Investigating Challenges and Opportunities in Developing Local Agriculture Food Production Systems in Sint Maarten: A Complex Adaptive Systems Analysis.

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Abstract –
Reliance on import augments vulnerability to exogenous shocks that threaten food security. This paper investigates challenges and opportunities for developing local food production systems in Sint Maarten, to build resilience and diversify its economy. We apply mixed methods; interviews, expert meetings, and participatory action research. After a first analytical cycle, we validated and adapted our initial explanatory model, to subsequently investigate it. We found systems interacting within a context lacking capacity and resources, creating negative feedback effects. We propose solutions that contribute to establishing a sound framework for decision-making and creating synergies within existing initiatives or through incorporating external resources.

Key words: Sint Maarten, Food security, Agriculture, Systems Analysis.

1. Introduction

Food security exists when all people, always, have access to sufficient and nutritious food to meet their dietary needs for a healthy life (FAO, 1996; FAO, 2020; FAO, 2021). Because of their setting, Small Island States, or SIS, can face unique challenges (Alberts, 2020), which include food security and the impact of exogenous shocks such as COVID-19. The United Nations states that (…) "many SIS face high import and export costs for goods as well as irregular international traffic volumes. Yet, they must rely on external markets for many goods due to the narrow resource base" (UN, 2023).

Extreme dependency of some SIS on imported food leads to major risks in food security. High food prices partially result from import taxes and transportation costs because of logistic inefficiencies, lack of economies of scale, and high vulnerability towards price fluctuations and global disruptions affecting the supply chain (Van der Geest & Slijkerman, 2019; Van Geelen, 2020). Simply put, how will people eat when the boats stop coming in? Van Geelen (2020) demonstrated that for Dutch SIS, high food prices are a limiting factor for sustainable economic development, and dependency on imports restricts food availability and the quality of perishable products.

Some SIS can be characterized as Small Island Tourism Economies, or SITEs (Mc Elroy, 2006; McElroy & De Albuquerque, 1988; McElroy & Parry, 2010). These are islands with small populations and limited resources, whose economic growth and livelihood overwhelmingly relies on tourism export and a consistent inflow of foreign direct investments (Shareef & Hoti, 2005; Cannonier & Galloway Burke, 2019). One can argue that within the context of being both a SIS and SITE, a one pillar tourism economy, further contributes to vulnerability and dependency on external, volatile, global developments that impact tourism influx.

For small island states that highly depend on tourism, developing local food production systems can build resilience against external threats, while simultaneously diversify their one pillar tourism economies. The Caribbean island of Sint Maarten (Saint Martin), listed as a SIS (UN, 2023), is such a case. The island spans 87 square kilometres, of which its Dutch side covers 34, making it the smallest populated islands shared between two nations (Guinness World Records , n.d.) and one of the smallest and most densely populated countries in the Americas (Worlddata, n.d.). The Dutch side's population, as of 2023, officially counts 57,500 registered inhabitants of a diverse makup (STAT, 2023). It is not uncommon for Sint Maarteners to, often proudly, proclaim that the island harbors well over 100 nationalities. Its GDP per capita is estimated at $ 35,900 US in 2022, which is the third highest in Latin America and the Caribbean (World Bank, 2022). The Sint Maarten Trust Fund (2022) estimates that tourism accounts for 45 percent of its GDP, 73 percent of foreign exchange income, and creates employment for one-third of the employed population. In terms of local food production, the country currently hosts only a handful of registered commercial farmers, who produce on a small scale, and its government published their first agriculture policy in December 2022 (Dep. of ETT, 2022).

In this paper we investigate the key challenges for developing local food production systems in Sint Maarten and seek to identify and map opportunities for improvement. Firstly, we review the literature on food security and food systems. Based on this review, we develop an initial conceptual framework and explanatory logic. Subsequently, we discuss the cyclical nature of our research design and methods, followed by a recount of our data collection and preliminary analyses wherein we further specify our initial conceptual framework. Lastly, we present our findings based on the adapted conceptual framework, detailing underlying mechanisms of issues and challenges, and present recommendations for improvement.

2. Literature review

2.1 Food security and COVID-19

Conventionally, we speak of food security "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996; FAO, 2020; FAO, 2021)

The FAO identifies four food security dimensions: food availability, economic and physical access to food, food utilization and stability over time. Furthermore, the conceptualization of food security is evolving to recognise agency and sustainability as additional dimensions (FAO, 2020; FAO, 2021; Clapp, Moseley, Burlingame, & Termine, 2022). Food *insecurity* severely negatively impacts national economies, and the livelihood and economic capabilities of vulnerable groups (WFP, 2021; WFP, 2021). At a global scale, we have not made general progress in achieving food security as described in Sustainable Development Goal (SDG) Target 2.1, i.e. ensuring access to safe, nutritious, and sufficient food for all people all year round, as reported by the FAO in successive years (FAO, 2020; FAO, 2021).

What is more, the COVID-19 pandemic has uncovered and exacerbated food insecurity, vulnerabilities in food systems, and threats to lives and livelihoods, especially for those living in fragile contexts (FAO, 2021). Something similar applies to the recent global inflation and increase in cost of living due to the war in Ukraine (WFP, 2022).

