementation) be improved?
29. What is the % of budget allocated by the Ministry of Finance to MOAFS?

Key Informant Questionnaire (NGOs)

Part A: Personal Information
Name:…….
Job title:……..
Organisation……
Telephone no:……
Email-address:……

1. What is the role of your NGO?
2. What do you understand by the term ‘’ urban agriculture’’?
3. Do you practice urban agriculture?
4. If yes, is it sustainable? Please elaborate more.
5. What types of urban agriculture do you practice?
6. What are the key agricultural products (vegetables, fruits, poulty /meat) produced/consumed in the city of Port-Louis or town of Vacoas?
7. Who are the main producers of the above mentioned question?
8. Concerning inputs, where do you procure your inputs for food products?
9. What is the origin of crops/vegetables/fruits delivered in the auction market in city of Port-Louis or town of Vacoas?
10. According to you, is there a need for ‘’urban agriculture policy’’?
11. Do you think that community gardens/micro gardens can be promoted via television programmes?
12. Can farmers in the city of Port-Louis or town of Vacoas sustain its citizens in terms of food security?
13. Who the main actors in the food supply chain are for instance at the (production, marketing, distribution, retailing stage)?
14. Does your NGO develop initiatives of growing organic vegetables to suit the citizens of Port Louis?
15. Does your NGO and activities promote income generation and financial autonomy through the sale of vegetables and fruits or surplus production? Is it sustainable?
16. What are the main challenges in the implementation of your projects to promote food security?

According to the Food and Agriculture Organisation, food loss" is used to refer to the decrease in food quantity associated with harvest, handling, processing, and transport, while "food waste" refers to that related to consumer food behavior, with the latter conveying a negative connotation resulting from human choices.

17. What are the post-harvest losses that occur at farm's level and market level?
18. Can you provide an estimation of the quantity of food loss for the above mentioned question?
19. What could the reasons for food waste and food loss occurring at the market in city of Port-Louis or town of Vacoas?

Annex 3: International partnership agreements to promote food security in Mauritius

(1) Collaboration with PAGE (Marina could you please correct this section with the right information)

The government of Mauritius recently launched its new national programme for 2020-2024: "Toward an Inclusive, High Income and Green Mauritius, Forging Ahead Together". The programme lays out the government's vision for the next four years and will be used as a source of inspiration and guidance for future policymaking. PAGE has supported several commitments of the new government's plan. For instance, it actively contributed to the Marshall Plan on poverty, job skills, industrial waste, competitiveness, clean production, and investments. In addition to that, the four main pillars that laid the groundwork for the new programme were conceived with support from PAGE. They are:

1. Investing in clean energy;
2. Shifting to a cleaner and greener Mauritius;
3. Mitigating risks from climate change;
4. Protection of marine resources.

Noteworthy as well, the programme lays out the following commitment: "To this end, an Economic Research and Planning Bureau will be set up at the Ministry of Finance, Economic Planning and Development. The Bureau will help to translate the Government Programme into an overarching and coherent action plan, within which private and public sector operators and institutions will operate."

By bringing different stakeholders together in this, and aiming to create long-lasting results, the government has shown its willingness to put sustainable development at the forefront of the strategy. It reflects the fruitful partnership between PAGE and Mauritius, which has started in 2016 and has been contributing to the following SDGs: SDG 4 (Quality Education); SDG 9 (Industry, Innovation and Infrastructure); SDG 12 (Responsible Consumption and Production); SDG 13 (Climate Action) and SDG 17 (Partnerships for the Goals).

(2) Country Programing Framework with FAO

The Country Programming Framework (CPF) which guides the Food and Agricultural Organisation (FAO) partnership with the Government of Mauritius, bringing together innovative, international best practices and global standards with national and regional expertise from 2022 to 2025, was signed in Port-Louis in May 2022. The signatories were the Attorney-General and Minister of Agro-Industry and Food Security, Mr Maneesh Gobin, and the FAO Representative for Madagascar, Comoros, Mauritius and Seychelles, Dr Mbuli Charles Boliko. The Country Programming Framework exercise was developed with different stakeholders within the purview of FAO's objectives, and consideration was given so that the priorities of the Framework matched with the "4 Betters" approach of the FAO, namely:

(a) better production to ensure inclusive food and agriculture supply chains at local, regional, and global levels,
(b) better nutrition so as to achieve food security and improved nutrition in all its forms,
(c) better environment in order to protect, restore and promote sustainable use of terrestrial and marine ecosystems and combat climate change through resilient and sustainable agri-food systems, and
(d) better life so as to promote inclusive economic growth by reducing inequalities in several areas.

The CPF was prepared following consultation and agreement with the Government of Mauritius, specifically with the Ministry of Industrial Development, SMEs and Cooperatives; the Ministry of Agro-Industry and Food Security; the Ministry of Health and Wellness; the Ministry of Blue Economy, Marine Resources, Fisheries, and Shipping; the Ministry of Gender Equality and Family Welfare; and the Rodrigues Regional Assembly. It identifies three priorities: increasing local food self-sufficiency to ensure efficient sustainable consumption and production patterns; transiting to climate smart agriculture so as to grow resilient agri-food systems in a changing climate and environment and prepare ourselves to combat the consequences of climate change; and promoting women's empowerment by reducing inequalities between men and women.

Annex 4: Additional Facts and Figures – Vacoas-Phoenix Market Fair

Vacoas Fair place consists of 1077 stalls for the sale of vegetables and fruits, 129 stalls for sale of haberdashery products, 38 stalls for the sale of seasonal fruits and 12 spaces for auction sale. The market fair is held twice, that is on Tuesdays and Fridays from 6.00 am to 6.00 pm. There are 6406 economic operators and 8316 classified traders (5600 for Vacoas) in operation within the town of Vacoas-Phoenix (Hardowar and Poran (2022). The study found that the market produces 25-30 tonnes of food waste weekly (Public Health Inspector, Municipal Council of Vacoas-Phoenix, pers. comm.)

Annex 5 - Value chain of the agricultural sector in Rodrigues

(Source: Mauritius National Export Strategy-Rodrigues Island Strategy, 2017-2021)