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World Agriculture Watch

Operational guidelines

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World Agriculture Watch operational guidelines

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Foreword

The Food and Agriculture Organization of the United Nations (FAO), the French Government, the French Agricultural Research Center for International Development (CIRAD) and the International Fund for Agricultural Development (IFAD) created the World Agriculture Watch (WAW) in 2011. Its purpose is to better qualify and understand the functioning and results obtained by the different types of farms, in order to take into account their diversity in developing public policies. It is a concrete tool contributing to the necessary coordinated response to the global challenge of sustainable food security and nutrition.

Following a pilot phase involving ten countries, a program document developed in 2019 set out a coherent framework for Agriculture Observatory projects whatever the territorial scale. The publication of these Operational Guidelines is an important step in this collective development involving all partners.

The World Agriculture Watch analyses the farm and household - or family group - focusing on family farms, regardless of their size, as the major producers and suppliers of local, national and international markets. As such, family farms require the greatest productive and organizational investments to enable appropriate responses to today's challenges: poverty reduction, social equity, and agro-ecological transition. Investments that could be more effective if they better corresponded to the diversity of farm types.

These Operational Guidelines, intended for development operators, farmers' organizations and investment projects supported by States and financial institutions, set out the principles for defining farm types and characterizing their diversity. They provide clear concepts and benchmarks to build "information systems" that profile farm types and measure their relative weight and multidimensional performance in relation to sustainable development issues. This publication will be supplemented by a harmonized framework of variables and generic indicators that can be adapted to diverse situations.

Now it is time to widely implement the Observatory's methodology in the field. At regional level, this has already begun in the Indian Ocean; and at national level through projects in Cambodia, Myanmar and the Philippines - supporting sectoral and agro-ecological interventions that benefit both governments and family producers' organizations.

The Observatory can provide the long-term perspective to amplify the voices and challenges of family farmers in the global arena, including through the UN Decade of Family Farming (2019-2028). Thus, the proposed tools make it possible to develop repeated observations over time, on smaller samples but with a more detailed approach. These tools are particularly well-suited to analyzing the transformation of agrifood systems.

We hope this Operational Guide provides clear guidance to practitioners and relevant stakeholders, to further support family farming and promote sustainable, resilient, inclusive and efficient agriculture.

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Poilin Breathnach edited the document and Jim Morgan (FAO, NSL) was responsible for publications coordination and layout.

Taking over from Pierre-Marie Bosc as coordinator of the WAW, Marie-Christine Monnier finalized the present version with him.

Abbreviations and acronyms

AFD	Agence Française de Développement (French Development Agency)
AHC	Ascending hierarchical clustering
API	Application programming interface
CIRAD	(Formerly) Centre for International Cooperation in Agricultural Research for Development (now CIRAD)
Data4SDGs	Global Partnership for Sustainable Development Data
FAMD	Factor analysis of mixed data
FAO	Food and Agriculture Organization of the United Nations
FIES	Food Insecurity Experience Scale
IFAD	International Fund for Agricultural Development
GAEZ	Global Agro-Ecological Zones
GIS	Geographic information system
GPS	Global positioning system
GSARS	Global Strategy to Improve Agricultural and Rural Statistics
HTTPS	Hypertext Transfer Protocol Secure
IDELE	Institut de l'Elevage (French Livestock Institute)
ILC	International Land Coalition
LSMS	Living Standards Measurement Survey
LSMS-ISA	Living Standards Measurement Study–Integrated Surveys on Agriculture
NGO	Non-governmental organization
REST	Representational State Transfer
SDG	Sustainable Development Goal

SRL	Sustainable Rural Livelihood
Tdh	Terre des hommes
TEEB	The Economics of Ecosystems and Biodiversity
UAA	Usable agricultural area
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNU-IAS	United Nations University Institute for the Advanced Study of Sustainability
WAW	World Agriculture Watch
WFP	World Food Programme
WHO	World Health Organization

Introduction

These operational guidelines for World Agriculture Watch (WAW) – or *l'Observatoire des Agricultures du Monde (OAM)* – are the product of a collective effort to define a comprehensive way of producing relevant and timely data on family farmers. We include smallholders, as one of their main assets is family labour.

WAW's focus has evolved since the first phase of the programme, which focused on data generation and the use of existing data sets.[1] A key change since 2017 has been a change in perspective: we no longer consider data to be a mere asset, but a key tool for better defining investment policies tailored to the needs of the world's very diverse family farm types. The need for relevant and accurate data to characterize the many farm types remains a serious issue, but these data should first and foremost serve the interests of the family farmers involved and their organizations.

Our approach embraces farming in all its diversity and is inclusive in its analytical definition of family farms. Certain policies and approaches tend to view smallholders as a group that would benefit from social protection to help them move out of the sector, or see family farmers as potential investors. In contrast, we believe that small-scale farmers can be supported in ways that match their needs, means and objectives, with social protection support in place to safeguard their livelihoods. This also applies to "better-off" family farmers: they, too, should benefit from both social protection and suitable investment policies. The nature of the work and the links between farming assets and patrimony unifies family farmers across the board.

The second key change in our approach has been to give priority to the identification and analytical characterization of family farms in the context of WAW's work to support the United Nations Decade of Family Farming. It does so by providing methodology, tools and support to family farmer organizations and associations. Several of its projects aim to lend direct support to these organizations for the development of their own information systems.

These changes are reflected in our programme document (FAO, 2019a), which sets out a common structure for the design of future projects. The framework facilitates a harmonized project structure that:

- **generates** new or mobilizes existing data sets to inform the analytical framework for characterizing agricultural holdings, especially family farms;
- **uses** the data to produce typologies that will help in developing strategies to support family farm investment programmes; and
- **shares** them at local level, but also through a global information system, making it possible to report on the importance of family farming.

These operational guidelines contribute to the definition of a harmonized analytical conceptual framework. They are based on previous efforts to standardize variables and indicators. Amid a scarcity of data, however, they add some specificities that can be classified into an approach and concepts.

1 See FAO (2016; 2019b; 2019c) for lessons learned and illustrations.

The approach relies on the participation of stakeholders - from identifying their needs to defining appropriate information systems for characterizing family farms. The purpose of data generation is to provide information to inform the development of investment strategies to support family farmers in the face of current challenges. There is no magic wand that will enable family farms to deal with climate change, ecological transition to more sustainable and inclusive food systems or social inclusion. At farm level, investments are needed to improve the productivity of both land and labour, to add value to raw materials and to diversify produce through agro-ecological production patterns. At the collective level, family farmer organizations need up-to-date, quality data, so they can have a say in policy debates – something that is far from the case at present.

In terms of conceptual specificities, the harmonized framework does not attempt to reinvent the wheel, but builds on existing definitions and concepts. It does not aim to replace existing information systems, but proposes mobilizing what already exists and is available for public use. Most of the time, such information is old, does not exist, or is not available to stakeholders (Bosc and Viberti, 2020).

WAW's analytical definition of agricultural holdings is based on the nature of the work conducted, its quantification and ownership of the means of production. This makes it possible, for example, to specify which farms come under "family farming", "family business farming", if there are permanent employees, or "agricultural firms", where all farm workers are employees.

Such information may seem "simple", but has not existed to date.

The WAW definition of family farming aligns with that adopted by the Food and Agricultural Organization of the United Nations (FAO) and its Members in 2014 (FAO, 2013). It is inclusive, however, in that it does not set an upper or lower limit on farm size. The family character of the farm takes precedence – be it on a small or a more consolidated area - as does the family ownership of assets, simultaneously the means of production and the family patrimony.

The conceptual framework emphasizes available capital (solely the result of past investments), agricultural production systems and off-farm activities developed by family members. Lastly, it takes into account activities, including non-market production, that form a key element of food security strategies or that serve as a safety net against market risks.

The most important feature of the WAW approach is that it aims to collate and produce information that currently does not exist, for example, on the structural characteristics of these farms and their performance in the context of the Sustainable Development Goals (SDGs). This information is analytical, not normative. The goal is to produce analytical information based on the agreed definition, but to leave the normative dimension to governments.

These operational guidelines are structured into three main sections. The first presents WAW's harmonized analytical framework for characterizing the diversity of family farms, including a subsection linking farm level with landscape and territorial approaches. The second provides simple and robust guidance on engaging in data production at farm/family (household) level. The third acts as a guide on how to develop inclusive and targeted investment strategies and programmes to strengthen the productive capacity of family farms using data sets to define typologies and information systems to monitor the effects of those investments.