2.2 Food security in Sint Maarten, Dutch Caribbean

Sint Maarten's extreme dependence on imported food, as well as being a tourism economy, yields vulnerability to price fluctuations, global developments, which both are major risks to its food security. Furthermore, between 2010 and 2016, Sint Maarten's food consumer price index (CPI) increased by 52.8%, as opposed to comparative islands such as Aruba, also a SITE (Alberts, 2020), with 11.7%, Bonaire with 13.1%, Curacao with 26.8%, Anguilla with 10.1%, and Antigua & Barbuda with 10.9%. The 'source areas' for import had considerably lower food CPI increases over that same period, i.e. Miami with 8.5% and The Netherlands with 13.8% (Ecorys, 2017). This is significant, though it needs to be noted that there are contextual differences between the islands that impact the numbers.

While the exogenous shocks of the COVID-19 pandemic and global inflation jeopardize food security on SITEs, they also provide an opportunity to review economic strategies to improve livelihoods and food security.

By stimulating, developing, and scaling environmentally, economically, and socially sustainable local food (production) systems and a strong agriculture sector, SITEs can strengthen national capacities, alleviate dependency on food imports, build resilience against exogenous shocks and risks, and economically diversify (World Bank Group, 2020; Van Geelen, 2020). Agriculture has profoundly shaped human history, and, since the works of the earliest economists, has always been included as a vital primary productive sector (Mazzucato, 2019). We need to eat daily to live and therefore, nutrition is something countries should want to exert some form of direct control over.

To gain a better understanding of how local food (production) systems may impact food security, we first need to gain a better understanding of both concepts.

2.3 Food security dimensions

We established that food security has six dimensions, which we describe in more detail below, following the FAO (1996; 2022) and Clapp et al. (2022).

(1) Availability addresses whether food is actually or potentially physically present, including production, food reserves, markets and transportation, and wild foods. Given that food is available, (**2) access** addresses whether households and individuals have sufficient physical and economic access to that food. Given that food is available and accessible, **(3) utilization** addresses whether households and individuals are maximizing the consumption of adequate and diverse nutrition and energy through appropriate preparatory and feeding practices. Given that food is available, accessible, and appropriately utilized, **(4) stability** addresses whether the entire food system is stable in providing the previous dimensions at all times. Long term instability, approximately six months or longer, is linked to chronic food insecurity, whereas short term or temporary instability is linked to transitory food insecurity (Fraanje & Lee-Gammage, 2018). Climatic, economic, social, and political factors can all be a source of instability.

The High Level Panel of Experts (HLPE) of the Committee on World Food Security proposes two additional food security dimensions. While these are not formally agreed upon, one can strongly argue for their conceptual relevance and legitimacy in the context of the right to food (FAO, 2021). Generally, **(5) agency** refers to what a person is free to do and achieve in pursuit of whatever goals or "values he or she regards as important" (Sen, 1985). As such, one does not only exercise their voice and makes decisions, but also acts upon these to improve their own and community's well-being (Fukuda-Parr, 2003). Pertaining to food security, agency translates as the capacity of individuals and groups to exercise a degree of control over their own circumstances and decisions about what foods they eat and produce, how that food is produced, processed, and distributed within food systems, and their ability to meaningfully engage in processes that shape food system policies and governance processes. As such, agency is a central aspect of addressing

inequities and power imbalances between actors within food systems (Clapp et al., 2022). It goes beyond access to material resources as it includes empowerment, i.e. the ability of people to take actions that help improve their well-being, food security, and nutrition, as well as their ability to meaningfully engage and influence in society (FAO, 2021; HLPE, 2020).

(6) Sustainability concerns the long-term ability of food system practices to provide food security and nutrition in a way that contributes to regeneration of natural, social, and economic systems and does not compromise the economic, social, and environmental foundations generating food security and nutrition for future generations (HLPE, 2020). It emphasizes the connections between ecosystems, livelihoods, society, and political economy to maintain food systems and support food security into the distant future (Clapp et al., 2022).

Whereas the first four food security dimensions are measured via agreed upon constructs, most prominently through "The Food Insecurity Experience Scale Survey Module (FIES)" by the FAO (2018), sustainability is very difficult to operationalize, and agency can vary from an individual to a national level.

2.4 Food systems and contextual factors

Since food security is a multidimensional concept and cannot be investigated separate from food systems (FAO, 2021; Haug & Ruth, 2018; Fraanje & Lee-Gammage, 2018), we need to establish an understanding of food systems and their components. Food systems can be described as encompassing the full range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption, and disposal of food products. They comprise all food products as well as the broader economic, societal, and natural environments in which these diverse production systems are embedded. They are composed of sub-systems, e.g. farming or supply systems, and interact with other systems, e.g. energy systems. Changes in other systems may cause structure changes in food systems. Within food systems, we can further identify food environments, which refer to the 'physical, economic, sociocultural and policy conditions that shape access, affordability, safety, and food preferences' (FAO, 2021).

Holistically approaching food systems entails including all relevant elements, their interrelations, and social, environmental, and economic impacts of solutions to achieve transformational systemic changes. Adopting such a systems level approach means not being confined to one single sector, sub-system (e.g. value chain or market), or discipline, and thus broadening the framing and analysis of issues as the result of a network of interlinked activities and feedback (Nguyen, 2018).

A sustainable food system lies at the heart of the United Nations' Sustainable Development Goals. Sustainability of food systems is alike sustainable food security, as discussed above. It delivers food security and nutrition for all while making optimal use of all input resources, provides broad based benefits for society, is environmentally sound,

economically fair and viable, and does not compromise the economic, social, and environmental bases to generate food security and nutrition for future generations or other countries or regions in different phases of life cycles (Capone, El Bilali, Debbs, Cardone, & Driouech, 2014; Nguyen, 2018; Group of Chief Scientific Advisors, 2020).

