



## Promoting sustainable food systems: An empirical analysis of local Food Hub governance models and structures in 12 African settings

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### ABSTRACT

African food systems are increasingly challenged by climate change, market instability, globalization, urbanization, and recent global crises. Such challenges, along with a mismatch between consumers' preferences and production opportunities, are generating vulnerabilities in the local food systems and exacerbating food insecurity and environmental problems such as land degradation, water scarcity, and loss of biodiversity. In response to these challenges, this study investigates the concept of Food Hubs as a potential adaptive governance mechanism. By analyzing and comparing information collected from 12 Food Hubs across five African countries, the research aims to uncover how local actors design and implement Food Hubs alongside the governance structures and mechanisms they adopt. Our results show that the 12 Food Hubs hold the potential to respond effectively to contemporary food system challenges, promote resilience in food systems, and enable more sustainable use of environmental resources. In particular, we point to the role played by the context in which they operate, its impact on their organizational structures, public/private stakeholders' involvement, and the array of formalization procedures, ranging from loosely binding agreements to the implementation of ad hoc institutions. This study contributes to an in-depth understanding of Food Hub development and governance, offering both empirical insights into their role in building sustainable and adaptive food systems in the African context and a theoretical contribution to the design, development, and implementation phase of Food Hubs (and similar organizations).

### 1. Introduction

African food systems are facing new challenges due to the combined pressure of environmental, social, and economic factors (Pereira and Ruysenaar, 2012). Climate variability – including more frequent and severe droughts, floods, and extreme weather events – significantly disrupts food production and distribution (Ghadiri et al., 2024; Zougmore et al., 2021). Rapid urbanization (Blekking et al., 2017) and market instability (Ayinde et al., 2022) intensify such vulnerabilities, threatening food security across the continent. These challenges are further exacerbated by recent global crises, including the COVID-19 pandemic and global conflicts, which have exposed the fragility of existing food supply chains, increased food and energy prices, and made

evident the mismatch between local production capabilities and evolving consumer demands (Pichon, 2022; African Food Systems, 2023; van Berkum et al., 2017). Taken together, these pressures undermine all dimensions of food security, including the availability, accessibility, and sustainable utilization of food resources (Bohle et al., 2009).

The combined pressures on African food systems, driven by both local vulnerabilities and global crises, highlight the urgent need for innovative governance mechanisms to strengthen food system resilience and sustainability (Zougmore et al., 2021). Addressing these challenges requires strategies that pursue multiple objectives: ensuring food security, promoting environmental sustainability and sustainable resource management, and supporting local economic development. Traditional

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approaches to food system governance, often characterized by centralized decision-making and rigid supply chains, have shown incapacity to address all these goals (Smith and Lawrence, 2018), particularly within the African context (Pereira and Ruysenaar, 2012).

In response, Food Hubs (FHs) have emerged as a promising model for addressing such challenges and transforming food systems. These organizational structures serve as intermediaries that manage the aggregation, distribution, and marketing of food products, primarily from local and regional producers, to strengthen their ability to satisfy wholesale, retail, and institutional demand (Barham, 2011). Despite the flourishing of the literature stream dealing with FHs in the past decade (see Berti and Mulligan, 2016), studies have so far overlooked the design, development, and implementation phases of FHs as well as the differences in FHs' governance structures, processes, and their determinants. Exploring these elements is key as they entail relevant practical and policy implications and provide insights into the interaction patterns occurring among actors within FHs.

This study fills this gap by analyzing and comparing 12 FHs located in 5 African countries, adopting an adaptive governance approach. Adaptive governance offers a dynamic alternative to traditional static governance and decision-making models, emphasizing flexibility, multi-actor engagement, and continuous learning as key principles (Rijke et al., 2012; Sharma-Wallace et al., 2018). By co-developing a shared definition of FH with local stakeholders, we provided a flexible tool to guide bottom-up development while enhancing the adaptability and resilience of food systems. The present study thus observes the concept of FH as a potential tool for enhancing adaptive food governance systems within the unique socio-economic and environmental conditions of the African countries in focus, thus offering a comprehensive perspective on the role of FHs in enhancing the adaptability and resilience of African food systems.

The research questions (RQs) to be addressed are the following:

**RQ1.** *How are local stakeholders developing and implementing FHs based on a commonly shared definition that entails principles of adaptive governance?*

**RQ2.** *Which common elements can be identified in the implementation processes of local FHs despite the individually driven nature of the process?*

The study has been developed as part of the EU Horizon 2020 R&I project Food and Local, Agricultural, and Nutrition Diversity (FoodLAND), which aimed at enhancing the diversity of food production and consumption in Africa through the creation of a network of local FHs connected to cities, fostering innovation in rural and peri-urban communities. By linking production and consumption, the project strengthens food supply chains, creates global and local market opportunities, promotes African diets, and provides nutritious, traditional foods to African and European consumers, addressing malnutrition, especially in women and children.<sup>1</sup>

A quasi-experimental approach was used to conduct this study. We identified 12 African food system settings characterized by latent nutritional responsiveness and ineffective governance structures. Starting from an umbrella definition of FH, co-developed with local actors, FHs were developed following the most suitable approach based on the specific context, needs, and actors to be involved. Each FH determined its governance model based on pre-defined categories, including decision-making process, governance principles, stakeholder types, type of agreement, vision, missions, and objectives.

This research extends the application of adaptive governance – previously employed in the analysis of rural communities (Edwards et al., 2018), natural disaster systems (Bakkour et al., 2015), biodiversity conservation (Basurto, Jiménez-Pérez, 2013), governance of urban water sector (Bos and Brown, 2012; Van Meerkerk et al., 2013), and

spatially distributed networks (Wyborn, 2015) among others – to the phenomenon of FHs. It advances the operationalization of adaptive governance (Sharma-Wallace et al., 2018), moving beyond state-centric views (Pereira and Ruysenaar, 2012), and offers insights into its organizational implementation. It also compares FH development across 12 settings, focusing on flexibility and participation.

## 2. Theoretical background

### 2.1. The Food Hub concept: evolution and debates

The FH concept has evolved significantly over time, with diverse definitions emerging across academic and practitioner domains (see Berti and Mulligan, 2016 for a summary). The United States Department of Agriculture (USDA) has developed one of the most widely employed definitions, describing FHs as a facility with a business management structure actively facilitating the aggregation, storage, processing, distribution, and/or marketing of locally/regionally produced food products (Barham et al., 2012; Barham, 2011). Beyond this operational definition, FHs have been conceptualized as re-localized distribution models or middle market infrastructures that connect local small and medium-scale farmers/producers with institutions, creating new value chains that strengthen local and regional food systems while advancing community sustainability and health goals (Knigge et al., 2016). Other perspectives highlight the role of FHs as organizations actively managing the aggregation, distribution, and marketing of food products whose sources are identified primarily from local and regional producers to strengthen their ability to meet wholesale, retail, and institutional demand (Fischer et al., 2015). Beyond logistics, FHs can also be understood as networks of grassroots, community-based organizations and individuals who work together to build a more socially, economically, and environmentally friendly food system that connects farmers directly with consumers (Barham et al., 2012; Blay-Palmer et al., 2013; Berti and Mulligan, 2016).

It can be argued that three distinct perspectives are emerging in FH conceptualization in relation to food security. First, the infrastructure-centric perspective views FHs as physical facilities enhancing food availability and accessibility through supply chain efficiency and market access (Barham, 2011; Knigge et al., 2016; Fischer et al., 2015). This is achieved through strategic aggregation of local production, enhanced storage and distribution facilities that minimize post-harvest losses, and better market coordination matching supply with demand. Second, the network-based perspective considers FHs as relationships between producers, consumers, and stakeholders, emphasizing social capital and community-building aspects (Knigge et al., 2016; Barham et al., 2012; Blay-Palmer et al., 2013). Thus, it reveals how FHs can strengthen food security by building social capital to be mobilized during disruptions, creating direct producer-consumer connections that enhance affordability, and facilitating knowledge exchange about production methods and nutritional values. This perspective is particularly relevant in the African context, where informal networks and community-based organizations often play crucial roles in food distribution and access. Third, the innovation system perspective frames FHs as centers of innovation and knowledge exchange that facilitate adaptation to changing conditions (Sgroi and Marino, 2022). The latter, though emerging, remains underexplored in the literature. Nevertheless, it holds potential in understanding how FHs can contribute to food security through the development and diffusion of innovative solutions to address production and distribution challenges.

Despite the growing interest in FHs, several challenges exist in their definition and understanding. A clear and univocal definition is still lacking, reflecting the variety of FH approaches employed in previous studies and the diversity of meanings assigned to this phenomenon, and existing ones mainly rely on reviews of the extant literature (Hermitin et al., 2022) and on emerging FHs' aspects. Moreover, such definitions are typically applied to already existing sites (Hyland and

<sup>1</sup> <https://cordis.europa.eu/project/id/862802>

Macken-Walsh, 2022), predominantly located in the Global North (Stroink and Nelson, 2013; Rose, 2017, among others), with only a few exceptions (see the study conducted by Perdana et al. 2022 on FH in Indonesia).