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A Conceptual framework and definitions


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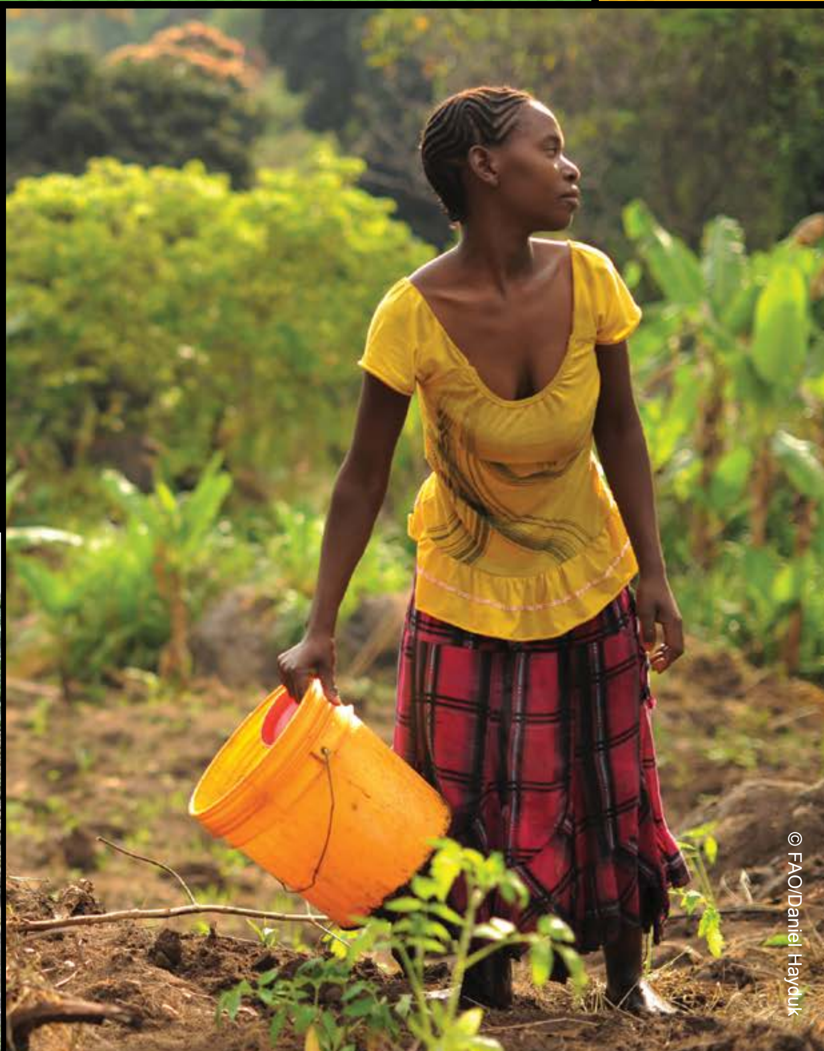
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A1. Defining family and other farm types from an analytical perspective[2]

For the International Year of Family Farming in 2014, the Food and Agriculture Organization of the United Nations (FAO) developed twin definitions of family farming, one substantive and one statistical (FAO, 2013; de la O Campos and Garner, 2014).

> **Substantive definition:** Family farming is "a means of organizing agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family capital and labour, including both women's and men's. The family and the farm are linked, co-evolve and combine economic, environmental, social and cultural functions."
>
> **Statistical definition:** "A family farm is an agricultural holding which is managed and operated by a household and where farm labour is largely supplied by that household."

A quantitative element is lacking here, however. These twin definitions remain ambiguous, as they still require adjectives and adverbs to describe farms' reliance on family labour and do not use quantitative data to characterize the nature of that labour. There are also other questions, such as how "family farming" ties in with other commonly used terms, such as "smallholder farming", "small-scale farming", "subsistence farming" and "peasant farming". And while the twin definitions have been agreed at the operational level, it is still not clear what a family farm actually is, as the definitions are not based on hard data that facilitate an analytical approach. Moreover, they say nothing about agrarian structures that are not family based, how to define them or how to characterize them.

Before we delve into family farms (see sections A2 and A3), it is useful to frame them against a backdrop of the world's other major forms of agricultural production.

A1.1. A "positive" definition of family farming

Production systems and national contexts aside, family labour is the primary criterion for defining family-type agricultural production. The second is ownership of at least part of the means of production.

We propose the following positive definition of family farming, which takes an analytical, neutral approach to the counting of permanent, non-family workers.

2 This section is inspired by Chapter 1 of Bélières and al. (2015) on the definitions and diversity of forms of family farming globally. The differences are minor and aimed at simplifying the subject for operational purposes. It is worth noting that the "patronal farming" described by Bélières and al. (2015) refers to family-owned (or -run) farm businesses that have at least some salaried workers in their labour force. This distinction is made in the book, but perhaps not very clearly.

Family farming is an organizational form of agricultural production that encompasses farms characterized by organic links between the family and the production unit and by the recourse to family labour, to the exclusion of permanent, hired workers. These links are formed by the inclusion of productive capital in the family patrimony and by the combination of domestic and economic rationale, both monetary and non-monetary, in the process of allocating and remunerating family labour, as well as in the choice of product distribution between final consumption, inputs, investment and accumulation (Bélières *et al.*, 2015).

This chimes with the view of early 20th century agrarian economist Alexander Chayanov. He defines family farms as agrarian structures where (1) the family and the unit of production are organically linked and (2) which draw exclusively on family labour, with no recourse to permanent waged employees (Chayanov, 1925).

These organic links are reflected in families' commitment of all or part of their working capital to the family farm and the amalgamation of domestic and commercial activities, be they market or non-market based:

- in the allocation of family labour and remuneration; and
- in the allocation of output between final consumption, intermediate consumption, investment and the accumulation of assets.

1. The "organizational" link between the family and the farm underlines the close relationship between the domestic and economic spheres. This type of relationship partly explains the resilience of family farms. The fluidity of the operating and domestic budgets and the fungibility of working capital and assets (in both directions) allows for adjustments to limit risk or to capitalize on opportunities.

Part of the flexibility of family farms lies in the budgetary and business links between the familial and economic units.

In terms of allocation, once intermediate goods have been paid for and borrowing costs have been cleared, priority is given to family consumption, then the wider community and, lastly, commercial stocks. Conversely, in times of economic, social or climatic difficulty, the family can be called upon to help offset operational difficulties.

This organizational link also takes into account the complexities of intra-familial relations when economic decisions are involved that affect wealth, the balance of power, the division of labour and compensation of work. Familial relationships – in agriculture as in life – involve tensions.

When this link is weakened or disappears, we tend to move towards other forms of production that follow different kinds of logic, as we will see later on.

2. The second criterion is the use of family labour. The literature on family farming includes various qualitative descriptions of the proportion of family versus paid work – "mostly", "almost exclusively", "predominantly", etc. These definitions all emphasize the importance of family work, but leave too much room for interpretation when it comes to what counts as family farming and what does not.

These qualitative approaches – and the majority of the literature – allow the definition to be adapted to different national contexts, but the resulting definitions, which could be described as "flexible or qualitative", obscure two issues, in our view.

Firstly, when talking about paid labour, it is important to distinguish between casual or temporary labour and permanent waged labour. The latter is structural and can change the make-up of the productive system (for example, the opening of a workshop that would not be possible without additional waged help).

Secondly, hiring a permanent worker means introducing a wage component at the heart of the production structure. This changes the farm's economic rationale significantly, as it must now prioritize the generation of sufficient money to pay the employee. This is quite different to the remuneration model in a strictly family setting, where compensation can be adjusted upwards or downwards depending on annual income. This ties in with the aforementioned notion of flexibility, which decreases as the number of employees increases.[3]

The flexibility of family farms also lies in their ability to reduce consumer spending in the face of working capital needs. This is not the case for types of farming that rely exclusively on waged workers.

This analytical definition sidesteps the pitfalls that can arise when context-specific elements are taken into account. These are mostly country-specific, informed by particular historical and institutional developments, rendering the usual definitions unusable from a comparison point of view.

As is convention, we have chosen a "strict" analytical definition that excludes permanent paid labour, but permits occasional hired labour, including regular day labour, ad hoc task-related labour and temporary or seasonal workers.

This definition is analytically robust and allows us to clearly identify the salary component within the production structure. This salary component, even if it is limited to a small number of permanent employees, allows us to draw a clear line between "family farms" and what we term "family business farms". The latter are still deemed to be family owned, because at least some family members still work the farm and the family retains control of the working capital.

This "positive" analytical definition – in that it is inherently sufficient to define what a family farm is – is crucial to other definitions, which we will limit to two main types, and consistent with that adopted by Hayami (2010), when he defined plantation farming, building on the definition by Jones (1968).

What is important is that we can review the dynamics of agricultural transformation and the effects of policy on these changes using a matrix common to all situations, allowing us to break with the normative definitions adopted in various countries and contexts. It also means going beyond this initial categorization and defining "infra-typologies" within the family farming meta-category (see sections C2 and C3 for more).