Following the above, we can ascertain that food systems cannot be investigated separate from adjacent systems, which we dub "contextual factors", which comprise policies, programs (Haug & Ruth, 2018), as well as social, political, economic, legal, and environmental systems (FAO, 2021). Establishing a sound notion of relationships between the various direct and indirect factors, drivers, synergies, and trade-offs involved, within and between these systems, is essential (Fraanje & Lee-Gammage, 2018; FAO, 2021; Haug & Ruth, 2018). We therefore need to encourage all actors involved, such as policymakers, practitioners, and the public, to engage the bigger interdisciplinary picture and facilitate multi-stakeholder sense-making, collaboration, coordination, and synergies, to ensure successful sustainable outcomes of direct and indirect food systems interventions.

3. Conceptual framework and research question

In our literature review we explain how contextual factors impact food systems and how both contextual factors and food systems impact food security (figure 1). To improve food security, we thus need to intervene in its drivers, i.e. contextual factors and food systems.

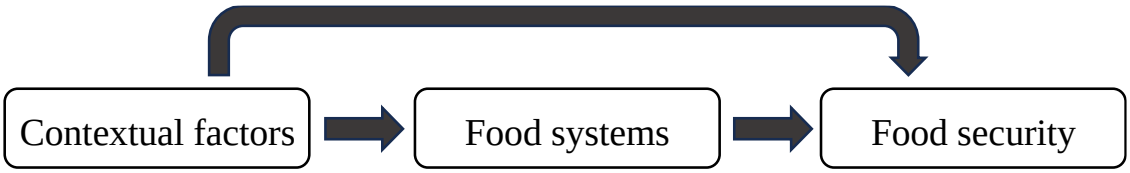

Figure 1. Food security drivers.

The HLPE have constructed a detailed and comprehensive conceptual framework (figure 2) on food security and systems to illustrate how various drivers impact food systems (HLPE, 2020; FAO, 2021).

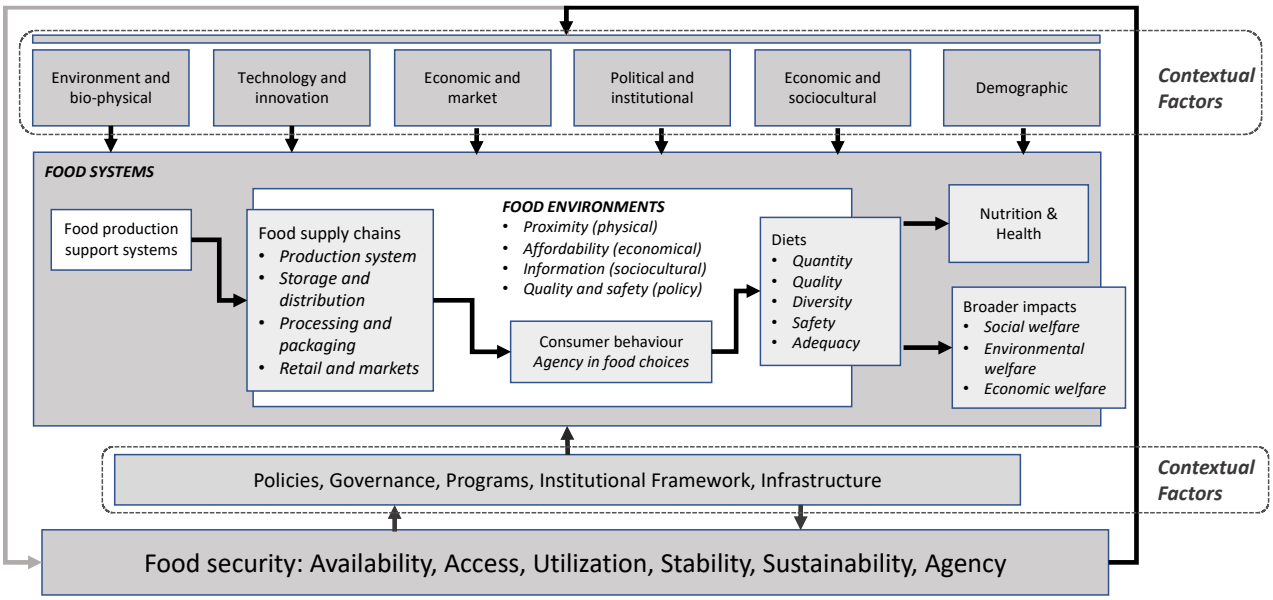

Figure 2, Generic conceptual framework food security. Adapted from HLPE, 2020.

Building upon the foundation of this framework and applying it to the setting of Sint Maarten, as a SITE, we constructed an initial research question that reads "what are the drivers and challenges for local food production in the small island tourism economy state of Sint Maarten". After validation of our conceptual framework, a process we describe in our data collection, we further specified our research question into.

What are most prominent drivers and challenges of the institutional framework, infrastructure, resources, and capabilities impacting the local food production systems on the small island tourism economy state of Sint Maarten, and which opportunities for improvement can we identify?

3.1 Explanatory logic of structure-conduct-performance

We can confidently assume that different actors, or stakeholders, in food and adjacent systems have different, and likely changing, perspectives on sustainability and form their own narratives, resulting in divergent ambitions and goals, and system level trade-offs due to their interactions (Rivera-Ferre & Ortega, 2011; Thompson, 2009). This implies that we are dealing with *complex adaptive systems* (SAPEA, 2020).