## 2.2. Adaptive governance in food systems

Adaptive governance is a flexible and multi-scalar approach that balances centralized and decentralized decision-making, promoting resilience and continuous learning, and generating long-term adaptation in a networked manner (Rijke et al., 2012; Bell and Morrison, 2015). This governance approach is relevant for managing complex systems – such as food systems (Smith and Lawrence, 2018; Hospes and Brons, 2016) – that face multiple challenges. Adaptive governance has emerged as a suitable lens for addressing complex environmental challenges (Sharma-Wallace et al., 2018), as its attributes often overlap with factors influencing the capacity for resilience (Voss and Kemp, 2006). Its core tenets - flexibility, resilience, and capacity for change – are key for effective environmental and resource management, sustainability achievement, and community building (Sharma-Wallace et al., 2018).

The main principles and mechanisms of adaptive governance have been identified as (i) inclusion and collaboration between actors, organizations, and institutions at different scales (Sharma-Wallace et al., 2018; Smith and Lawrence, 2018); (ii) broad participation characterized by local and “nested” decision-making (Smith and Lawrence, 2018); (iii) flexible and reflexive institutional processes that promote experimentation, continuous learning and shape future social structures (Rijke et al., 2012; Folke et al., 2005); (iv) promotion of leadership capacity (Sharma-Wallace et al., 2018); (v) development of social capital, community empowerment, and engagement (Sharma-Wallace et al., 2018).

In the context of food systems, adaptive food governance refers to flexible, community-based approaches customized to specific situations and challenges (Smit and Wandel, 2006). Bohle et al. (2009) define adaptive food governance as an approach that leverages social connections and grants local communities greater authority over food-related matters, encouraging local participation, resilience, learning, multi-level nesting, and polycentricity.

Adaptive food governance involves a diverse range of participants, which form dynamic and flexible networks of collaboration. Within these networks, shaped by the initiative of the participants, subtle norms of interaction are established, influencing the context in which decisions about food are made, priorities are discussed, and the governing principles themselves are defined (Sakdapolrak, 2007). Informal networks, especially during times of rapid change, can serve as platforms for generating new ideas and innovations, thereby increasing the responsiveness and adaptability of local food value chains (Smith et al., 2016). Self-organization thus emerges as a vital feature of adaptive governance systems, often implemented through interactions and learning processes (Rijke et al., 2012). Leadership can drive adaptive processes by mobilizing people, resources, and knowledge to drive change (Folke et al., 2005; Boal and Schultz, 2007).

Despite its theoretical promise, adaptive governance often remains more conceptual than operational. Practical implementation remains a challenge as it requires enabling conditions such as flexible institutional arrangements, mechanisms for catalyzing self-organization, and effective leadership to bridge gaps and foster collaboration (Hospes and Brons, 2016; Shinn, 2016). Transformation within adaptive governance occurs when actors adapt their perceptions, criteria, and strategies, enabling governance structures to evolve in response to complex challenges (Voss and Kemp, 2006). For example, engaging actors across scales in decision-making, information sharing, and network formation enhances responsiveness and resilience within food systems, particularly during crises (Smith et al., 2016).

## 2.3. Food Hubs as adaptive governance mechanisms: a new conceptualization

Traditional FH conceptualizations, focused primarily on logistics and efficiency, may result ineffective in contexts like the African one, where informal networks and community-based organizations play a key role in food production and distribution. Drawing on Smith and Lawrence's (2018) assertion that adaptation is context-dependent and framed in various ways by a variety of actors, we propose reconceptualizing FHs as adaptive governance mechanisms within local food systems, defined as:

*“a community of local operators aimed at making shared research and development decisions and enabling the adoption of innovations. The Food Hub acts as a centre of innovation, providing an organizational/institutional framework for the collaboration between private and public actors/organizations operating in the local food value chains; providing information as well as logistical and organizational facilities; and strengthening the sustainability, nutrition-responsiveness, agro-biodiversity, cultural value, and food diversity of local food systems”.*

The definition has been developed as part of the activities of the FoodLAND project. The process leading to this definition consisted of a review of the existing literature and definitions of FHs, which were categorized according to their focus and approach. Following an iterative process, the authors' team identified useful concepts from the literature on FHs and other related phenomena (i.e., living labs, districts, clusters, meso-institutions) and derived a preliminary definition and its distinctive elements. This definition underwent a refining exercise through bilateral meetings with local FH actors and was validated at the general project meeting.

The new definition, while maintaining a partial focus on the logistic-related dimension brought about by previous studies, moves beyond the idea of FH as mere physical infrastructures and sees them as dynamic entities capable of fostering adaptation and innovation rooted in the local context. It does so by emphasizing three key dimensions:

1. *Institutional flexibility of FHs*, enabling FHs to adapt their governance structures to local contexts and changing conditions by means of variable degrees of formalization, responsive governance structures, and adaptive decision-making processes;
2. *Multi-actor innovation networks*, fostering knowledge co-creation and innovation development, validation, and diffusion across a broad range of stakeholders of the local food systems (public institutions, civil society, private entities, and farmers' associations);
3. *Adaptive capability building*, highlighting the role of FHs as mechanisms for building system-wide adaptive capacity through skills development, resource mobilization, and network building.

At the same time, the definition has been conceived to address and mitigate uncertainty-related aspects that pose challenges to adaptive governance. These include ambiguities in governance purposes, unclear governance contexts, and uncertain governance structures (Rijke et al., 2012). In line with the operative framework outlined by Rijke et al. (2012), our definition takes into account three fundamental steps: the clear identification of governance scope, the systematic mapping of the context, and the continuous evaluation of the outcomes of governance mechanisms.

## 3. Materials and methods

### 3.1. Study areas

The study areas of this research are 12 rural FHs located in five African countries (Kenya, Morocco, Tanzania, Tunisia, and Uganda). The project goal was to create a network of local FHs - paired with separate cities - to mobilize relevant actors in rural and peri-urban communities and serve as injection points for introducing innovations. Local partners

(universities and NGOs) have selected the location of the FHs and paired cities based on their knowledge of the context. Fig. 1 presents a map of the network of the local FHs in rural and peri-urban areas, paired with cities.

The 12 FHs have different geographical, cultural, and socio-economic backgrounds, being in both Sub-Saharan and Northern African countries. More information about the FHs is presented in Table 1, which also provides information on locations and promoting actors involved, and in Appendix A, which provides further context information. In each FH, technological innovations are implemented to enhance, on the one hand, actors' individual agency and learning and, on the other hand, the competitiveness and sustainability of the local primary production sectors while strengthening the conditions for supplying the population with affordable, healthy, and nutritious foods.

### 3.2. Data collection & analysis

To address the research goal, data is derived from reports produced by local actors (universities and research centers, NGOs, ministries, etc.) in the 12 FHs. The template to fill out the report was distributed to partners and then filled out in late 2021 - beginning of 2022, covering the year 2021. Despite the standardized track for all the reports, flexibility has been left to local partners to report the information according to the relevance in their local context (for instance, great flexibility has been recorded in questions related to the governance structure). They were used to keep track of the FH creation process containing information concerning their design and conception (e.g., stakeholders involved and to be involved in the FH together with their roles and responsibilities; vision, mission, and FH objectives; the FH structure in terms of formalization, governance principles adopted, and objectives). The collected reports and, if available, the documents formalizing the FHs (as Memorandum of Understandings or Manifestos) have been analyzed following qualitative content analysis methodology (Mayring, 2000) using the software NVivo.

The analytical process was performed according to the coding principles from Saldaña (2021). Through this process, text fragments were classified into data units and associated with a series of conceptual categories (codes). In our case, the text fragments from the reports were coded and grouped in common themes in order to highlight the differences between the FHs in terms of (i) stakeholder types and their roles and responsibilities; (ii) governance structures in place (in terms of participatory processes, multi-level and polycentric governance, openness and transparency, and representation mechanisms); (iii) the vision, and (iv) the mission defined by each FH.<sup>2</sup> Visions, missions, and objectives are analyzed separately as each one of these constructs embodies the nature and purpose of organizations and can, therefore, provide relevant insights into the level of flexibility, resilience, polycentricity, multi-level nesting, local participation, and learning characterizing adaptive food governance systems (van Assche et al., 2022). This focus is further motivated by the critical role that a shared vision among stakeholders plays in addressing complex sustainability challenges effectively and in facilitating long-term and sustainable solutions (Halbe and Adamowski, 2019).

To further enhance the results, a World Café was conducted on January 20, 2023, in Zanzibar (Tanzania) with FHs' local actors. A World Café is a simple participatory method allowing large group dialogues and dynamics (Fouché and Light, 2011; Powel and Single, 1996). The event was facilitated jointly by a research institution, an NGO, and a non-profit foundation. Approximately 60 participants representing all FHs took part in the World Café, with 7–8 participants per

<sup>2</sup> All answers are based on specific questions formulated by researchers and sent to local facilitators (NGOs, universities, public and private actors) to be submitted and co-answered with all the local actors of the Food Hubs. Further details and questions are provided in Appendix B.

thematic table per session (each session around 35 min with six discussions held in parallel). Participants were partners of the projects and stakeholders: NGOs, universities, farmers cooperatives, and processing companies. During the World Café, FH representatives and actors had 1.5 hours to discuss three main thematic issues that is, FH governance, gender equity, and innovation. See Appendix B for an overview of the main topics covered in each thematic table.