3 This assumes minimum labour regulations, which is often far from the case.

A.1.2. The other forms of farming: family business farming and entrepreneurial farming

Family business farming

Family business farming refers to farms that draw on both family and permanent waged labour. The family still owns most of the capital and at least one family member manages the business. The farm essentially relies on family assets for working capital, but participation from outside the family circle is not ruled out, provided the family retains control over capital- and product-allocation decisions.

The business logic prioritizes productive activities that enable the payment of permanent employees, as well as the overall remuneration of family work through the accumulation of assets, without necessarily seeking to maximize the return on invested capital.

Family business farms belong to the wider family farming category, as the family retains ownership of the means of production. They differ from family farms in that they are more "consolidated" and able to support permanent, waged workers.

Entrepreneurial farming

Entrepreneurial farming refers to holdings with farming operations that rely exclusively on waged workers. The operating capital is held by public or private entities without any family connections.

This is where family farm rationale and business logic part ways. We move into a different economic sphere, where social relationships are governed exclusively by the wage component, regardless of the job in question. Wage vary considerably according to skillset, hierarchical level and remuneration. The primary business objective is to optimize (though not necessarily maximize) return on investment.

The farm holding may be autonomous or part of a larger operational group, which may influence the decision-making capacity of the farm manager.

In both family business farming and corporate farming, the wage component tends to dominate, making the productive system more rigid, as labour is allocated based on work schedules (unlike family farms, where the labour force usually lives on site), incurring management costs absent from family-only farms.

Our definition of family farming bears similarities to the definitions of peasant farming of Ellis (1993) and others.[4] Unlike these definitions, however, our proposed analytical definition of family farming is inclusive, embracing family farms whatever their size. We also include in our process small-scale farms and more consolidated farms that also rely on permanent hired labour (family business farms). Thus, we focus on what unifies the category and distinguishes it from entrepreneurial or industrial farming - family ownership of the at least part of the means of production, the fluidity between family patrimony and working capital, and the reliance on family labour.

4 For an analysis of other proposals, see Bélières *et al*. (2015).

A2. Characterizing family farms in all their diversity

Agricultural diversity lies in the social and economic dynamics of production, distribution and trade, which are complex and strongly linked to the context in which they operate. To analyse and understand this diversity, we need to approach it from a production-system perspective, to see how the various components interact (for example, livestock, annual crops or perennial crops). The diversity of farms can then be captured by creating typologies based on production structures and farm performance.

This systemic approach (Mazoyer and Roudart, 1997; Cochet, 2011; 2012) assumes that family and farm logic can be explained by their factors of production (land, labour, capital) and that technical and economic performance can be measured using criteria that take into account not only economic objectives, but a financial rationale specific to the family's interactions with the farm, which are not merely associated with a desire to maximize agricultural production and/or monetary reward and/or consumption trends (Ancey *et al*., 2015).

The desire for security at a suboptimal level of production is understandable in farms that are highly exposed to risk, where social security takes priority over economic performance. Moreover, the logic of farming families must be understood in the context of livelihood strategies that evolve outside the agricultural sector, as families can also undertake non-agricultural income-generating activities, be it locally, nationally or internationally, through migration (Mercandalli and Losch (eds), 2019).

These "activity systems" (Paul *et al*., 1994; Gasselin *et al*., 2012) mean we must develop comprehensive approaches that go beyond the production system and focus on all activities of the family group, so as to understand the importance of agricultural activities within these diverse activities. Placing agriculture at the heart of an activity system allows us to better understand the economic and social dynamics governing agricultural activity. For more, please see Cortès (2000) on the mobility of farm family members and Laurent (2005) on multiactivity practices.

The Sustainable Rural Livelihoods (SRL) framework takes a comprehensive approach to characterizing the livelihood strategies of rural families, their productive assets and capital (physical, financial, human, social and natural) and their diverse activities in other sectors, locally or externally, through migration, be it temporary or permanent (Chambers and Conway, 1992; Scoones, 2009). Performance is based on the three dimensions of sustainable development: environmental, social and economic. Economic performance is not limited to monetary performance, but also includes non-market dimensions, such as family food production.

A2.1. Units of observation

To analyse the diverse types of agricultural production globally, including family farming, and the structural change they are undergoing, we must define the units of observation in question (household, family, farm – see section A1). The family farm is simultaneously an economic unit and a social unit, with dynamics deeply rooted in a specific context (Lamarche, 1991; Ellis, 2000). Whether individuals engage in productive activities on or off farm, the household's overall livelihood is decided at the collective level. This does not just include those members involved in working the farm – or even just the household in the strictest sense – but a fairly broad group of individuals that needs broad definition.

A2.1.1. Families and households

According to Lenoir, the concept of family corresponds to a system of inclusion/exclusion associated with "the history of the social space, in which concepts and ideas related to the institution of the family take on meaning" (Lenoir, 2013, p.41). In the context of agricultural modernization, the rural family has often been treated as a *nuclear family* (the head of the family, a man, helped by his wife and children), while actual family composition varies considerably depending on sociocultural context. Defining a family on the basis of kinship and relationships can be problematic. This is often the case with regard to domestic servants, labourers, shepherds or apprentices, who are often seen as caregivers, with the same standing as relatives, living, eating and working with without pay and participating fully in the production and social reproduction of the family and farm (Ancey and Fréguin-Gresh, 2015). It is also an issue when it comes to the complex composition of domestic groups in West Africa and the indigenous communities of Latin America, which can be very broad and numerous (sometimes in excess of a hundred people not necessarily bound by kinship or relationship) and which can operate a common farm holding, with "satellite" parcels of land worked by certain individuals or households.

To overcome this challenge, socioeconomic surveys tend to refer to the concept of *household*. In the statistical sense, the term is generally used to refer to all occupants of the same dwelling, without those people necessarily being united by kinship or relationship (in the case of cohabitation, for example). The Living Standards Measurement Survey (LSMS) defines a *household* as a group of people who eat together and live under the same roof, although this definition does not always apply, as in Oceania or the Sahel, for example, where an economic unit does not necessarily correspond to a unit of consumption or agricultural production (Ravallion, 1992). Even so, in some sub-Saharan African countries where LSMS surveys are conducted, such as Côte d'Ivoire, this definition is used, with *household* referring to all people living in the same dwelling and eating together. Those who spent only the previous night in the home are not considered part of the household; a member must have been part of the household for at least three of the previous 12 months to qualify.

For WAW, *household* refers to the residence in which a group of individuals usually lives, as defined for most national statistical purposes. According to this definition, a *household* may consist of one or more nuclear *families*, made up of parents and their children, whether or not they are complete (for example, where a member of the nuclear family has migrated or left). In cases where the economic unit is socio-culturally distinct (as mentioned, for example, in West Africa or Oceania), it is useful to define a specific unit (domestic group, lease, plot, etc.) that corresponds to the reality on the ground. It is worth noting that the concept of *household* also has a spatio-temporal dimension, defined as a residence in which individuals *usually* live. The *household* only includes people who live under the same roof for at least six months of the year; this period is arbitrary and in line with that generally used to define long-term migrants.

Nevertheless, migrants should be accounted for if they maintain exchange flows (of money, goods or services) with the family. Remittances are an important resource for many countries and households.

A2.1.2. A generic definition of the farm

The *farm* is an economic unit dedicated to agricultural and livestock production, under single management (be it individual or collective), comprising a plot of land (used entirely or in part), regardless of its operating model, tenure or legal status, infrastructure, equipment or draught animals (FAO, 2015). Farm labour can be familial and/or waged. While household or family members may be involved in farm activities, they may also undertake productive activities in other economic sectors outside farming, either full or part time (individual or collective multiactivity or diversification, local or mobile). The production can be for market or for non-monetary exchange, or frequently for both market and non-market purposes, such as self-consumption, gifts within family and neighbourhood networks … based on reciprocity (Sabourin, 2013).

As noted in section A1, there are two main types of farm: (1) those that are part of home economics run by households or farming families (family farms and family business farms) and (2) those involving other socioeconomic forms of activity of an entrepreneurial nature (public or private).

It is worth mentioning that there can be variations in these farm types in national statistics, as in the case of Haiti's 2010 General Census of Agriculture, where the farm is defined as a unit of production that meets certain conditions, including minimum size (in reality, size generally refers to area and/or a scattering of trees and/or animals that could achieve a certain minimum net annual income – a criterion widely used in censuses that only recognize farms above a certain threshold).

A2.1.3. Rural and urban

Definitions of "rural" vary from country to country, but there are commonalities. The definition is rarely positive and, more often than not, national statistics deem rural areas to be empty, unlike urban areas.