To successfully transform these complex food and adjacent systems, we need to take a comprehensive approach encompassing not only regulatory, functional, and processes aspects, that reside at a structural level, but also behavioural aspects, addressing the duality between structure and agency (Bourdieu, 1984; Giddens, 1984). One way of doing so is to draw upon the structure-conduct-performance paradigm for evaluating food and adjacent systems as the foundation for an explanatory logic (Nguyen, 2018; Porter, 1979). This framework prescribes that its three elements interact in the following way. The (1) structure of systems is dynamic and driven by complex and varying mechanisms regarding governance and social, political, economic, and environmental developments. It generates incentives for stakeholders influencing their decision-making, capacities, and ultimately their (2) conduct (behaviour). At the same time, stakeholders are also interdependent and impact each other's decision-making processes and capacity to act. By governance mechanisms we mean the rules, processes, and instruments that structure interactions and decision-making between public and/or private entities to realise collective goals for a specific domain (Kooiman, 2003). Therefore, explicitly addressing that agency, and the ability to meaningfully engage in processes that shape governance processes, is a central aspect in our investigation.

The overall (3) performance of the food and adjacent systems, which is generally assessed in terms of trade-offs within, social, economic, and environmental sustainability, results from the aggregated conduct of stakeholders in the systems (Nguyen, 2018). The system's performance generates feedback that influences the conduct of stakeholders and the structure of the system in an evolutionary process.

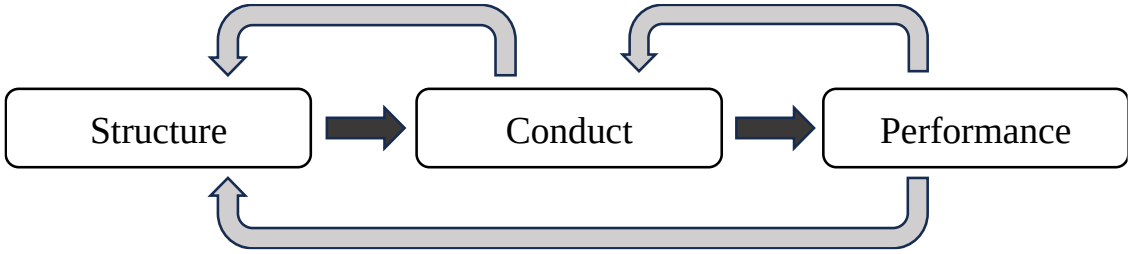

Figure 3. Structure-conduct-performance paradigm.

To illustrate the above mechanism with a simplified example, imagine that structure of a food production value chain (encompassing farms, wholesale, and retail) incentivises actors to purely pursue maximizing individual profits. This will guide their decision-making and behaviour, which then, taken together, informs how the system operates. In this fictional example we may predict that the system will produce low quality unsustainable products. However, it also implies that actors potentially have power to

initiate systems changes, for example, by increasing consumer value by improving product quality, establishing new standards, and forcing other actors to do the same.

To improve system performance, we need to identify and analyse root causes of underperformance, binding constraints, and seek to leverage opportunities. Theory prescribes several interventions such as changing stakeholder behaviours, developing a joint vision and strategy, an integrated set of solutions, supported by multi-stakeholder partnerships, and facilitate rather than being directly involved (Nguyen, 2018).

4. Design and methods

Our research design is best described as a combination between a descriptive and exploratory case study. A case study approach naturally applies as we are investigating a contemporary real-world system, where there are many more variables at play than objects of interests, interacting in a complex manner, all while there are unclear boundaries between the system of interest and other systems (Yin, 2018). A concern in case studies, and qualitative research for that matter, is the need for rigor. One way to achieve this is by clearly outlining the research process and justifying each decision made (Yin, 2018; Gioia, Corley, & Hamilton, 2012). We have presented our research questions, case of interest, and initial explanatory logic, and will proceed to discuss our data collection methods and criteria for interpreting our findings. Within our case study approach, we collect and analyse qualitative data from multiple sources, through multiple methods. Hence, we apply triangulation of data and methods, which helps us to address our complex research setting better than any single method alone (Hennik, Hutter, & Bailey, 2020; Yin, 2018).

Building upon the notion expressed earlier that we need to explicitly address agency and the ability to meaningfully engage in processes that shape governance processes, especially those stakeholders that lack information and political and structural support (Eise & Rawat, 2021), we borrow elements from community-based and participatory action research methodologies, involving key stakeholders in various phases of our research, most prominently in the analysis of our findings. Community-based participatory research is about creating partnerships, building coalitions, developing relationships, and coordinating action. It involves active and meaningful participation of groups and communities affected by the issues studied, in all phases of research to support community-driven objectives, produce meaningful results and have positive impact (Nelson G. , Ochocka, Griffin, & Lord, 1998). Furthermore, as we investigate complex *adaptive* systems, we also include an action-research component, which emphasises simultaneously investigating issues and generating solution-oriented knowledge by taking action within the system in which the issues are located. The elements of investigation and solution generation are linked by critical reflection, providing context that allows for a deeper understanding of the issues (Bradbury, 2015; Bourner & Brook, 2019). We argue that including stakeholders in this manner contributes to their empowerment and their ownership of problems and solutions. As such, we contribute to positive impact, sustainable solutions, and promoting social equity.

Following the above, we apply three concrete data collection methods consisting of interviews, participatory action research, and expert meetings. All participants were fully informed on the objectives of the project as known at the time of their engagement, were provided the option to remain anonymous, and have given their permission to be recorded. After our interactions, the participants were informed on the project's progress, until the project was concluded.