Table discussions during the World Café have been recorded, and field notes have been collected to integrate the results of the qualitative content analysis. Despite being a powerful tool for participatory dialogue, two main limitations of this methodology need to be accounted for. First, the time-constrained conversational format and frequent table rotation might lead to short discussions and potentially surface-level interactions among participants who may only have the time to touch upon several topics (Fouché and Light, 2011). Second, unequal participation is a significant limitation of the World Café, as participants with dominant personalities, communication skills, or higher status might overshadow introverted participants (Schiele et al., 2022). To face these limits, trained moderators have been assigned to each table and results have been presented in plenary for further discussion and validation.

## 4. Empirical results

This section introduces the empirical results to provide insights into the way local stakeholders have developed and implemented FHs and to evaluate the degree of integration of adaptive food governance principles, such as adaptability, flexibility, participation, and resilience. A complete overview of the results is reported in Appendix C. Direct quotations from the documents or World Café discussions are provided using italics and quotation marks.

### 4.1. Strategic orientation and focus

The governance structure and degree of formalization are determined by the vision and mission of the FHs, as well as their goals. Our data shows three distinct strategic orientations among the FHs: (i) business-oriented, (ii) quality and nutrition-oriented, and (iii) society-oriented FHs. Kenyan FHs (K2 and K3) clearly oriented their FHs towards a **business and competition-oriented** approach. In such settings, the FH is considered a tool to promote cooperation, competitiveness, commercial agreements, and entrepreneurship. Their vision embodies this approach, with KE2 declaring its ambition to become *"the market leader for mangoes value-added products in Kenya"* (KE2). Similarly, in their missions, they foresee their impact in terms of capacity building of specific value chain actors (KE3).

In contrast, other FHs (MA1, MA2, and KE1) can be considered more food **quality- and nutrition-oriented**. Here, the focus shifts from pure market dynamics to enhancing product excellence. These FHs see their role as improving agricultural output, particularly the quality and nutritional performance of farmers' products, and ensuring high-quality produce reaches consumers. Such focus is also embraced in the FHs' missions, where impacts are expected in terms of improved food security and access (UG1 and UG3).

The FHs of Enfidha-Chebika (TN1) and Jendouba (TN2) can be considered **society-oriented**, as their visions extend beyond economic results and aim for more socially impacting improvements, such as improving the social conditions of local consumers, producers, retailers, and researchers and generating behavioral change. On the farmers' side, they see the FH as an opportunity to adapt to new technologies, while on the consumers' side, they see the FH as a tool to improve their nutritional conditions in terms of access to fresh and healthy food. These hubs conceptualize themselves as catalysts for systemic change, targeting improvements in social conditions, technological adaptation, and community food access. This is also evident in their missions, where impacts are expected in terms of gender balance and employment opportunities.

FHs' strategic orientations seem to be deeply rooted in the nature of

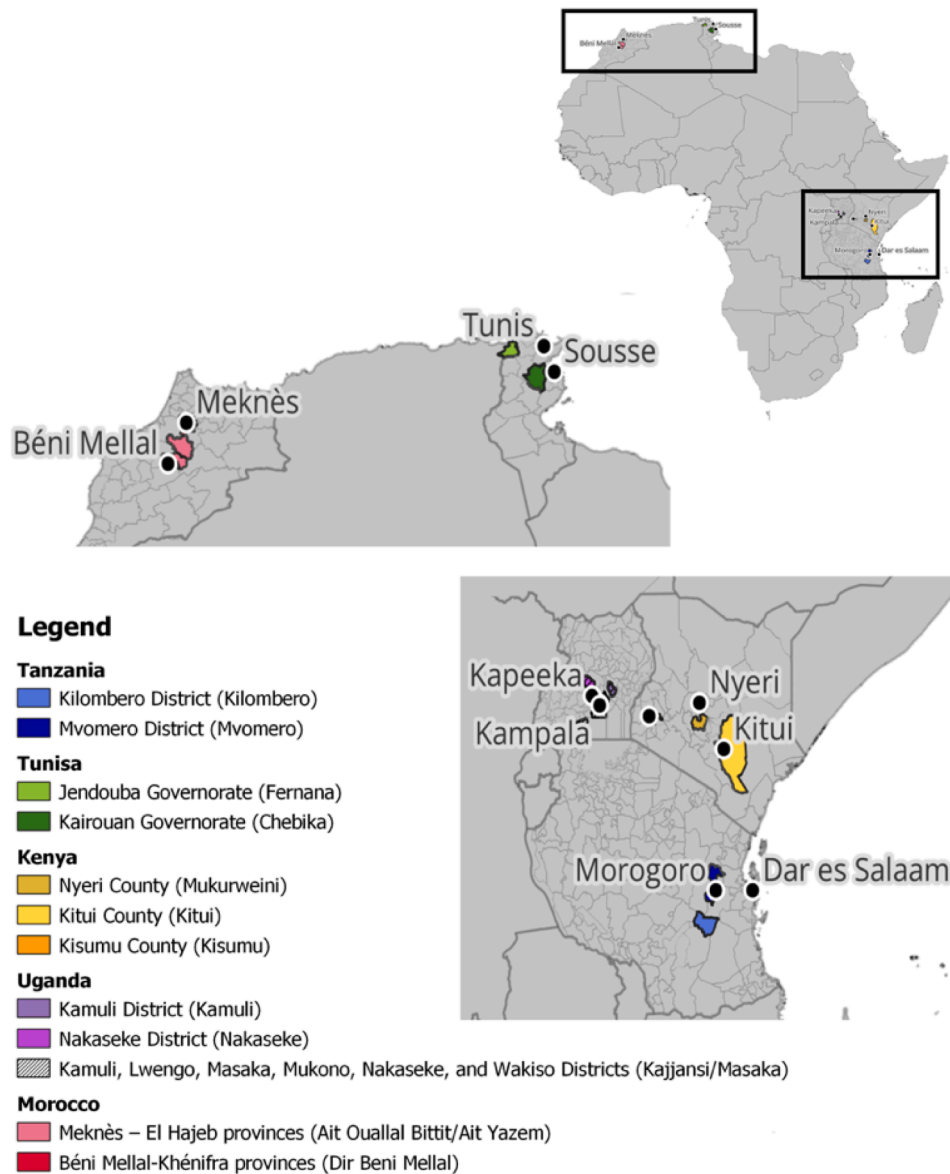


Fig. 1. Map of the local FH network in rural and peri-urban areas.

Table 1  
Food Hubs information.

Food Hub	Country	Administrative level	Paired city	Code	Promoting actor(s)/coordinator(s)
Zoyout Dir Beni Mellal / Khenifra	Morocco	Béni Mellal-Khénifra Region	Béni Mellal (MA)	MA1	National School of Agriculture of Meknès
Ait Ouallal Bittit / Ait Yazem	Morocco	Prefecture of Meknès	Meknès (MA)	MA2	National School of Agriculture of Meknès
Enfidha, Chebika	Tunisia	Governorate of Kairouan	Sousse (TN)	TN1	Institut Supérieur Agronomique de Chott Meriem
Jendouba	Tunisia	Governorate of Jendouba	Tunis (TN)	TN2	CEFA Tunisie; Institut National Agronomique de Tunisie
Mukurweini	Kenya	Nyeri County	Nyeri (KE)	KE1	University of Nairobi; Tamarillo Kenya Limited
Kitui	Kenya	Kitui County	Kitui (KE)	KE2	University of Nairobi; Kitui Enterprise Promotion co. Ltd
Kisumu	Kenya	Kisumu County	Kisumu (KE)	KE3	Ministry of Agriculture, Livestock, and Fisheries
Mvomero, Morogoro rural	Tanzania	Mvomero District	Morogoro (TZ)	TZ1	Sokoine University of Agriculture; District Agriculture, Irrigation and Cooperatives Offices
Kilombero / Lindi	Tanzania	Kilombero District	Dar es Salaam (TZ)	TZ2	Sokoine University of Agriculture; District Agriculture, Irrigation and Cooperatives Offices
Kamuli	Uganda	Kamuli District	Kalerwe (UG)	UG1	Makerere University; Volunteer Efforts for Development Concerns
Nakaseke	Uganda	Nakaseke District	Kapeeka (UG)	UG2	Makerere University; Volunteer Efforts for Development Concerns
Kajjansi / Masaka	Uganda	Nakaseke District	Kampala (UG)	UG3	National Agricultural Research Organization

their promoting actors. When private companies drive the FH creation, their priority revolves around market positioning and profitability, as in the case of Kenyan FHs. Conversely, when the promoting actor is a public one – like universities or NGOs – the FHs tend to emphasize broader societal goals, such as the creation of resilient food networks and addressing community needs. This is the case of Kamuli (UG1), coordinated by a public university and an NGO, the focus is on the creation of a “*self-reliant and resilient food network*”, on themes such as improved access to quality products and communities. Another example of promoting public actor-led FHs are the Tunisian ones, whose visions promote a societal-oriented approach, with a focus on the social conditions of stakeholders, as they aim “[...] to create a sustainable “*institution*” composed of all the stakeholders involved in the value chains of selected agrifood products and having mutual interests.” (TN1 and TN2).