The United Nations defines the urban population as the population living in areas classified as urban according to the criteria used by each area or country and the rural population is obtained by subtracting the urban population from the total population of the area considered (UNDESA, n.d.).

However, there is no uniform definition of "urban". It is an attribute most often based on the size of an agglomeration, population density and administrative districts or, in some cases, the provision of services.

By way of illustration, we cite some of the definitions used in those countries studied by the RuralStruc programme, an initiative of the World Bank, the French government, CIRAD and the International Fund for Agricultural Development (IFAD). In Kenya, for example, the National Bureau of Statistics refers to any community with a population of less than 2 000 as "rural".

In Morocco, a rural area is defined as any area not within the perimeter of an urban area. The perimeter of urban areas is changing as cities expand, however, and rural communities are being reclassified as urban communities. There is no statistical definition of the rural population. In Nicaragua, the urban population is defined by demographic size and level of access to businesses and services (road layout, electricity, drinking water, commercial and industrial establishments). By means of deduction, the rural population corresponds to those people living in communities of less than 1 000 inhabitants that do not have these facilities.

A2.2. Creating a positive definition of family farming versus other farm types

As mentioned in section A1, WAW is based on a positive definition of family farming that can be summarized as follows:

Table 1. Criteria for differentiating the main forms of agricultural production

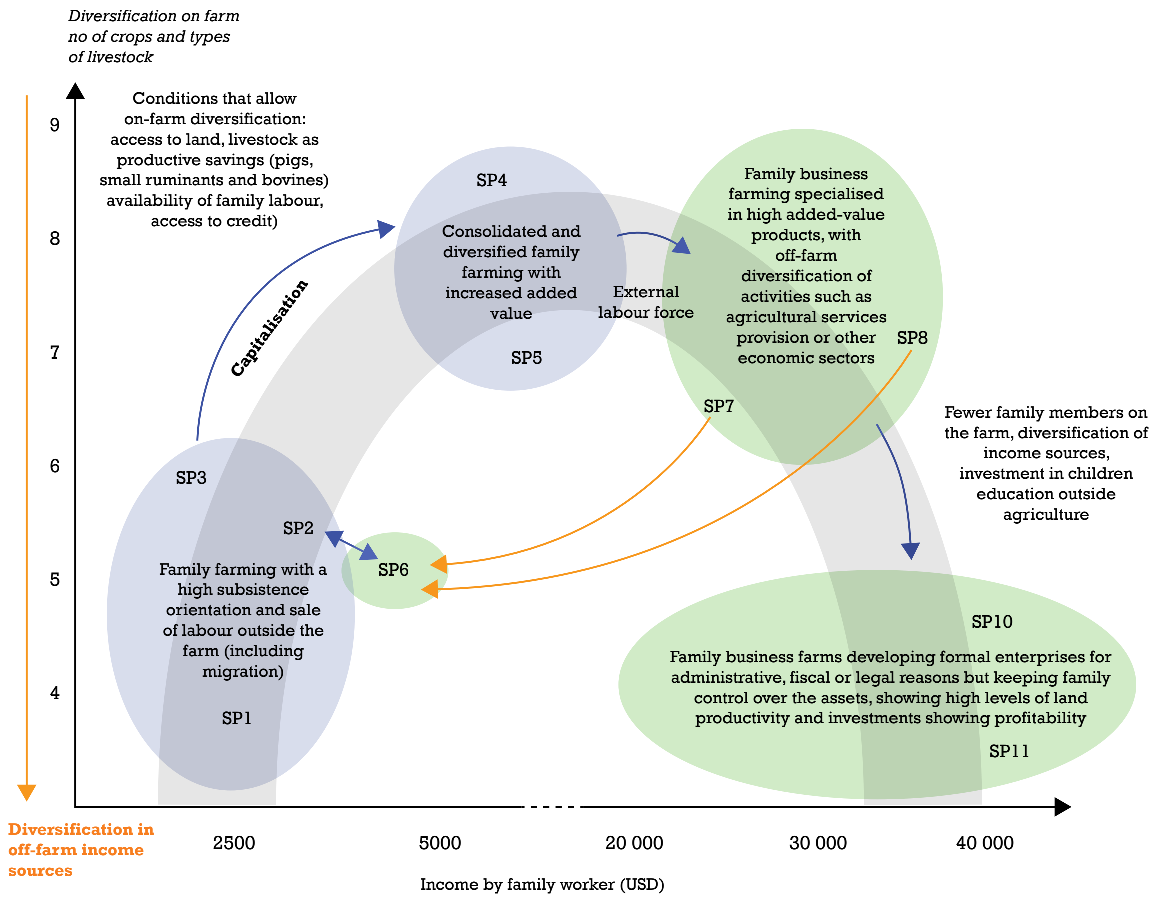
	Commercial or industrial farming	Family business farming	Family farming
Type of labour	Only waged employees	Mixed, some waged employees	Family, no permanent waged employees
Origin of invested capital	Shareholders	Family or family association	Family
Management type	Technical	Family/technical	Family/technical
Legal status	Public limited company or other company type	Operator status, associative form	Informal or operator status
Land status	Owned or formal rental agreement	Owned, formal (rental) or verbal agreement (for example, sharecropping)	

Source: Bosc et al., 2015.

Box 1. The capitalization trajectories of family farms

Qualitative studies in Nicaragua provide information on the dynamics of asset accumulation and the development trajectories of certain production systems, particularly in the country's coffee-growing region (Arribard, 2013; Huybrechs *et al.*, 2016). The results show the key role played by agricultural diversification (from grain-based production to mixed production of food, market gardening, coffee and livestock), facilitated by access to land, livestock (which constitutes living wealth) and financing (in particular, microfinancing). Diversification can lead to labour growth, which can involve the use of external labour when dominant relationships and family solidarity cannot be relied upon for labour for whatever reason (when children are emancipated, in education or migrate, for example). It can also lead to a change in the way the farm is managed, with the head of the family becoming the "boss" and manager of agricultural activities. This, in turn, can evolve into agricultural specialization in higher value-added production (for example, quality-assured coffee or the fattening of bull calves) and the diversification of a family's sources of income. Notably, this is being enabled by technical training for young people (who can then sell their agricultural services to other farms), allowing families to earn higher incomes, which they can then reinvest in the farm.

Figure 1. Diversification trajectories of family farming



Source: Fréguin-Gresh (unpublished document)

Table 2. Examples of secondary segmentation criteria for family farm types

Criteria	Terms
Security of tenure (including access to collective resources)	Insecure tenure
	Secured tenure (legal, customary, both)
Investment capacity	Reduced
	Enlarged
Own consumption[1]	Yes
	No
Presence in downstream markets[2]	Low presence/present only in local markets
	Present in procurement markets with local standards
	Present in international niche markets
	Present in international commodity markets
Multiactivity/activity system	Agriculture only versus multiple activities
Level of diversification or agricultural specialization	Specialized agriculture versus diversified farming system
Substitution of family labour with hired labour	Family labour only with no substitution
	Moderate substitution with hired labour
	High rate of substitution with hired labour
Objective and end-purpose	Simple production (priority is final consumption by the family)
	Family and social accumulation
	Productive and social accumulation

1 This criterion requires fine tuning at farm/household level. It does not exclude farming for different types of market.

2 A farm can produce for different types of market and, at the same time, use some of what it produces to feed at family members, at least in part.

3 The substitution of labour by capital is a classic strategy in the development of agricultural holdings which results in changes in the nature and distribution of the work mobilized on the farm between the members of the family group but also between the family workforce and external labor. These changes will depend on the contexts and in particular on the availability, conditions and levels of remuneration and employment in the agricultural sectors.