While we set out using a conceptual framework and explanatory logic based on theory, our analytical plan for interpreting our findings comprises inductive elements as well, due to the unique context of our project, which is Sint Maarten. We thus not only seek

to describe, and to some extent, explain, but also seek to explore and adapt our generic framework, investigate that adaptation in a new cycle, and generate new hypotheses. Figure 4 depicts our analytical cycle and iterations, initially following principles described in grounded theory and qualitative research (Bryman, 2016; Hennik, Hutter, & Bailey, 2020), where in the second iteration we investigate our adapted framework by *pattern matching* as described by theory (Yin, 2018), while allowing for emerging insights and new hypotheses.

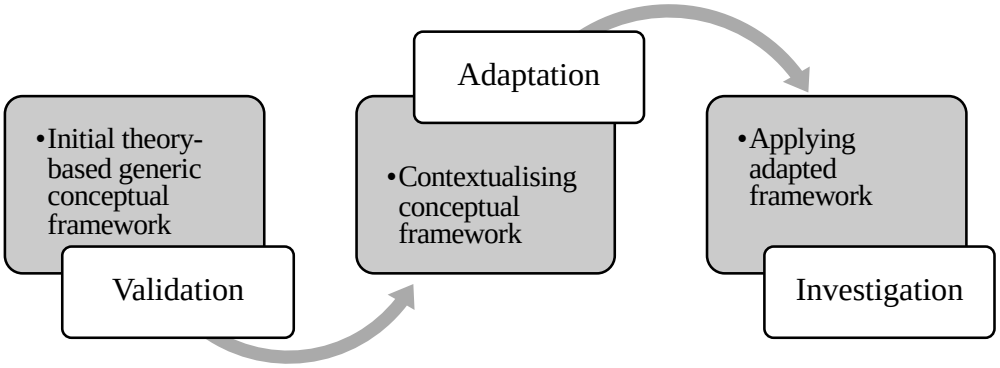

Figure 4. Analytical cycle.

5. Data collection and preliminary analyses

Based on our literature review and initial conceptual framework, we identified food system stakeholder groups, and contacted individuals representing these groups for exploratory interviews, in total $n = 29$, with the following groups, agriculture $n = 9$, government $n = 8$, retail and import $n = 4$, NGOs $n = 2$, education/research $n = 4$, and power and energy infrastructure $n = 2$, noting that most respondents simultaneously represent private citizens. Based on the results of these interviews, we validated our initial conceptual framework, describing how food systems and contextual factors impact food security, confirming that it indeed fits the context of Sint Maarten. Additionally, we further contextualized our model, putting more emphasis on *contextual factors* as critical elements for Sint Maarten at the time of conducting this research.

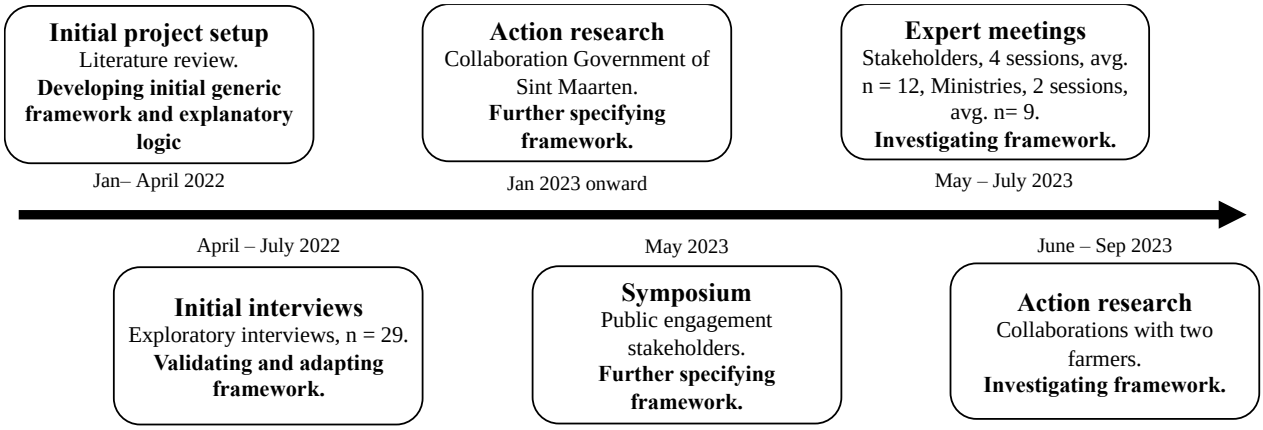

Figure 5. Project activities timeline.

We continued to contextualise and detail our conceptual framework, by engaging Sint Maarten's communities through a symposium, of which most parts were recorded for review at a later time, visiting farmers markets, and by officially collaborating with the Department of Economy, Transportation & Telecommunication (ETT) of the Ministry of Tourism, Economic Affairs, Transportation and Telecommunication (TEATT) of the Government of Sint Maarten, which is responsible for agriculture. We established that the government of Sint Maarten is a key stakeholder and to ensure positive sustainable impact, we need to find synergies between their efforts and our research, acknowledging the importance of a research-policy interface for food security (Roodhof et al., 2021), putting action research into practice.