While most FHs mention sustainability, their interpretation may vary, ranging from environmental considerations to food supply chain sustainability, financial viability, and long-term resilience. For example, the Ugandan FHs prioritize economic sustainability as a core objective. Similarly, the mission of the Kenyan FH of Kitui (KE2) provides explicit emphasis on the business dimension of the FH (“*to establish and manage business enterprises that complement the agribusiness and other economic activities in Kitui County*”). Similarly, FHs differ in the level of engagement of their strategic interventions, ranging from more macro-level approaches to product-specific ones. Some FHs present a focus on the food system as such (i.e., MA1 and MA2 “*Healthy, efficient, resilient and sustainable food systems*” and UG1 “*To connect food producers & consumers in communities to have self-reliant and resilient food networks*”). Initiatives such as the one pursued by UG1, TN1, and TN2 have explicitly included a focus on the community and the targeted local population by referring to “*value chain stakeholders*” (TN1), “*local population nutritional conditions*”, “*community gardens*”, “*consumers*” (TN2), and “*communities*” (UG1). At the product-specific level, FHs like TN1, KE2, and UG2 concentrate on specific value chains or agricultural products (i.e., “*selected agri-food products*” - TN1; “*Mangoes*” - KE2; “*fish*” UG3). This tiered approach highlights the adaptive flexibility of FHs in tackling local food system challenges.

## 4.2. Governance structures and mechanisms

FHs adopt considerably different approaches to formalization and governance, reflecting their socio-economic and institutional contexts. These variations are apparent in the processes used to formalize collaboration and in the mechanisms adopted to ensure participatory, transparent, and inclusive governance.

### 4.2.1. FHs' formalization approach

A first level of formalization of cooperation among stakeholders is represented by the adoption of Memoranda of Understanding (MoU) as a collaboration instrument. These non-legally binding agreements serve as a framework to articulate shared objectives, roles and responsibilities, and lines of action among the signing parties. The methods chosen by the FHs to operationalize MoUs present some variation. In Morocco, the formalization process required integrating the chosen agreement with the creation of *ad hoc* legally recognized associations, such as the “*Association Carrefour de l'Alimentation de Beni Mellal*” (MA1 and MA2), with their own statute. In other cases, such as that of Kenyan FHs, MoUs have been built upon pre-existing contractual relationships between the processing Small and Medium-sized Enterprise (SME) and the farmer groups providing the raw products (KE1 and KE2), thus leveraging existing structures. Tanzanian FHs provide another example of adaptation, using non-contractual platforms and conceiving and formalizing the FH starting from the existence of an agriculture multi-stakeholder platform for the farming season (TZ1) and of a multi-stakeholder post-harvest management platform (TZ2).

An interesting feature in Tanzanian FHs (TZ1 and TZ2) is the use of a Manifesto as a preliminary step. The Manifesto is a non-legally binding

document reporting shared vision and values among actors. While both MoUs and Manifestos are non-legally binding tools representing a preliminary step for formalizing the cooperation among different actors in a journey that may end up with stricter terms (i.e., Memorandum of Agreement containing conditional agreements - including sanctions for non-compliance - or establishment of a horizontally driven legal entity acting as an aggregator), Manifestos are less structured than MoUs, and they provide a foundational consensus, potentially evolving into more formalized arrangements.

### 4.2.2. Participatory governance

The governance structures within FHs emphasize representation and inclusivity, often relying on participatory mechanisms to ensure an equal distribution of powers and partners' representation. Many FHs use formal election systems to appoint coordinators and representatives, thus fostering the active involvement of members in governance (KE2, MA1, MA2, UG1, UG2, and UG3). More stringent rules have been implemented in some FHs, where voting rights are exclusively granted to those active members who have paid a member fee (MA1), thus promoting accountability among stakeholders.

Alternative approaches to representation are also evident. For instance, in the Kisumu FH (KE3), representatives are nominated by the chief officer of the Agriculture and Livestock Department, while the Enfidha-Chebika FH (TN1) allows stakeholder groups to nominate their own coordinators. In line with this effort to foster participatory governance, the Ugandan FHs (UG1 and UG2) have taken significant steps to ensure active engagement and representation of all FH members in collective decision-making processes. These efforts include the clear assignment of roles and responsibilities, reinforcing the principle of inclusivity. Additionally, reports from various FHs (MA1, MA2, UG2, and UG3) emphasize the importance of active participation, underlying the need to implement processes that enhance member participation and guarantee fair distribution of decisional power. For instance, the Moroccan FHs emphasize participatory governance through specific provisions in their statutes, which outline clear criteria for active membership; active members are defined as natural or legal persons engaged in agricultural activities within the Fès-Meknès region, representing farmer groups or contributing directly or indirectly to the promotion and defense of consumer rights. Membership is also extended to entities carrying out economic activities related to agriculture, such as agro-industry, trade, and logistics, as well as associations focused on consumer advocacy. This reflects their commitment to inclusivity, structured governance, and engagement across a wide range of stakeholders.

### 4.2.3. Transparency and accountability in decision-making

Openness and transparency of the decision-making processes, as well as publicity, are ensured in all FHs through different mechanisms. In the Tunisian FHs, decisions are taken after consultation and are made publicly available via involved associations. In the FH of Mukurweini (KE1), quarterly meetings are planned to share progress reports and to gather feedback from the participants, while other FHs conduct annual audits to maintain transparency (KE2) or use public notice boards to display decisions reached by consensus, ensuring accessibility to all members (UG1).

To further institutionalize transparency, some FHs have established dedicated committees and bylaws. For example, the Ugandan FHs (UG2 and UG3) have formed management and executive committees with the specific aim of committing to transparency and openness and building trust with stakeholders.

### 4.2.4. Gender equality in FH governance

Gender equality promotion is one of the core principles of the FHs, as the specific needs and challenges faced by men and women must be distinctly recognized and addressed in the design and implementation of any FH intervention. This is the reason why each FH includes some

tailored measures and recommendations concerning gender balance and promotes mechanisms preventing the exclusion of women. In Moroccan and Kenyan FHs (MA1 and KE2), women are assigned leadership roles, also granted through the adoption of rotational systems to ensure equity (KE2). Tanzanian and Ugandan FHs integrate gender considerations into their operations by selecting crops traditionally cultivated by women (TZ1 and TZ2) and applying gender-sensitive criteria for farmer involvement (UG3).

In some cases, FHs have collaborated with women-only associations to address gender-specific challenges. The Tunisian FH in Enfidha-Chebika (TN1), for example, works with associations composed exclusively of women farmers, empowering them within the governance framework. However, not all FHs have implemented mechanisms to ensure gender balance. Reports from FHs in Kenya (KE3) and Uganda (UG1) acknowledge the percentage of female participation but lack detailed provisions for balanced representation in governance.

### 4.3. Stakeholder engagement and roles

The establishment, governance, and development of FHs involve a wide ecosystem of actors whose configurations and responsibilities vary across contexts. However, it is possible to identify common patterns in the typology of FH actors and their roles.

A central element of the FH governance model is the role the FH plays itself, which functions as an advocacy platform engaging both the general public and governmental institutions. FHs serve as mediators, bringing together the needs of farmers, producers, and consumers while

fostering an environment conducive to innovation. Information from reports also highlights that the FH is perceived by participants as an enabling environment enhancing mutual trust among actors - which in turn impacts the decision-making process - promoting cooperation, which is beneficial for establishing relationships and tapping into the resources and expertise of partners. For instance, during the World Café, local actors were asked to share their direct experience on how this form of multi-actor governance approach facilitated innovation in food production. In Kenya (KE2), the FH was instrumental in the transition from peanut farming to quinoa cultivation by mobilizing various stakeholders across the food value chain, thereby securing market opportunities for the new product.

Fig. 2 outlines the FH stakeholders map, illustrating the actors involved in the FH activities (each color group corresponds to a different group of stakeholders, and rounded squares summarize the roles and responsibilities of stakeholders' groups). The main actors involved in FHs' composition are NGOs, research institutions and universities, farmers, cooperatives, public institutions and administrations, civil society members, and private actors.

Universities and research institutions - both public and private - bear responsibility for the monitoring and evaluation of FHs' environmental impacts. Their pivotal involvement within the FH activities revolves around capacity building, as they provide training to govern the FH and facilitate knowledge transfer among FH actors. Furthermore, these entities assume a crucial role in terms of research activities, as they are in charge of co-producing and disseminating innovations.