Source: Bélières *et al.*, 2014

A3. A common framework for defining and monitoring global agriculture

A3.1. Reasons for choosing the Sustainable Rural Livelihoods (SRL) framework

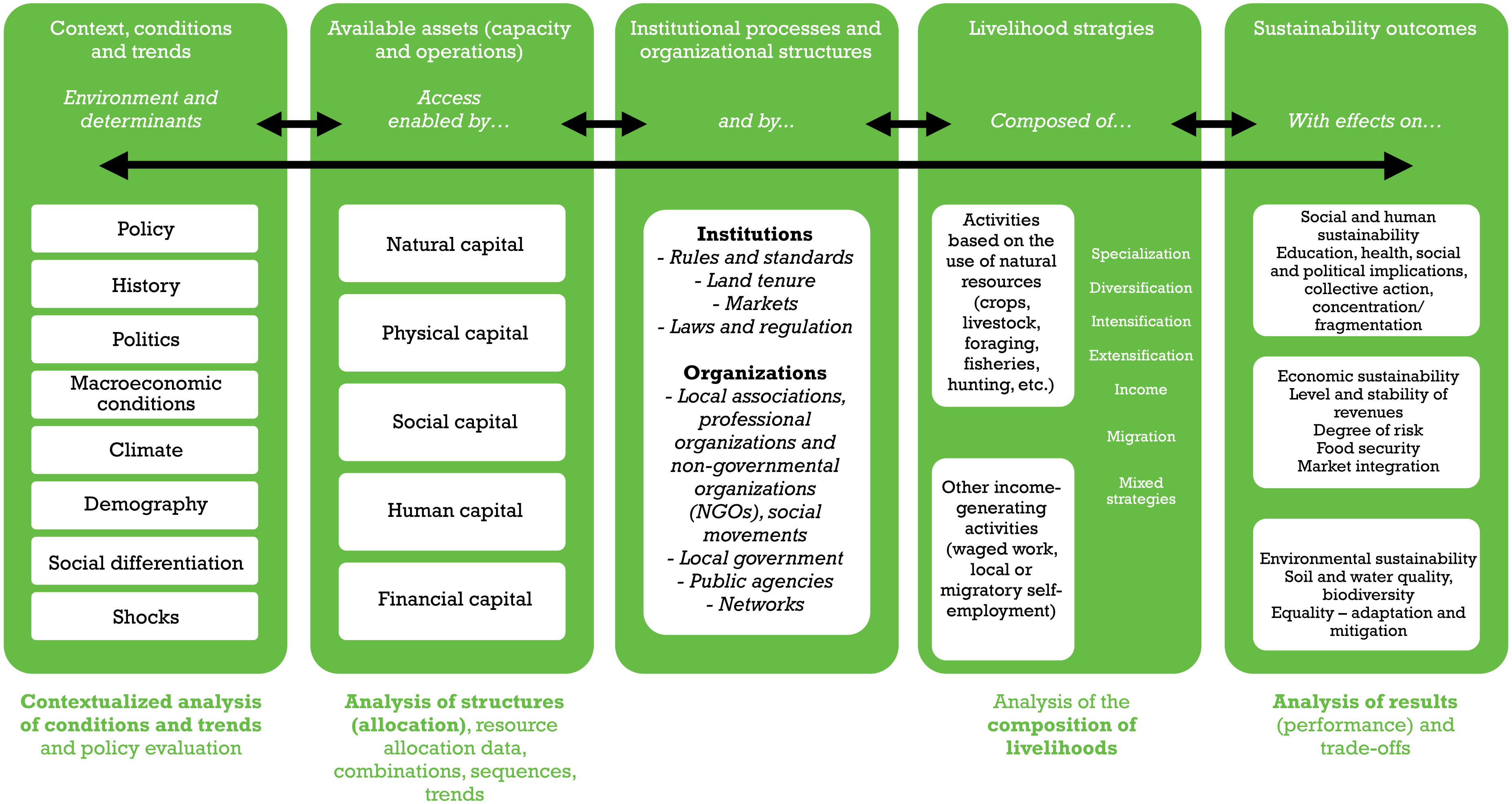
The WAW initiative offers a harmonized analysis framework to guide the targeting of public policy interventions and the move away from standardized instruments, which are often unsuited to highly diversified agricultural systems. WAW's common framework is based on the SRL framework and has been adapted with a view to studying the diverse forms of family farming and to analysing their structural transformation (Sourisseau *et al*., 2012; 2014; Bosc *et al*., 2015).

Chambers and Conway (1992) define *livelihoods* as the activities that people can undertake to earn a living based on their tangible and intangible assets, including "resources and stores, claims and access". Livelihoods, therefore, depend on assets (and the ability of individuals and collectives to use them, or *capabilities*) and the activities and practices in which people engage to survive. "A livelihood comprises people, their capabilities and their means of living including food, income and assets. Tangible assets are resources and stores, and intangible assets are claims and access. A livelihood is environmentally sustainable when it maintains or enhances the local and global assets on which livelihoods depend, and has net beneficial effects on other livelihoods. A livelihood is socially sustainable which can cope with and recover from stress and shocks, and provide for future generations" (Chambers and Conway, 1992). Sustainability is broken down into the usual three elements: environmental, social and economic.

There are several reasons for our choice of framework:

- The SRL framework is widely known and used internationally. Referencing it opens up the possibility of dialogue between multicultural teams.
- It is based on the use of several types of assets or capital, the allocation of which determines the livelihoods undertaken.
- It emphasizes the relationships between households, their community and institutions, within which they manage their strategies.
- It recognizes the central role played by social structures, organizations and institutions, opening up the prospect of work involving collective action and public policy.
- The framework takes into account the non-market dimensions of agricultural activity (grants, payments in kind and own consumption, in particular).
- It goes beyond the methodological individualism that often underlies farm analysis, incorporating a multilevel and dynamic approach to understanding the diversity of farm activities and practices and agriculture's distinct place within business and revenue systems.
- It is compatible with an agricultural production systems-based approach and with the conceptual framework of the agriculture–food nexus, or UN Environment's The Economics of Ecosystems and Biodiversity (TEEB) agrifood initiative (TEEB, 2018).
- It combines the standardization essential to the development of comparative analyses with the adaptability needed when taking diverse contexts into account.

Figure 2. The SRL framework



Source: Authors from Scoones 1996 and Sourisseau et al. (2012) and (2014)

A3.2. Turning the SRL framework into easy-to-use indicators

A3.2.1. Structural indicators (assets or capital)

The SRL framework is often used for its ability to demonstrate the diversity of capital that an individual or group can draw on for its livelihood. The indicators that enable the characterization of farm structure can be split into five categories: natural capital, physical capital, human capital, social capital and economic or financial capital.

Natural capital is a stock of natural resources on which households can draw to provide goods and services that earn them a living. Natural capital includes a wide range of resources, including intangible public or common goods (such as the atmosphere and biodiversity) and assets used directly in agricultural production (such as trees and land). It also includes types of asset where we must consider factors such as access (rights of access, use, alienation, etc.), quality and how the natural asset mix varies over time and space. Natural capital comprises the following elements:

- farmland, not only in terms of physical area, but also type of land tenure and resources use rights associated with that land;
- the location of farm holdings in relation to agro-ecological zones (and what that means in terms of soil quality and agronomic potential) and their distance from basic infrastructure, roads, etc., which can determine the choice of production methods implemented;
- whether or not there have been improvements to the plot (for example, anti-erosion, water or soil management systems); and
- access to and use of natural water sources and other types of natural resources, including biodiversity (animal, plants and microorganisms) and common areas that could involve different rights of access or use, such as forests and rangelands.

Physical capital refers to the infrastructure and tangible goods required to develop the household's productive activities and the farm. It comprises physical goods (infrastructure, tools and equipment) and access to certain technologies:

- accessible infrastructure, such as storage sheds and livestock buildings (owned or used, as well as rights of access or use);
- accessible tangible goods (tools and equipment, owned or with rights of access or use);
- draught or pack animals (donkeys, camels, horses, etc.);
- outdoor areas planted with perennial trees or shrubs (for example, coffee, cocoa or rubber trees, olive trees, acacias or fruit trees) or trees in domestic gardens that meet families' food and nutritional needs; and
- specific technological innovations (improved crop varieties or genetically modified organisms (GMOs), anti-erosion measures, etc.).

Table 3. Examples of physical capital variables

Land development	Planting perennials
• Presence (or lack) of anti-erosion measures or water/soil management measures • Presence (or lack) of development to facilitate aquaculture (ponds, watering holes, either individual or common) • Presence (or lack) of irrigated systems (gravity irrigation, canals, etc.) • Presence (or lack) of greenhouses with varying levels of capital growth (polytunnels, small greenhouses, large greenhouses)	• Presence (or lack) of plots with perennial planting (olives, rubber, pistachios, etc.) • Presence (or lack) of agroforestry cropping patterns
Livestock	**Equipment**
• Presence (or lack) of beehives • Presence (or lack) of fishponds • Presence (or lack) of small stocks (poultry, rabbits, goats, sheep, etc.) • Presence (or lack) of bigger stock (cows, pigs, etc.) • Presence (or lack) of draught animals (donkeys, horses, cattle, buffalo)	• Presence (or lack) of tools for the working the soil (manual, animal-drawn, light motor-drawn, tractors and attachments) • Presence (or lack) of tools for crop maintenance, weeding, pest management and harvesting • Presence (or lack) of irrigation equipment (pumps, sprinklers, drip feeders, water source) • Access to equipment and tools (individual or collective) • Presence (or lack) of transport equipment (cart, vehicles, trailers, etc.) • Presence (or lack) of agricultural processing equipment
Buildings and infrastructure	**Domestic garden**
• Presence (or lack) of infrastructure for the storage and preservation of produce • Presence (or lack) of infrastructure for short-cycle breeding (poultry, pigs) and small ruminants • Presence (or lack) of infrastructure for cattle breeding (barn, milking parlour, dairy)	• Presence (or lack) of a domestic garden, with/without fruit trees and with/without domestic livestock

Source: Authors.