The above activities allowed us to further specify those themes within the contextual factors of our conceptual framework that are most prominent for the context of Sint Maarten. We then organized two expert meetings on the themes identified, inviting representatives from all relevant stakeholder groups. We grouped the themes into two topics for practical reasons, (1) "Policies, Political environment, Governance" and (2) "Infrastructure, Resources, Capabilities". These two topics were each split over two sessions. In the first session we identified opportunities and challenges. In the second meeting, held two weeks later, so that participants had time to process the content, we

identified and probed roadmaps to solutions. The expert meetings were recorded with consent of the participants and transcribed for analysis using AtlastTi.

Following the above, we organized two inter-ministerial (expert) sessions for key stakeholders from ministries of the government of Sint Maarten, where we focused on inter-ministerial collaboration regarding local agriculture development, in which we integrated insights obtained from the earlier expert meetings. These sessions were attended by representatives from Ministries and Departments of Health, Education, Spatial Planning, Economy, and Culture. Similarly to the stakeholder expert sessions, these were also split over two sessions, first identifying opportunities and challenges and two weeks later, identifying and probing roadmaps to solutions. The inter-ministerial sessions were not recorded, due to possible sensitive information.

All sessions were prepared through careful deliberation with research assistants, local professionals, and partners at the department of ETT, devising a workflow and establishing a clear scope, while leaving room for emerging insights, to ensure maximum participative engagement and effectiveness.

Additional to the expert meetings, we actively collaborated with two local food producers, visiting their farms on several occasions, interviewing them, and having research assistants working alongside them, to map their activities, perceptions, problems, and needs.

As established earlier, investigating food systems requires a holistic approach, considering how the systems' elements and varying perceptions and interests of actors are interrelated, interact, and influence each other in a complex way. We therefore tried to acknowledge and approach this notion in a simplified way by matching our expert and inter-ministerial meetings findings with experiences of local food producers and our partners at the department of ETT.

6. Findings and Discussion

We approach food systems, as well as the relevant adjacent systems we identified for the unique context of Dutch Sint Maarten, namely the political environment, policies, governance, infrastructure, resources, and capabilities, as *complex adaptive systems*. Furthermore, we theorize that their *structure* incentivizes decision making and *conduct* of actors, which then aggregates into what we describe as *performance* of the system. To account for applying an initial *generic* holistic conceptual framework to a *unique* research site, we opted to analyse our findings in iterative cycles. This section presents the findings of our last iteration, where we investigate our contextualised framework while leaving room for emerging insights and is structured as follows. *Firstly*, we present a high-level descriptive analysis, highlighting the frequency of main topics mentioned during the *four* stakeholder expert meetings and various interviews. *Subsequently*, we match what the theory prescribes with patterns we observed in all our *six* expert meetings (i.e. including the inter-ministerial sessions), interviews, and *action research* efforts within (1) the department of ETT and (2) with farmers. *Finally*, based on the preceding analyses, we generate and argue for new hypotheses, solutions, and interventions, which we embed in theory.

Starting our final analysis, we applied *in vivo* coding for the four expert meeting transcriptions, and subsequently translated these *codes* into overarching *categories* (Gioia, Corley, & Hamilton, 2012), which we validated with our other collaborators. The results of the descriptive analysis are presented in figures 6, 7, and 8, depicting the frequencies of *categories* mentioned.

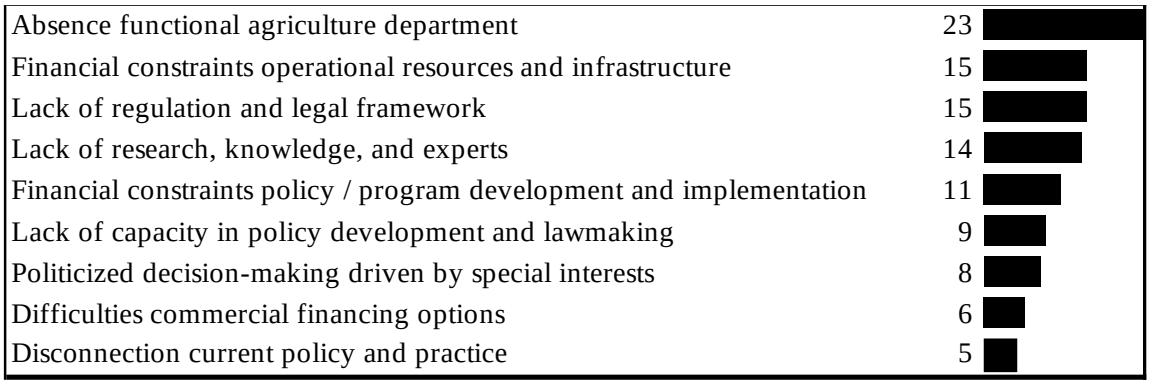

Figure 6, Challenges.

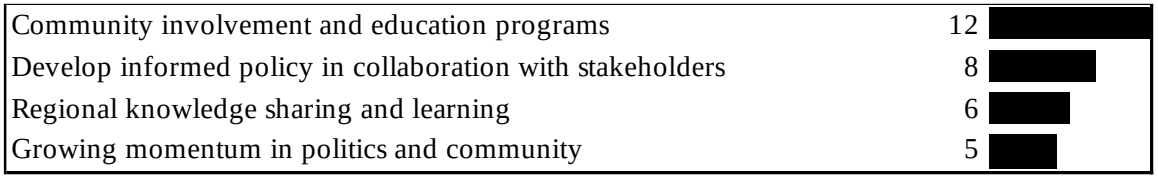

Figure 7, Opportunities.