A similar role in terms of capacity building is played by NGOs, which

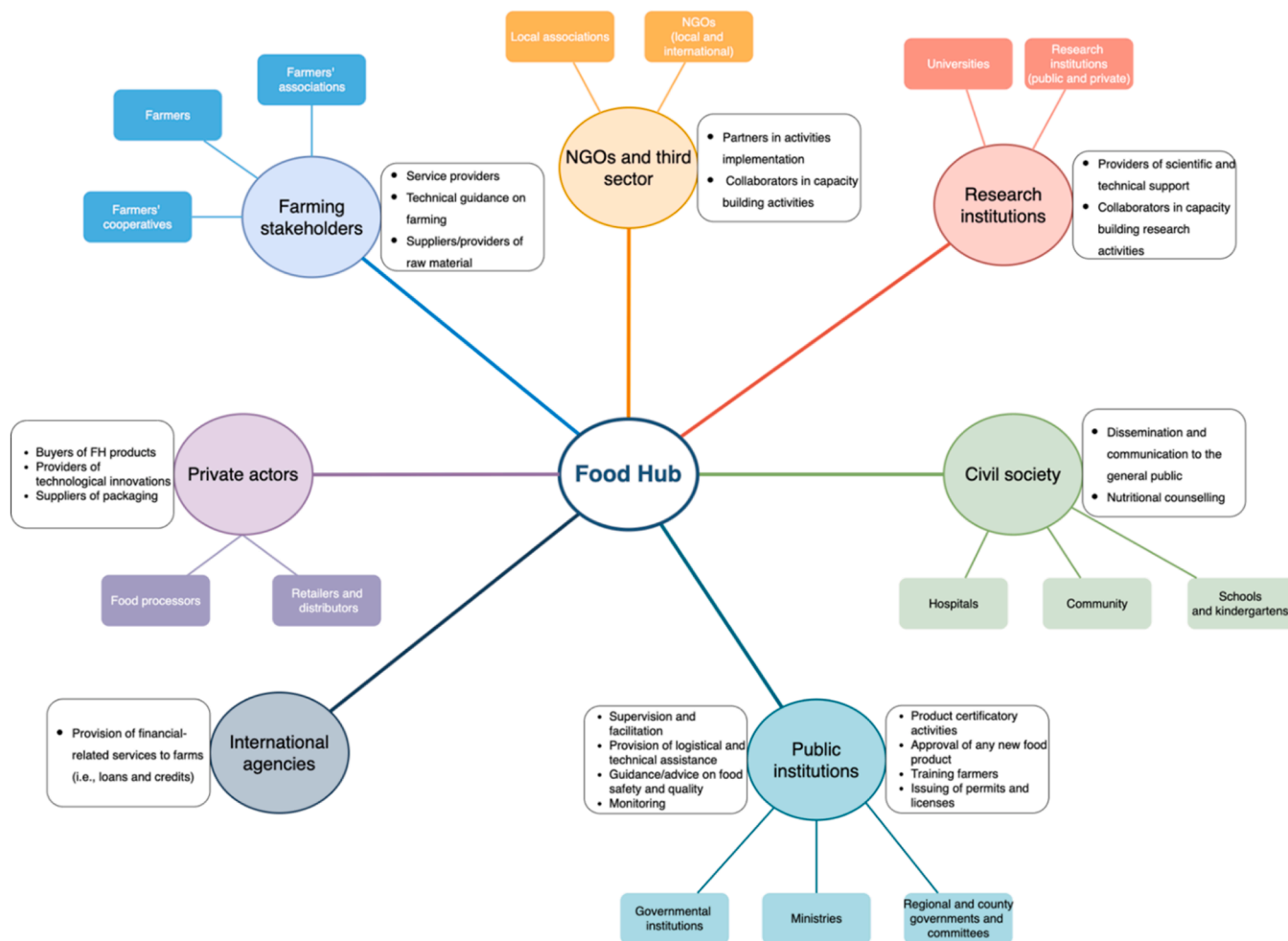


Fig. 2. FHs' stakeholder map. Own elaboration.

play a significant role in providing knowledge to enhance the FHs' internal skills and resources to improve their effectiveness in achieving their goals. In many cases, NGOs act as facilitators/coordinators, as well as direct incubators of the FH (i.e., hosting and organizing activities), as in the case of CEFA<sup>3</sup> for the Agricultural Development Group (GDA) in Tunisia. In other cases, the NGOs participate in the FH design and implementation by supporting and guiding the FH establishment and formalization, identifying relevant supply chain actors, and providing capacity-building-related activities (UG2). Furthermore, NGOs are crucial for assessing the needs of local actors and establishing network linkages to business platforms, service producers, and new funders or stakeholders in order to ensure the FH's financial stability. The capacity-building role played by NGOs and research institutions is understood by FHs' participants both as "capacity to be" and "capacity to act", where the former relates to the FH's internal governance, coordination, and communication mechanisms and the latter concerns the support on specific issues, networking capabilities with other actors, fundraising.

Governmental and public institutions at various levels – national, regional, and local – are also involved in FHs development. National ministries provide technical training to farmers and inspect FH operations (as seen in Kitui (KE2)). In some cases, such as the Kisumu FH (KE3), the Ministry of Agriculture supports the coordination and day-to-day management of the FH, thus acting as the FH project coordinator. In the Moroccan FHs (MA1 and MA2), public institutions take on strategic roles by advising on food safety and environmental requirements (i.e., aquaculture sector requirements) and offering technical counseling.

The FHs are also populated by private actors such as farmers and SMEs. However, their levels of engagement differ significantly. Some FHs limit farmers' participation to membership status without extending their engagement to more substantive roles, responsibilities, and direct participation in operational aspects (TZ2). This limitation can be attributed to the geographical extension of the FH, to the geographical distance among stakeholders, hindering effective collaboration and meetings, and to a lack of transparency within FHs regarding the required effort and participation from farmers. Conversely, other FHs actively engage farmers in governance, education activities (MA1), and even the FH establishment process (TN2).

FHs also engage with trade unions and farmers' associations or co-operatives, mainly with the role of achieving a stronger local representation in the preliminary meetings and round tables. This ensures that the needs and preferences of local actors can be efficiently considered and integrated into the development of the visions, missions, objectives, and activities of FHs. They also perform a networking role, supporting the organization of dissemination events and campaigns. In some FHs (TN1 and MA2), they play a proactive role, participating actively in FH meetings, consultations, and decision-making processes and providing guidance on food choices and consumer preferences. In other cases, such as Kajjansi/Masaka (UG3), they also perform marketing activities to improve product competitiveness.

Finally, actors from civil society (e.g., national or community radio) and other private actors (such as supermarkets and kindergartens) are involved and assigned different roles and responsibilities in the FH governance structure. In Morocco (MA2), the national radio assists in the communication and dissemination of the FH activities. Private actors such as private schools, retailers, and SMEs have been formally involved in the FH for networking purposes (TZ1 and TZ2) or as distributors or clients (UG1). Finance trust banks for the provision of loan capital and international investment companies (UG2).

<sup>3</sup> The Comitato Europeo per la Formazione e l'Agricoltura (CEFA) is an Italian NGO working in Tunisia, Tanzania, and Kenya, among others, in the fields of agriculture, training and education, work, and gender equality.

## 5. Discussions

### 5.1. Developing and implementing FHs in the African context

FHs are emerging as crucial players in addressing the complexities of food systems and mismatches between production and consumption in both advanced economies and emerging ones (Matson and Thayer, 2013). Our empirical findings indicate that, within African food systems, their role is to address local needs, serving as aggregators and connecting local farmers and producers with consumers to ensure fair and equal access to healthy food, to encourage community engagement, and to improve linkages between rural and urban areas.

Starting from a co-developed and commonly shared definition of FHs, local stakeholders have developed and implemented local FHs with different characteristics, in line with previous research (Franklin and Marsden, 2014; Sonnino et al., 2016). This study shows how the FHs' scale and scope are connected to their context, which influences stakeholders' involvement to ensure coordination and clear objectives.

Several differences emerge in terms of their organizational structures; while the majority of FHs have opted to formalize their commitment through MoUs, FHs have been further formalized either as newly created and legally recognized institutions, as in the case of Moroccan FHs, or as leveraging existing platforms, adapting and expanding their roles to fulfill the visions, missions, and objectives established by the FHs, as in the case of Tanzanian FHs.

A consistent and commonly shared endeavor of FHs is the effort to involve both public and private partners to ensure the long-term acceptance and sustainability of the FH through a collaborative approach (Blay-Palmer et al., 2013). All FHs involve public/governmental institutions. Yet, such actors show different degrees of participation and involvement, which is mirrored in the assignment of responsibilities and roles. For example, Tunisian public institutions have been assigned a supervisory, facilitating, and assistance role, while Kenyan ones are in charge of product certification, approval of new food products, training, and issuing permits and licenses. In terms of the variety of actors involved, Tanzanian FHs and Moroccan ones have foreseen the involvement of civil society, thus pursuing a wider scope and resonance of their activities. On the other hand, Ugandan ones have focused on a large number of farmers and local governments, mirroring their visions and missions.

### 5.2. FHs as tools for adaptive governance

The governance structures in place embody, to a certain degree, principles of adaptive governance that allow the FHs' structures a higher degree of adaptation to external events. (Smit and Wandel, 2006). Indeed, relying on governance attributes identified in the literature and researched in the FHs, the following insights emerge:

First, mechanisms for cooperation and conflict resolution are foreseen (McCord et al., 2016). In the case of the Uganda FH, for instance, decisions are reached by consensus, and notices are pinned on public notice boards (UG1). This mechanism ensures a balance of power within the community involved, which is not granted when talking of adaptive governance in practice (Sharma-Wallace et al., 2018).

Second, the flexibility of FHs as organizations is partially ensured (Folke, 2006). The current governance structures show a certain degree of flexibility, given their reliance on MoUs and Manifestos, which are flexible and non-binding structures. However, the decision-making mechanism is moving in the opposite direction. Representation is mostly guaranteed through elections every 3 or 4 years. While this element ensures democracy, it also puts aside the possibility of poly-centric and flexible decision-making mechanisms. Additionally, some FHs allow only active members to vote; some other FHs do not foresee elections at all, and representatives are elected by the government. Last, what emerges from all the FHs is that a mechanism for removing representatives is missing. Overall, it is hard to say which degree of



flexibility has been proposed by FHs. Some of them seem to have higher flexibility if we measure it by considering decisional mechanisms and structures.

Third, community-based engagement systems (Berti and Mulligan, 2016) have been, in all cases, considered. Some FHs opened the invitation to join to different types of stakeholders, including local farmers, while others set up mechanisms to ensure women's representativeness. Local knowledge and needs have been considered in the FH regarding farming and livestock productive practices. Farmers have been involved in the test stage of the innovations, interviewed, and consulted about their attitude towards them; the whole pre-test and pilot tests have been run along with local farmers and based on an iterative process so that pieces of knowledge from any actor involved could be taken and merged into the final innovation deployment. In some cases, the innovations revealed a partial inability to serve local needs.