Human capital can be interpreted in a number of ways. One sees the individual as an "asset" belonging to a specific entity (household, extended or nuclear family, etc.) or "labour" available to work the farm. This asset is not necessarily 100 percent engaged in farm work. Individual characteristics (age, gender, social status, health status, etc.) are important when classifying and estimating the human capital involved in agricultural activity or other sectors. Others view human capital as an investment target in the accumulation process. It involves identifying the role of the individuals, their skill set and knowledge (level of education and training), experience and ability to work.

- Quantity of work:
  - number of family members;
  - number of family workers (by age and sex) and number of nuclear families or households in the extended family;
  - roles of and time spent by family workers on the farm (by age, sex, status within the family, health, etc., specifying whether certain family members are precluded from conducting certain activities); and
  - employment of external labour: (1) permanent (number of workers, specifying types of activity, remuneration and work-related benefits); (2) temporary/seasonal/jobbers (number of man days, specifying types of activity, periods when labour is used, with a work schedule, if possible, as well as compensation and work-related benefits).
- Quality of work:
  - formal education (by family member, including age, gender, family status, etc.), for example, number of years spent in school, level of academic achievement;
  - level of training, other than formal education (for example, technical training or project-related skills, years of experience);
  - time spent working on household activities, including domestic tasks;
  - skills that fulfil a particular role in household/farm operations (such as management, budgeting, entrepreneurial approach, risk tolerance), either as a result of personal character traits or experience; and
  - degree to which basic needs are being met (food/nutrition).

Social capital is a concept for which there are also many definitions and interpretations. It can be defined as the range of social resources that people use to achieve their goals, namely:

- networks, relationships and connections, be they vertical (boss/client) or horizontal (between individuals with common interests, family ties, social and/or geographical proximity – neighbours, for example), which increase people's confidence and ability to work together and increase their access to institutions (such as political entities or civil organizations);
- memberships of formal groups (the nature and quality of which should be described), which often require members to agree to rules, standards and sanctions (for example, social control) and which govern these obligations and are supposed to respond to individual needs, such as certain forms of representation;
- relationships of trust, reciprocity and exchange that facilitate cooperation, reduce transaction costs and facilitate the provision of basic safety nets, procurement and distribution channels, and the cost of resources channelled by these social relationships.

As Ternaux and Pecqueur (2008) write, social capital is thus more defined by what it does or enables than by what it is. These include:

- membership (or non-membership) of social networks and formal groups (such as professional, political or social organizations or associations, special interest groups, non-governmental organizations, or NGOs) involving vertical or horizontal institutional relationships or arrangements;
- social connections and interactions between the farm, its social circle and local institutions.

Financial or economic capital includes:

1. available reserves, such as savings, cash or bank deposits, liquid assets (such as farm animals or jewellery), loans or credit lines;
2. regular cash flows. Income aside, the main flows include public or private transfers and pensions, which can make a positive contribution to financial capital, as long as they are reliable. The key components are:

- cash income, public transfers, private transfers, such as migrant remittances; and
- an ability to self-finance.

To select the appropriate variables for characterizing diverse farm capital, specific attention should be paid to those assets that could improve technical and economic performance compared with similar farms, but which would not have the opportunity to invest and improve their asset allocation. For example, while two farms might be comparable in terms of family labour, land area and soil quality, if one has access to financing for investment in irrigation equipment or greenhouses and the other does not, they will have significantly different production capacities. It is worth noting that some indicators may incorporate two different types of capital (as is the case with livestock) and that it is possible to weight indicators of the same type of capital type to create a single indicator.

Table 4. Capital criteria used to characterize family farm types in Haiti

Human capital	Social capital	Physical capital	Natural capital	Financial capital
Level of education and training of the farm manager	Avails of technical assistance/advice	Mechanization level (tractor, tiller, milking machine, irrigation pump, etc.)	Land area that is forested, fallow, under water	Access to credit
Gender, age of the farm manager	Member of cooperatives or associations	Level of transport equipment	Access to water points on the farm	Uses of credit
Number of family members employed on the farm	Participates in support groups (for example, Kombit and Eskwad in Haiti)	Number of animals by type Herd size (number of tropical cattle units)	Total usable agricultural area (UAA) by crop (% of crop UAA/ total agricultural UAA)	

Number of permanent waged workers	Number of trees planted
Number of men x number of days of temporary work	Legal status of the farm
Operating management of the farm	Degree of land insecurity as a function of tenure type

Note: Criteria based on 2010 general agricultural census data

Source: Fréguin-Gresh and Razafimahefa (2016); Fréguin-Gresh et al. (2016)

A3.2.2. Indicators of activities and practices

The majority of current databases – for example, general censuses of agriculture and the LSMS – allow a fairly detailed characterization of the operations, activities and practices of households and farms. It is thus possible to characterize activities and practices based on variables related to farming methods in the areas in question: the available data generally refer to the way in which plots are used to cultivate annual, semi-permanent or perennial crops, or natural or sown pastures, but also to tree and livestock censuses, in some cases including the identification of techniques (or varieties) and growing practices (fertility, weed and disease management) and livestock (feeding schedules, health care, etc.). Using such indicators makes it possible to characterize agricultural livelihoods in addition to certain other activities, sometimes based on the use of natural resources (aquaculture farms, logging, etc.). The most recent agricultural censuses include a "farmer's family" section, allowing us to at least estimate the diversified off-farm activities of farm household members.

A3.2.3. Performance and sustainability indicators

The SRL framework treats performance in a normative way, in line with the conventional environmental, social and economic dimensions of sustainable development. However, it is also possible to view sustainability in terms of producer and household ability to adapt to changes in the economic and institutional environments, their ability to continue living on the land, even if it means also working other plots in other locations, connected by a familial transport system. This ability to adapt can also lead to a reconfiguration of a farm's activity system and extend it beyond the family unit (Fréguin-Gresh *et al.*, 2015). While there are no agreed composite indicators that enable us to measure the sustainability of livelihood strategies, we can use the Sustainable Livelihood Security Index, which incorporates the three interrelated elements (Singh and Hiremath, 2010):

- *Ecological safety*, as measured by variables such as forest cover, soil- and water-quality parameters, air pollution and groundwater depletion;
- *Economic efficiency*, as measured by variables such as land productivity, labour productivity, trade surplus and input-to-production ratio;
- *Social equity*, as measured by variables such as land, asset and income distribution, the poverty line and women's literacy (Singh and Hiremath, 2010; Kamaruddin and Samsudin, 2014).

A4. The territorial and landscape approach – a study in time and space

A4.1. Territories and landscapes

WAW's framework for analysing agricultural production draws on numerous scientific disciplines (geography, agronomy, economics, sociology, history and politics), allowing us to study territories to varying degrees of complexity. We aim to study the changes under way in rural households and farms, along with their performance at territorial and landscape level wherever possible. We use FAO (2019a) conceptions of landscape and territory:

> *"Territorial approaches tend to focus on socioeconomic objectives and the revitalization of local economies for joint interests of economic stakeholders along key value-chains in the territory, while landscape approaches tend to prioritize biophysical/ecological objectives and start from the environmental and natural resource dimensions, for integrating livelihood considerations."*

Both dimensions are needed, as agricultural activities involve the use of natural resources, which are part of the landscapes they help to shape. In turn, the management of common natural resources at landscape level will influence the use and management of natural resources at farm level. We also need to consider the territorial level, as the socioeconomic infrastructure indispensable to agricultural development and basic data on population and other socioeconomic aggregates are produced at this administrative and political level.