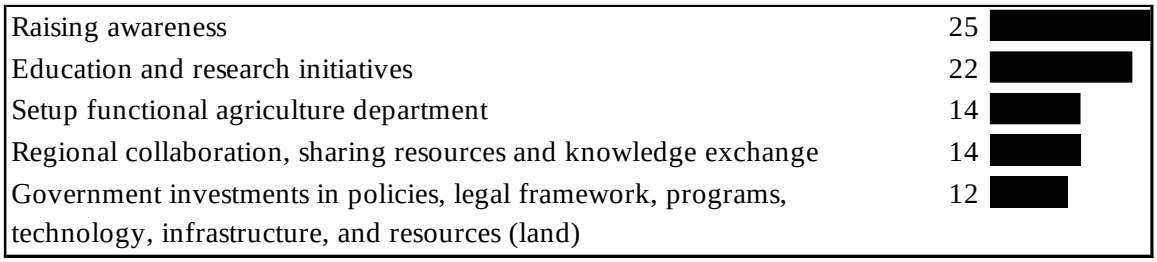

Figure 8, Roadmaps to solutions.

Pertaining to the solutions, there are several positive feedback and interaction effects applicable. Firstly, raising awareness, education, and research initiatives may positively impact the challenge of capacity building, which in turn may again positively impact raising awareness, education, and research initiatives. Furthermore, education and research initiatives may positively impact regional collaboration and involving youth, which both can have long term positive impact if managed appropriately. We have identified several other interaction effects and established concrete interventions due to the action component of our project, which we will discuss below.

Now that we obtained a descriptive overview of the main categories in the relevant themes identified for Sint Maarten, we seek to build explanations and descriptions of underlying mechanisms at play, by looking at how and/or why certain outcomes occur (Yin, 2018). We discuss three main findings from our *pattern matching* analysis, in which we pay special attention to identified key players' roles, which are politics, government, farmers, and the community, and their incentives and decision-making. After our explanation building for each finding, we address possible solutions, recommendations, and interventions.

6.1 Financial resources

There are certain sequences of interventions in order, due to various interdependencies. As such, we will first address the issue of deficiencies in governmental financial resources for agriculture in Sint Maarten. This is mentioned by all stakeholders in every session and in interviews, and various explanations are provided. A root cause seems to be that political decision-makers do not see value in investing in agriculture. They are perceived to believe that it is not possible, either not offering substantiation for their claims, or stating that it will not yield a clear monetary return on investment. Though, sentiments seem to slowly change toward a more favourable attitude. Addressing the situation from a systems perspective, and based on our action research efforts, it becomes clear that before any major investment is to be made, several building blocks need to be in place. There needs to be (1) a sound infrastructure supporting policy development and research, that supports developing clear insights on the feasibility, sustainability, impact, and return on investment of various agriculture developments. Furthermore, our findings show that all stakeholders believe investment decisions to be largely politically motivated, it can be argued that (2) community support, or lack thereof, for the matter impacts investment decision-making

within government. However, mobilising the community can prove difficult. Vaas et al. (2020) provide a thorough participatory action research account on community inertia when dealing with an invasive species in Sint Maarten's neighbouring island Saba. They argue that communities can be inert because of habitual community practices, comparable to institutional inertia. Furthermore, community inertia occurs when community members do not view issues as a problem due to uncertainties and perceived low impact, leading to a feeling of high cost trade-off when acting (Munck af Rosenschöld, Rozema , & Frye-Levine, 2014) and when communities believe that existing power dynamics prevent them from addressing the issue (Bachrach & Barantz, 1963). Non-government participants have consistently voiced a lack of faith in the functioning and quality of the political and governmental institutions of Sint Maarten, which they believe are mainly led by opaque personal interests of decision-makers. Furthermore, farmers are distrustful of the government's integrity when it comes to sharing business plans and innovations. This incentivizes farmers and others to acutely look out for their own interests. However, we did observe a growing momentum supporting the development of local agriculture, partially due to the COVID-19 pandemic, where people in quarantine picked up local gardening, leading to a new interest in agriculture.

We can identify several negative interaction and feedback effects from the above, where a need for community support to influence political dynamics is lacking, partially due to perceived poor political institutions which in turn informs poor political processes (Acemoglu & Robinson, 2012). Good political processes are a prerequisite for good decision-making. To start building the policy and research infrastructure that precedes agriculture development from within government, strong and good decisions, especially on (social) returns on investments, are needed.

Based on our analysis, we argue that, from a governmental point of view, to break the presumed negative feedback effect, the next steps toward developing sustainable local agriculture should build upon the current growing momentum supporting agriculture and contain arguments to convince decision-makers to make small investments and look for funding contributing to sound and informed policy development and research. However, these activities need not be limited to initiation by policy makers, as the community and practitioners can also be facilitated into taking on part of the work, which may also help in overcoming the lack of capacity in policy making. The above contributes to providing clarity and a foundation for subsequent informed decision-making. Furthermore, if communicated well, it may also help improve community awareness and perception on the functioning, quality, and even inclusiveness, of political and governmental institutions.

Our action-research interaction has created a concrete intervention in the form of a proposal to perform an economic impact analysis for developing an agriculture sector, which builds upon this research project and feeds into the macroeconomic model applied to Sint Maarten. Another concrete initiative currently effectuated by the Government of Sint Maarten, is a train-the-trainer program on Aquaponics as a new technology for producing crops, funded by the EU.