In conclusion, FHs display different degrees of engagement, participation, and representation (Smit and Wandel, 2006). This result is in line with the idea that each of them should have developed their own structure and rules (Smit and Wandel, 2006) based on local knowledge and needs (Carlisle and Gruby, 2019), given few unique goals at the starting point of the project. The different promoting actors that have guided the conception and implementation of the FHs have highly influenced the visions and objectives of the FH as well as the formalization procedures. So far, the analysis conducted on FHs does not provide any evidence of their ability to encourage resilient places where bottom-up initiatives are facilitated (Bristow, 2010), nor is there strong evidence of their ability to establish synergies with other governance initiatives and actors, i.e., local and regional food initiatives (Nelson et al., 2013), with the exception of Tanzanian FHs, that by leveraging on already functioning multi-stakeholder platforms have created synergies and avoided resource wastages. Similarly, Kenyan FHs are capitalizing on existing relationships between local farmers and private companies.

## 6. Conclusions

The 12 FHs exhibit diverse and distinctive characteristics, making it challenging to derive a singular and definitive conclusion about their structure and functioning. Adaptive governance principles are detected in most of them, especially when it comes to stakeholder engagement, focus on local knowledge and needs, flexibility in the structures, continuous learning, and representativeness. However, the fact that they show such characteristics *today* does not guarantee that they will continue to do so in the future, as Sharma-Wallace and colleagues (2018) point out. To better understand their long-term impact and adaptability, the present study should be revisited several years after the project concludes (for instance, five years after the end of the project) to assess the medium-term impact and the ability of FHs to sustain and adapt in the long term. Additionally, more care should be devoted to mapping informal stakeholders of the food economy and their linkages to the FH's objectives and governance principle, given the important role they play in African economies (International Monetary Fund, 2017). Since one of the main goals of the project and the FHs was strengthening rural-urban linkages, it will be interesting to enquire also into the ability of FHs to serve as adaptive tools to overcome the current multiple crises that food systems in Africa are facing, from climate change to price volatility due to wars.

This study contributes to the streams of the literature dealing with FHs and adaptive governance systems. Indeed, it goes beyond mere theoretical discussions by offering evidence-based insights on FHs as potential adaptive food governance systems. The research delves into how FHs are operationalized by local actors and which patterns in use, entailing principles of adaptive governance, are established. Key aspects explored include the role of flexibility, resilience, and stakeholder engagement through participatory approaches. Furthermore, the study

introduces a novel focus on the design, conception, and implementation phase of FHs, which has been so far under-investigated in the FH literature, mainly focusing on already existing sites located in the Global North. By expanding the geographic scope of analysis and focusing on the early phases of FH development, this research opens avenues for studies focusing on dynamics and principles shaping FHs as adaptive food governance systems.

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Declaration of Generative AI and AI-assisted technologies in the writing process

COPILLOT AI has been used to revise the English in some sections, such as abstract, introduction, discussions.

## CRediT authorship contribution statement

**Valentino Marini Govigli:** Writing – review & editing, Conceptualization. **Elisa Carloni:** Writing – review & editing, Writing – original draft, Formal analysis. **Giordano Claudia:** Writing – original draft, Supervision, Funding acquisition, Conceptualization. **Gianluca Di Fiore:** Visualization, Software, Methodology, Formal analysis. **Luca Mulazzani:** Writing – review & editing, Funding acquisition, Conceptualization. **Marco Setti:** Writing – review & editing, Project administration, Funding acquisition. **Luca Falasconi:** Writing – review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## APPENDIX A. – Context of the study: FH information

Food Hub (Code)	Macro administrative level	FH area and inhabitants	FH structure	Dietary information	Nutritional issues	Main agricultural productions (% of farmers)	Technological innovations
Zoyout Dir Beni Mellal / Khenifra (MA1)	Béni Mellal-Khénifra Region	<ul style="list-style-type: none"> <li>• 238 sq.km.</li> <li>• 42855</li> </ul>	Town and villages	Prevalence of meat and cereals	<ul style="list-style-type: none"> <li>• Increasing rates of overweight and obesity (prevalence among women)</li> <li>• Anaemia</li> </ul>	<ul style="list-style-type: none"> <li>• Wheat (~48 %)</li> <li>• Olive (~47 %)</li> <li>• Onion (35 %)</li> <li>• Potato (~19 %)</li> </ul>	<ul style="list-style-type: none"> <li>• Precision irrigation systems</li> <li>• Centrifugation, filtration, and clarification</li> <li>• Precision irrigation systems</li> <li>• Precision protection systems</li> <li>• Smart storage systems</li> </ul>
Ait Ouallal Bittit / Ait Yazem (MA2)	Prefecture of Meknès - El Hajeb provinces	<ul style="list-style-type: none"> <li>• 2156 sq. km.</li> <li>• 132,746</li> </ul>	Medium and small villages				<ul style="list-style-type: none"> <li>• Biodegradable mulching</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Community gardening and hydroponic system</li> <li>• Osmotic dehydration and solar air drying</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Smart storage systems</li> <li>• Solar drying</li> <li>• Juicing, extraction, and fortification</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> </ul>
Enfidha, Chebika (TN1)	Governorate of Kairouan	<ul style="list-style-type: none"> <li>• 100 sq.km.</li> <li>• 80,000</li> </ul>	Town and villages	Increasing consumption of dairy and meat products, sugar, fat, and salt	<ul style="list-style-type: none"> <li>• Increasing rates of overweight and obesity (prevalence among women, 50.9 %)</li> <li>• Micronutrient deficiency (iron, vitamin A and D)</li> </ul>	<ul style="list-style-type: none"> <li>• Wheat (~48.2 %)</li> <li>• Olive (42.4 %)</li> <li>• Barley (32.1 %)</li> <li>• Fava bean (25.5 %)</li> </ul>	<ul style="list-style-type: none"> <li>• Biodegradable mulching</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Community gardening and hydroponic system</li> <li>• Osmotic dehydration and solar air drying</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Smart storage systems</li> <li>• Solar drying</li> <li>• Juicing, extraction, and fortification</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> </ul>
Jendouba (TN2)	Governorate of Jendouba, province of Fernana	/	Villages				<ul style="list-style-type: none"> <li>• Osmotic dehydration and solar air drying</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Smart storage systems</li> <li>• Solar drying</li> <li>• Juicing, extraction, and fortification</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> </ul>
Mukurweini (KE1)	Nyeri County	<ul style="list-style-type: none"> <li>• 2631 sq. km.</li> <li>• ~760,000</li> </ul>	Town and villages	Maize, wheats, and beans	<ul style="list-style-type: none"> <li>• 32.8 % of children achieve Minimum Dietary Diversity</li> <li>• 26 % national prevalence of stunting and 11 % underweight.</li> <li>• Increasing rate of overweight and obesity in boys and girls</li> <li>• Micronutrient deficiencies (iron, zinc, iodine, vitamin A, calcium)</li> </ul>	<ul style="list-style-type: none"> <li>• Maize (92.1 %)</li> <li>• Bean (60.8 %)</li> <li>• Coffee (32 %)</li> <li>• Pigeon pea (26.3 %)</li> <li>• Banana (21.1 %)</li> </ul>	<ul style="list-style-type: none"> <li>• Precision harvesting systems</li> <li>• Smart storage systems</li> <li>• Solar drying</li> <li>• Juicing, extraction, and fortification</li> <li>• Bio-based packaging</li> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> </ul>
Kitui (KE2)	Kitui County	<ul style="list-style-type: none"> <li>• 30430 sq. km.</li> <li>• 1136,000</li> </ul>	Town and villages				<ul style="list-style-type: none"> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> </ul>
Kisumu (KE3)	Kisumu County	/	Villages centered on a major city (Kisumu)				<ul style="list-style-type: none"> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> </ul>
Mvomero, Morogoro rural (TZ1)	Mvomero district	<ul style="list-style-type: none"> <li>Mvomero: <ul style="list-style-type: none"> <li>• 7325 sq. km.</li> <li>• 312,109</li> </ul> </li> <li>Morogoro (rural): <ul style="list-style-type: none"> <li>• 11,925 sq. km.</li> <li>• 339,000</li> </ul> </li> </ul>	Town and villages	<ul style="list-style-type: none"> <li>• Prevalence of carbohydrate-rich foods with a low intake of micronutrients</li> <li>• Legumes are the second most consumed food group</li> </ul>	<ul style="list-style-type: none"> <li>• Undernutrition prevalent among children under the age of 5</li> <li>• Overweight and obesity among women (17.3 % and 16.2 %)</li> <li>• Micronutrient deficiency (iron, zinc, vitamin A, iodine and calcium)</li> <li>• Prevalence of anaemia among women and children under 5</li> </ul>	<ul style="list-style-type: none"> <li>• Maize (62.8 %)</li> <li>• Rice (42.5 %)</li> <li>• Bean (29.5 %)</li> </ul>	<ul style="list-style-type: none"> <li>• Selection of new improved legume lines</li> <li>• Biodegradable mulching</li> <li>• Precision harvesting systems</li> <li>• Smart storage systems</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> <li>• Integrated aquaculture systems</li> <li>• Smart storage systems</li> <li>• Solar drying and osmotic dehydration</li> <li>• Bio-based packaging</li> </ul>
Kilombero / Lindi (TZ2)	Kilomber district	<ul style="list-style-type: none"> <li>Kilombero: <ul style="list-style-type: none"> <li>• 14,918 sq. km.</li> <li>• 451,817</li> </ul> </li> <li>Lindi: <ul style="list-style-type: none"> <li>• 6979 sq. km.</li> <li>• 194,143</li> </ul> </li> </ul>	Town and villages (in Lindi mostly villages)				<ul style="list-style-type: none"> <li>• Smart storage systems</li> <li>• Solar drying and osmotic dehydration</li> <li>• Bio-based packaging</li> </ul>
Kamuli (UG1)	Kamuli district	<ul style="list-style-type: none"> <li>• 1557 sq. km.</li> <li>• 580,000</li> </ul>	Mostly villages with small town	Plant-based diets: cereals and roots, tubers, bananas, and legumes	<ul style="list-style-type: none"> <li>• Prevalence among children of stunting (29 %) and underweight (11 %)</li> <li>• 27 % stunting at national level</li> <li>• 41 % underweight at national level</li> <li>• 24 % of females in reproductive age are overweight or obese</li> </ul>	<ul style="list-style-type: none"> <li>• Maize (76.2 %)</li> <li>• Bean (65 %)</li> <li>• Coffee (23 %)</li> </ul>	<ul style="list-style-type: none"> <li>• Agro-ecological intensification</li> <li>• Smart storage systems</li> <li>• Milling</li> <li>• Extrusion and baking</li> <li>• Precision irrigation / fertigation systems</li> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Bio-based packaging</li> </ul>
Nakaseke (UG2)	Nakaseke district	<ul style="list-style-type: none"> <li>• 3477 sq. km.</li> <li>• 235,000</li> </ul>	Mostly villages with small town				<ul style="list-style-type: none"> <li>• Precision harvesting systems</li> <li>• Solar drying</li> <li>• Bio-based packaging</li> </ul>