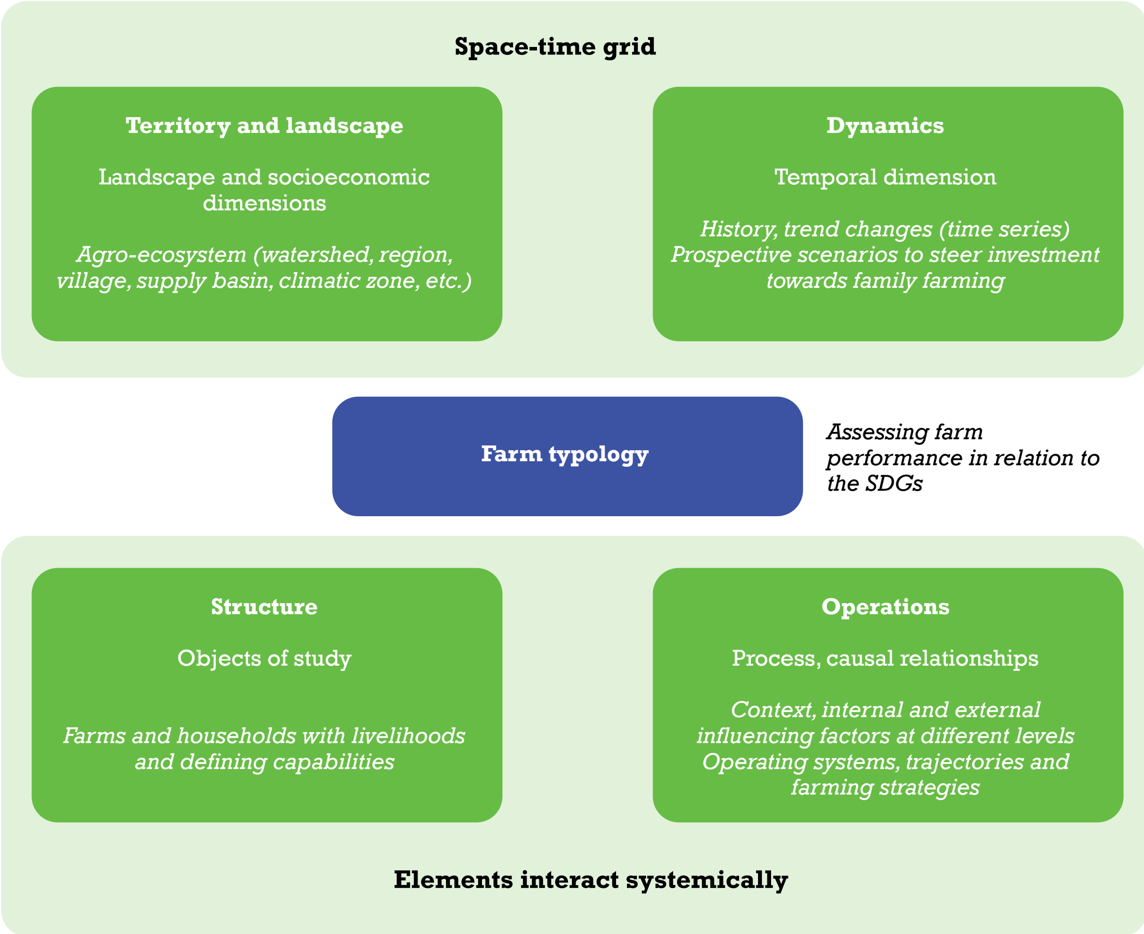
A territory typically encompasses several landscapes or types of landscapes, but, in some cases, a territory can involve several, separate jurisdictional territories, for example, the Kagera watershed, which is shared between four countries, Burundi, Rwanda, Uganda and Tanzania (FAO, 2017b). More generally, this is the case for any agroecological unit forming a homogeneous landscape large enough to be spread over several territories defined according to other criteria (political, administrative, etc.).

Defining a landscape can be tricky, however. It would be misleading to think that a landscape is a homogeneous ecological habitat. Rather, it is a "dynamic bio-cultural mosaic of habitats and land [and sea] uses" (UNU-IAS *et al.*, 2014) that have various agrarian functions and rules for the management of natural resources (Primdahl, Kristensen and Busck, 2013).

The framework has a *spatial* dimension to it (the territory and the various landscapes within it) and, sometimes, a *temporal* dimension, which allows us to identify transformational dynamics (see section B4). The farm holdings to be studied in a given landscape are analysed based on typology. This approach tries to explain farm operations by examining the contextual elements and factors that influence them at various levels, so as to understand transformational trends and the strategies farmers use to deal with them. The framework can also be used to assess farm performance, particularly in relation to the SDGs, including environmental and natural resources indicators, see Darras A., *et al.* (2021) and Ginot *et al.* (2021).[5]

[5] A full set of variables and indicators is available at: https://agritrop.cirad.fr/597467/ and https://agritrop.cirad.fr/598620/

Figure 3. The components of the territorial and landscape approach



Source: Authors.

Territories and landscapes are generally deemed suitable areal units for studying the diversity of farms, rural families, households and how they are changing. While landscape approaches focus on natural resources and ecological dimensions, territories are the appropriate units for development policy design and implementation. Investments in infrastructure are decided at territorial level. Territories are defined or measured in administrative units, which are used in basic statistics.

The term "territory" is often polysemic. For WAW purposes, a territory is a geographical area, continuous or otherwise, over which powers are exercised and the boundaries of which can refer to several disciplinary approaches.

Table 5. Complementary approaches to defining territories

Approach	Example	Benefit	Boundaries
Socio-political and historical *Strategic areas*	Countries, regions, provinces, counties, governorates, villages, etc.	• Spatial entity for identifying and managing societal problems, formulating policy and development actions • Institutional and administrative approach that chimes with existing statistical measures • International standards that are easily applicable	• Boundaries are not necessarily aligned with on-the-ground realities (socio-technical networks, biophysical environment, economic activities)
Socio-environmental *Developable areas*	Watersheds, climatic zones, common land, biomes, etc.	• A coherent natural resource management unit, adapted to ecological dynamics that is not necessarily homogeneous	• Boundaries do not always tally with economic activity
Socioeconomic *Developed areas* *Productive and trading areas*	Production, supply, employment areas, development-project intervention zone, etc.	• Territory is represented by its stakeholders and their activities • Suitable for the implementation of certain economic development actions	• Boundaries are often blurred and fluid; not always adapted to real local situations
Sociocultural *Inhabited/settled areas, as perceived by inhabitants*	Sense of belonging and influence, common cultural identity, community, common language, etc.	• Relative homogeneity of the socio-technical regime • Territoriality boosted by networks of stakeholders, their activities, their goals and strategies • Suitable for economic development actions	• Boundaries are blurred and fluid

Source: Authors, based on Marzin et al. (2017); Benoît et al. (2007); Lardon (2012); Signoret (2011).

Defining a territory by its administrative boundaries may be appropriate when it comes to formulating decentralized planning policies, as envisaged by WAW. Indeed, WAW proposition links data produced by territorial observatories with existing statistical datasets (see section B1 on baseline surveys and adjusting the sample). Thus, the scale of the administrative territory allows the data from territorial observatories to be harmonized with current national data-collection mechanisms.

Organizational and administrative hierarchies differ from country to country. They can generally be represented on a scale that starts at zero (national level) and increases with each new administrative division.

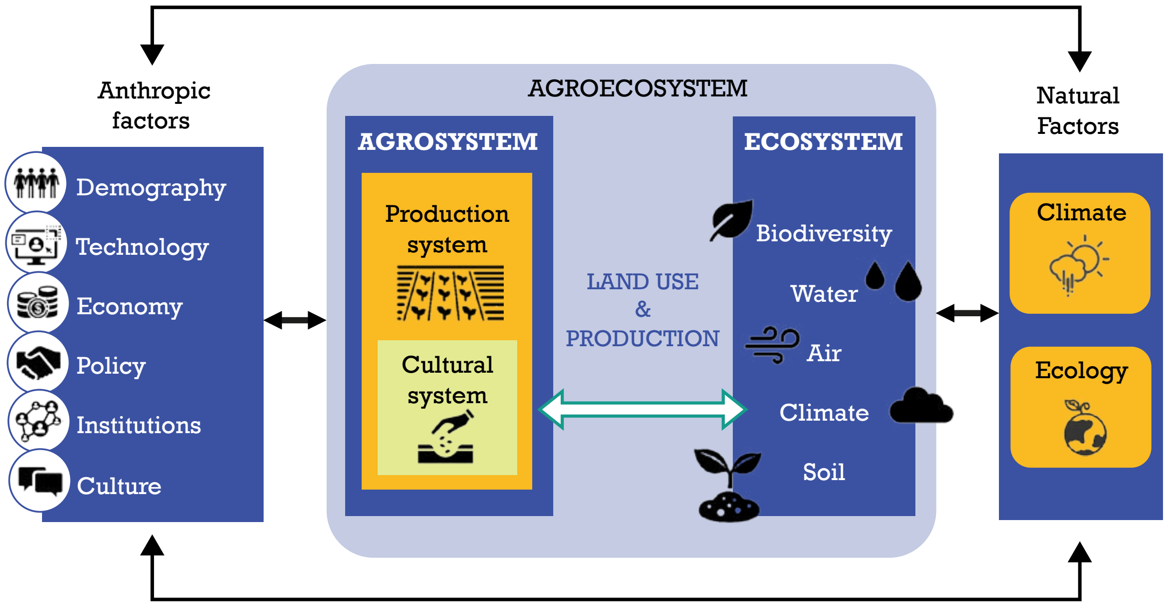
To ensure that its common international standards are consistent, WAW recommends using the administrative divisions recognized by the United Nations Second Administrative Level Boundaries (UNSALB) programme. The programme compiles a list of national agencies that classify the administrative boundaries within their countries. Datasets and further information are available at https://gadm.org/.