Further potential interventions came from the two inter-ministerial sessions, where one objective was to find synergies between initiatives and programs contributing to agriculture development in Sint Maarten, to increase efficiency and effectiveness. Concrete initiatives identified were education programs, where several schools in Sint Maarten receive funding for agriculture programs, and farmers markets. These initiatives were identified to have synergies with educating, creating awareness and visibility, and indirectly increasing community support.

6.2 Regulatory and legal framework

Developing quality regulatory and legal frameworks for agriculture in Sint Maarten has various requirements. In this section we will leave out the financial requirements and address two other main requirements, namely capacity and expertise. Simply put, we are talking about capable, knowledgeable, and available people, both as policy makers and external stakeholders that are consulted for policy development. Our findings show that these are lacking. Farmers are running their operations without clear regulation, as this is absent. One might say, they will ask for forgiveness not permission, and they feel that are fully in their right to do so, after engaging with government for longer periods, on multiple occasions, not experiencing clear tangible results. They feel that they are not being supported or heard and occasionally are at the short end of what they experience as *ad hoc* regulation enforcement.

Comprehensive and meaningful policy development takes patience, inclusive research, creating partnerships, and interdisciplinary and multi-stakeholder engagement, sense-making, and coordination. This is a tall order for a situation where the basic requirements, such as financial resources and capacity, are lacking. Furthermore, we found that the structural work-context of policy makers contains a substantial amount of institutional sludge, i.e. barriers that hinder progress, resulting in frustration, fatigue, and cynicism (Sunstein, 2019), causing delays, unnecessarily increasing workload, and decreasing efficiency and effectiveness.

We again see evidence of negative interaction and feedback effects, in this case mainly within one system, that of policy makers involving agriculture, which is embedded in a larger ecosystem of government that contains operational inertia and institutional inefficiencies, while experiencing changing demands. This context substantially restricts the range of effective interventions that can be made based on this project. Put differently, even if an intervention is developed by policy makers, will it get through the institutional sludge?

The challenge of doing the same or more with less is common within the quest for efficiency and effectiveness in organizations (Simon, 1997; Cyert & March, 2013). However, the matter is urgent, as the negative impact on farmers, as mentioned, is significant and continues unless something changes. Possible solutions are tapping into external resources or internal innovation (Mintzberg, Lampel, Quinn, & Ghoshal, 2003). Regional collaboration, sharing resources, and knowledge exchange may prove valuable and provide a basis to perhaps ‘leapfrog’ ahead, as the knowledge and processes do not

need to be developed internally. Concrete examples are the Rural Agriculture Development Authority in Jamaica and how Anguilla supports local farming, amongst others through tax benefits. However, we believe that a minimum level of infrastructure and capacity needs to be present to not only absorb the knowledge, but also efficiently and effectively translate it into processes and procedures. Another option, once more, came out of our action-research approach, and that is to implement digital technology, to digitalise processes of a to-be-established agriculture department pertaining to monitoring the implementation of regulation, standard operating procedures, quality control, and sustainable practices.

6.3 Market developments

Currently in Sint Maarten, the market, i.e. farmers, is leading developments in agriculture. Farmers clearly state that they welcome governmental action but will not wait on it to act themselves. This has led to interesting developments. Some have taken it upon themselves to lead regarding practices and standardizing operations, developing and learning independently, and are taking advantage of better conditions across the water in Anguilla. However, for all participants, the door toward collaborating with the government is open. During the process of this research project, and in our expert meetings, where representatives of government were present, we observed the gap between the two groups decreasing and mutual understanding increasing through constructive conversation.

We observe that there is much fragmentation and little coordination in Sint Maarten in terms of agricultural practices, access to resources, and knowledge, both operational and regarding institutional and regulatory frameworks. We therefore conclude that there are many missed opportunities for practitioners to substantially improve their activities in terms of knowledge acquisition, learning efficiencies, operational effectiveness, and sustainability management. The wide and diverse range of market led local food production system initiatives begs for coordination, overview, and preferably collaboration.

We can link these developments to the lack of capacity in policy development, as policy makers can tap into market led developments by practitioners, creating various synergies. Having farmers and practitioners meaningfully contribute to policy development, includes them in governance shaping processes, and makes them feel heard and appreciated. This is another form of inviting external knowledge and resources to contribute to development, as mentioned above, providing an efficient basis to ‘leapfrog’ ahead, avoiding reinventing the wheel. Furthermore, the digitalisation of policy processes is fully compatible with including practitioners’ knowledge and can also serve as a hub disseminating knowledge on regulation compliance, standard operating procedures, quality control, sustainable practices, and for education purposes, thus being effective in both directions.

7. Synthesis and conclusions

The development of local food production systems in the small island state of Sint Maarten is proving to be a complex challenging endeavour. Many of the most urgent challenges interact with each other creating negative feedback effects, within an overall context that is lacking capacity and resources. We identified how stakeholders are restricted by these contexts and seek to individually optimize their situations. The various potential system level roadmap solutions we presented and discussed commonly deal with attempting to capitalise on low hanging fruits and overcoming the challenge of doing the same with less or doing more with the same, by finding synergies through external collaborations or innovative approaches.

Overall, there is a lack of a comprehensive infrastructure for policy development, implementation, research, and meaningful stakeholder engagement, while residing within a fragmented environment low on capacity and resources. Therefore, the next steps forward, whether they are new initiatives or seeking synergies in existing ones, should contain some level of contribution to constructing said infrastructure and a framework for informed decision-making. As such, contributing to future decisions and actions being more informed and coordinated within the larger objectives of developing local agriculture in Sint Maarten. This way one can build top down, while simultaneously capitalizing on existing and emerging initiatives.

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