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(continued)

Kajjansi / Masaka (UG3)	Nakaseke district	<ul style="list-style-type: none"> <li>• 5120,2 sq. km.</li> <li>• 3313,076</li> </ul>	Cities and villages	<ul style="list-style-type: none"> <li>• Vitamin A and iron deficiency are the most common micronutrient deficiency</li> </ul>	<ul style="list-style-type: none"> <li>• Aquaculture integration technology for rural and peri-urban areas</li> <li>• Solar drying</li> <li>• Milling</li> <li>• Fish smoking, salting, fermenting</li> <li>• Extrusion and baking</li> <li>• Bio-based packaging</li> </ul>
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**APPENDIX B. – Details about data collection**

6.1. Vision and mission definition

The **vision** statement gives the FH direction and promotes internal and external growth and purpose in the long term. The vision of the FH also accounts for its intentions and goals in creating social, economic, institutional and environmental impact potentials

The questions that have guided the definition of the FHs’ vision statements are the following:

- How do you see your food hub in 5/10 years?
- Which changes do you foresee for the local economy and people’s lives, thanks to the food hub?
- Which are the food hub’s impact potentials? (i.e., the creation of access to healthy local food for low-income consumers, contributing to community development through incubating small local firms and drawing from job training programs).

The **mission** is a declaration of intent of the FH and represents the tangible objectives it wants to reach and how to reach them. It answers questions like:

- What do you plan to achieve thanks to the food hub? (reducing the unemployment rate, increasing gender equality, promoting interconnectedness with urban areas, etc.)
- How do you plan to increase gender equality in the food hub?

6.2. World Café data collection

To capture diverse perspectives, participants were encouraged to share insights linked to their respective Food Hubs. The structured questions guided dialogue on key elements for innovation adoption, governance roles and challenges, and addressing gender gaps within the Food Hubs’ development and operations. The questions are reported below:

- **Thematic table on FH governance:**
  - o What are the partners’ roles in the governance of Food Hubs in each country or city where they have been created?
  - o What are the main challenges and issues faced by Food Hubs, and what best practices, if any, have been adopted?
  - o What operational proposals can be made for the future of Food Hubs?
- **Thematic table on gender**
  - o In our FoodLAND tasks (creating the Food Hubs, designing the innovations, etc.), have we considered existing gender gaps? If so, what measures have been taken to reduce them?
  - o What additional actions can we take to further address existing gender gaps moving forward?
- **Thematic table on innovation**
  - o What are the key elements for successful innovation implementation?
  - o How is the Food Hub contributing to fostering innovation adoption?
  - o What are the main challenges emerging from the Food Hub experiences, and what are the next steps to overcome them?

**APPENDIX C. – Tables summarizing results across FHs**

Table A: Summary of FH’s visions, missions, and objectives

Code	FH Vision	Mission	Objectives
MA1 MA2	Healthy, efficient, resilient and sustainable food system	Improving nutritional performance through sustainable agriculture by representing farmers and consumers, contributing to local and regional sustainable agriculture initiatives promoting local products, fostering public-private partnerships, raising consumer awareness about food quality, supporting research and training, ensuring gender inclusivity, and building collaborative platforms for agricultural and nutritional development	<ul style="list-style-type: none"> <li>• Improve nutritional performance through nutrition-oriented agricultural production and processing technologies</li> <li>• Represent and link economic operators and farmers with consumers</li> <li>• Promote food quality, food safety, sustainability and innovation</li> <li>• Support capacity building</li> <li>• Enhance regulatory frameworks</li> </ul>

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TN1	A sustainable institution with mutually interested stakeholders of selected agrifood value chains	In the short-run, to promote innovation adoption; in the long-run, to enable local producers and stakeholders to adapt their production methods and strategies to new technologies and opportunities over time	<ul style="list-style-type: none"> <li>• Coordinate partnerships to strengthen agro-biodiversity and nutritional performance through research and development initiatives</li> <li>• Increase the flexibility of the agrifood sector and value chains by spreading innovations</li> <li>• Enabling stakeholders to capitalize on new opportunities</li> <li>• Reduce economic vulnerability and enhance the welfare of producers and consumers</li> <li>• Energy saving through solar and air drying processes; reduce pollution with bio-based packaging and eco-friendly production</li> <li>• Create jobs by expanding food cultures, enhancing research, and developing ecological food products</li> <li>• Dehydrate unsold food to extend its life and create nutritious products to replace unhealthy snacks</li> <li>• Increase women balanced dietary food consumption, promote nutritional education, and deliver communication campaigns for dietary recommendations</li> <li>• Conduct training for consumers, producers, and retailers; implement school activities on healthy diets, hygiene, and environmental responsibility</li> <li>• Build networks among students, teachers, farmers, and local communities to support healthier diets and cooperation between universities and international research institutes</li> <li>• Increase the number of food operators and consumers interested in novel, nutritious products</li> <li>• Strengthen research collaborations among Italy, European institutes, and Tunisia; promote scientific publications and conferences</li> <li>• Empower young generations through educational programs that encourage healthy habits and environmental responsibility</li> </ul>
TN2	A center of innovation and collaboration, fostering sustainable food systems by addressing local dietary needs, reducing waste, promoting eco-friendly practices, enhancing education, strengthening agro-biodiversity, and connecting stakeholders across value chains.	Enhance social conditions and protect ecosystems by connecting local consumers, producers, retailers, and researchers to facilitate information exchange and collaboration. Smallholder farmers and food processors will have a collaborative space to innovate, reducing storage issues and spoilage. Gender equality will be promoted to prevent exclusions, jobs in bio-based packaging will be created. Health and dietary awareness will be raised through campaigns targeting vulnerable groups, and cooperation between researchers and producers will drive sustainable practices. School pilot projects will teach food sustainability, hygiene, and healthy habits, with plans to expand and collaborate with universities for broader knowledge-sharing	
KE1	Providing healthy value-added Tamarillo products	Deliver the highest quality from farmers' produce	Promote agribusiness through training and value addition of Tamarillo fruit
KE2	Market leader in mango value-added products	Establish and manage business enterprises in Kitui County to support agribusiness and other economic activities, creating job opportunities and a ready market for agricultural products while maximizing shareholder value	<ul style="list-style-type: none"> <li>• Increase incomes via commercialized agricultural value chains, improving livelihoods of small-scale farmers</li> <li>• Focus on mango production, processing, and marketing through developing technologies, knowledge, skills and abilities</li> </ul>
KE3	Develop innovative water filtration solutions	Build capacity of local and regional aquaculture actors	Test and integrate novel technologies
TZ1	Not indicated	Not indicated	
TZ2			<ul style="list-style-type: none"> <li>• Bridge production and consumption</li> <li>• Enhance food security, nutrition, and food safety through training and innovation for hub members and value chain actors</li> <li>• Foster collaboration and a unified voice to advocate for food value chain and nutrition interests</li> <li>• Promote entrepreneurship around the FH, creating conditions for improved food security, nutrition, and effective product commercialization</li> <li>• Develop a platform to connect research with practical application, identify training needs, and facilitate innovation testing and validation</li> <li>• Promote agriculture value chains through improved production (e.g., high iron beans)</li> <li>• Improve access to quality products supporting nutrition and food security among members</li> <li>• Raise nutrition awareness on the benefits of local food mixtures and new technologies to boost consumption</li> <li>• Disseminate knowledge about the advantages of adopting new technologies</li> <li>• Create a cooperation framework for knowledge and technology transfer among Food Hub members</li> <li>• Promote entrepreneurship create the conditions for effective commercialization of nutritious food products</li> </ul>
UG1	To connect producers and consumers in communities to have self-reliant and resilient food network	Improve access to quality products by adding value and transferring knowledge to support sustainable production and consumption among farmers	<ul style="list-style-type: none"> <li>• Adopt innovative technologies for horticultural production and nutrition performance while strengthening agro-biodiversity</li> <li>• Foster gender-responsive sustainable fish farming</li> <li>• Improve access to markets</li> <li>• Boost innovation (e.g., climate-smart practices)</li> </ul>
UG2	Improved utilization of horticultural biodiversity	Maximize the production and use of horticultural foods to promote nutritional diversity and improve biodiversity.	
UG3	Economically prosperous, self-driven and sustainable fish hub	Enhance food security and incomes via aquaculture value chain	

Table B: summary of FH's involved stakeholders, formalization procedures, and governance principles

FH Code	Types of actors involved	Formalization procedure	Equal distribution of power and partners' representation	Participatory processes in decision-making	Openness and transparency of decision-making processes	Gender equality
MA1	<ul style="list-style-type: none"> <li>Public research institution</li> <li>Local public institutions</li> <li>Farmers' cooperatives</li> </ul>	MoU - formal institutional arrangements with ad hoc legally recognized association with its own statute	<ul style="list-style-type: none"> <li>FH coordination is determined by election</li> <li>The structure, organization, and management are overseen by public authorities</li> <li>Structures, roles and functions are created</li> </ul>	<ul style="list-style-type: none"> <li>The FH's governance includes a public organization that observes and ensures food safety and quality compliance</li> <li>Decisions are made during meetings with majority participation</li> </ul>	<ul style="list-style-type: none"> <li>Decisions are reported in minutes and circulated to all members of the FH</li> <li>Draft of periodic reviews and reports</li> </ul>	<ul style="list-style-type: none"> <li>Electoral quota</li> <li>Encouragement of cooperatives and women's associations to be part of the FH</li> </ul>
MA2	<ul style="list-style-type: none"> <li>NGOs and associations</li> <li>Public research institution</li> <li>Local and regional public institutions</li> <li>NGOs and associations</li> <li>Agricultural cooperatives</li> <li>National radio</li> </ul>		<ul style="list-style-type: none"> <li>Member voting rights are granted to active members who have paid their fees</li> </ul>	<ul style="list-style-type: none"> <li>An ordinary general assembly elects the president of the association, sets the vision, reviews reports, and oversees the association's activities</li> <li>A board of directors oversees and controls activities, while an executive board ensures decision implementation</li> </ul>		
TN1	<ul style="list-style-type: none"> <li>Regional and national public institutions</li> <li>Universities</li> <li>NGOs</li> <li>Farmers' associations</li> </ul>	Not indicated	Each stakeholder is free to nominate a coordinator who will have one voice in the decision making	<ul style="list-style-type: none"> <li>The decisions within the FH are taken after consultation with all the stakeholders and participants</li> </ul>	<ul style="list-style-type: none"> <li>Decisions are shared through the participating associations and organization</li> </ul>	NA
TN2	<ul style="list-style-type: none"> <li>Universities</li> <li>Public research institutions</li> <li>NGOs</li> <li>Farmers' associations</li> <li>Public institutions</li> <li>Trade unions</li> <li>Private actors (i. e., service providers)</li> </ul>	Not indicated	Not indicated	Not indicated	Not indicated	<ul style="list-style-type: none"> <li>Women make up the majority of participants and are the primary beneficiaries of the activities</li> <li>Promoting gender equality is fundamental to the Food Hub's mission</li> <li>Girls and women actively participate in the analytical processes</li> </ul>
KE1	<ul style="list-style-type: none"> <li>Public research institution</li> <li>Farmers' groups</li> <li>Local and national public actors/authorities</li> <li>Private actors (retailers and suppliers)</li> <li>Communities</li> </ul>	MoU - built on existing contractual relationship between SME and farmers	Coordinators are selected based on minimum education requirements	<ul style="list-style-type: none"> <li>Community leaders and local elders are part of the FH, though not involved in daily operations</li> <li>Assistant chiefs are engaged for arbitration in case of disputes</li> </ul>	<ul style="list-style-type: none"> <li>Quarterly meeting to be used as a forum to share progress reports and to get feedback from the participants</li> <li>Website updates</li> </ul>	Elective posts follow the gender parity rule
KE2	<ul style="list-style-type: none"> <li>University</li> <li>Public research institutions</li> <li>Farmer cooperatives</li> <li>Local and national public actors</li> <li>NGOs</li> <li>Private actors (i. e., retailers)</li> <li>Communities</li> <li>Kindergarten</li> </ul>	MoU - built on existing relationship between local farmers and SME	Elections held during the annual general meeting and roles are stipulated in the available policy manual	Not indicated	<ul style="list-style-type: none"> <li>Quarterly meeting to be used as a forum to share progress reports and to get feedback from the participants</li> <li>Annual audits</li> <li>Websites updates</li> </ul>	Gender balance is considered as per the government policy of rule of gender, that is one third gender representation
KE3	<ul style="list-style-type: none"> <li>Public research institutions</li> <li>NGOs</li> <li>Private actors (i. e., small- and medium-sized enterprises)</li> <li>Ministries</li> </ul>	Cooperation agreement	<ul style="list-style-type: none"> <li>Food Hub coordinators are nominated by the Chief Officer in the department of Agriculture Livestock and Fisheries</li> <li>The government code of conducts and ethics</li> </ul>	Not indicated	<ul style="list-style-type: none"> <li>Accomplished through community involvement and field events</li> <li>Publications</li> </ul>	Not indicated

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TZ1 TZ2	<ul style="list-style-type: none"> <li>• Agricultural training institutes</li> <li>• Cooperative groups</li> <li>• Civil society organizations</li> <li>• Congressional budget offices</li> <li>• Farmers</li> <li>• Farmers' groups</li> <li>• Financial agencies</li> <li>• Governmental agencies</li> <li>• NGOs</li> <li>• Private actors (i. e., food processor, processors groups)</li> <li>• Research institutes</li> <li>• U.S. Agencies for International Development-related actors</li> <li>• Community radio</li> <li>• Nutrition committees</li> <li>• Transport association</li> </ul>	Manifesto (to become MoU in the future)	<p>evaluates the FH coordinators competence and capacity</p> <ul style="list-style-type: none"> <li>• Members voluntarism and District Agriculture Irrigation and Cooperative Officer coordination</li> <li>• Roles and responsibility are shared between District Agriculture Irrigation and Cooperative Officer and the FHs members</li> </ul>	Not indicated	Not indicated	Not indicated
UG1	<ul style="list-style-type: none"> <li>• NGOs and associations</li> <li>• Public research institution</li> <li>• Private actors (processors, retailers, market agencies)</li> <li>• Governmental institution</li> <li>• Private school</li> <li>• Farmers' cooperatives</li> <li>• Financial institutions</li> <li>• Public and private hospitals</li> </ul>	MoU	<ul style="list-style-type: none"> <li>• The members fully participate directly or represented in decision making and not just informed about decisions already made</li> <li>• The coordinators are elected through the annual general meeting that is conducted every calendrer year</li> <li>• Roles are assigned as per the constitution</li> </ul>	<ul style="list-style-type: none"> <li>• Collective/ participatory decision making is emphasized, whereby all members participate, and decision is reached on by consensus</li> </ul>	<ul style="list-style-type: none"> <li>• Decisions are shared with members through stakeholder engagement, community meetings and reports</li> <li>• Announcements are posted on public notice boards</li> </ul>	The FHs ensures no discrimination based on gender, race, color, ethnicity, national origin, sexuality, disability, religion, political belief, marital status, or age
UG2	<ul style="list-style-type: none"> <li>• Public research institution</li> <li>• Private companies</li> <li>• NGOs</li> <li>• Local public institutions</li> <li>• Farmers' groups</li> <li>• Producers' groups</li> </ul>	MoU	<ul style="list-style-type: none"> <li>• There is maximum involvement of all members in all the decision-making process</li> <li>• Free and fair election process for the hub leaders using secret ballots</li> <li>• The roles and responsibilities are designed together by the entire team of the hub.</li> </ul>	Not indicated	Openness and transparency are guaranteed through the establishment of sub-committees and executive committees	<p>Gender equality is achieved through:</p> <ul style="list-style-type: none"> <li>• Subcommittees focused on member rights and ensuring that gender equality is practiced</li> <li>• Gender-inclusive leadership structure of sub-committees and of the executive committee</li> <li>• Bylaws providing a framework that promotes openness, transparency, and gender equality in all activities and interventions</li> </ul>
UG3	<ul style="list-style-type: none"> <li>• Fisheries officers - District local government</li> <li>• Fish farmers</li> </ul>	MoU	<ul style="list-style-type: none"> <li>• FH leaders are democratically elected</li> <li>• Decisions are taken through established Hub Management Committees</li> </ul>	Not indicated	<ul style="list-style-type: none"> <li>• Dissemination materials</li> <li>• Email</li> <li>• Social media platforms</li> </ul>	<ul style="list-style-type: none"> <li>• Gender as a critical selection criterion for choosing FH farmers</li> <li>• Selected activities to form a gender-responsive stakeholder group</li> </ul>

## Data availability

The data that has been used is confidential.

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