The socio-political/administrative approach is not always best, however, when it comes to defining territories in a useful way for stakeholders in rural and agricultural development. This is the case with watershed and landscape scales or indices, for instance, which are used to compare territorial units based on water-resource management. They can be a useful analytical basis for implementing an observatory, however. Some economic actors (such as cooperatives) collect data on the structure and performance of farms in territories with socioeconomic boundaries (such as supply basins, priority economic areas and protected natural areas), which are of interest to stakeholders keen to develop their information systems. The boundaries may, therefore, correspond to geographical areas for which both the landscape and the concept of agroecosystem can be useful.

A4.2. The landscape and agroecosystem as common denominators

The concept of the agroecosystem, which stems from geography and agronomy, allows us to reconcile the multiple definitions of a territory. It recognizes the interaction between a productive social system (the agro-system) and a farmed ecosystem (Cochet, 2011). For Gliessman (2015), an agroecosystem is a "site or integrated region of agricultural production understood as an ecosystem". Its main challenge is to achieve natural ecosystem-like characteristics while maintaining harvest.

Figure 4. Representation of an agroecosystem and its determining factors



Source: Authors, based on Jahel (2016).

Gliessman (2015) connects landscape and agroecosystem, incorporating the productive dimension through the systemic approach of agricultural activities within a complex set of interactions with and uses of non-agricultural land:

> *"Looking for agroecosystems in the context of landscapes reveals the agroecosystem concept is crucial for understanding how humans modify the surface of the earth and how the apparently distinct landscapes of wildlands, agricultural lands and urban areas are in fact closely intertwined. In other words, the agroecosystem is a central concept in the ecology of human land use."*

The agroecosystem consists of one or more identifiable agro-ecological zones, or agro-physiognomic units (Deffontaines and Thinon, 2008). These relatively homogeneous zones are grouped in various ways over a given study area, forming an agroecosystem.

A4.3. A spatial dimension to make the data usable

The spatial dimension of the territorial approach helps when comparing different types of data. It allows us to use inputs from recognized geographical information systems, such as FAO's Global Agro-Ecological Zones (GAEZ) programme, designed in partnership with the International Institute for Applied Systems Analysis (FAO, n.d.).

The layers of information available in the GAEZ system can be used as a basis for identifying and characterizing territories. The agro-ecological or agro-physiognomic units making up the agroecosystem in question can be identified by cross-referencing different layers of GAEZ information:

Land resources

- soil-system resources (predominant soil type, presence of nutrients, excess salinity, etc.)
- hydrological resources (main watersheds, water availability levels, irrigated areas, etc.)
- land situation (altitude, slope, orientation, etc.)
- land use (primary land use; five classes can be used to describe natural resource-based activities)
- protected areas
- selected socioeconomic and demographic data (population density, ruminant breeding, etc.)

Climatic conditions

- thermal system (climatic zones, frost-free periods, temperatures, etc.)
- humidity system (precipitation, evapotranspiration, etc.)

GAEZ also provides other useful data (for example, growing periods, crop suitability and yield gaps).

We can also draw on other geographical information systems. We would broadly recommend using them and cross-referencing the different layers of information to identify the relevant agroecosystems. For example, Fréguin-Gresh and Razafimahefa (2016) used the following information on Haiti to identify major agroecosystems:

Demography

- population density
- demographic and migratory situation and developments

Accessibility and provision of basic roads and infrastructure

Land use

- the status and evolution of land use
- the natural hazard situation

Economy

- the importance of agricultural and non-agricultural economic activities
- food security

WAW suggests whenever possible to also collect data on altitude, slope, soil type and temperature, as well as extreme heat and flood risk in order to classify major agroecosystems, see Fréguin-Gresh and Razafimahefa (2016) for examples in Haiti and Nicaragua.

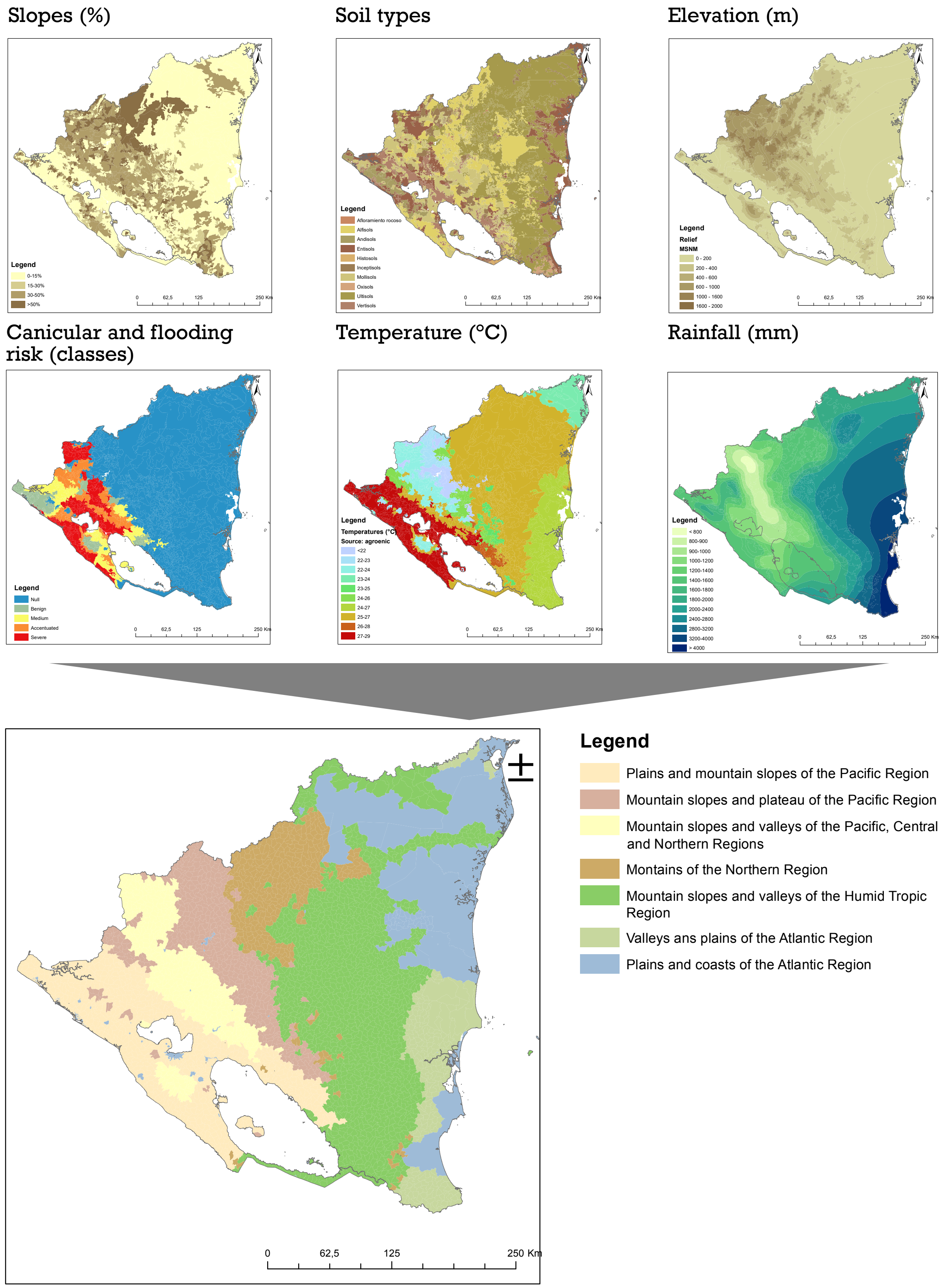
Regardless of territory, to classify your chosen agroecosystem, it is important to define it using three variables:

- scale
- breadth (whether the territory is continuous or not)
- geo referencing

Ideally, it should be representable in a geographic information system in the form of one or more polygons, so as to be shareable, reusable and comparable. Areas with blurred, unidentifiable boundaries are difficult to work with under the WAW framework.

The use of remote-sensing technologies and artificial intelligence can also assist in the compilation of updated land-use maps. Here, we would recommended eo-learn (Lubej, 2018) or CIRAD's Moringa processing chain, which can create accurate land-use maps when used in conjunction with field surveys. They have the advantage of allowing sample adjustment (see section B1) for growing areas at the time of the survey or over the course of the year, and to monitor changes in land use over time.

Figure 5. Identification of agro-ecological zones in Nicaragua: an example



Source: Fréguin-Gresh and Razafimahefa (2016).

A4.4. Interconnected levels : from farm level to territory level

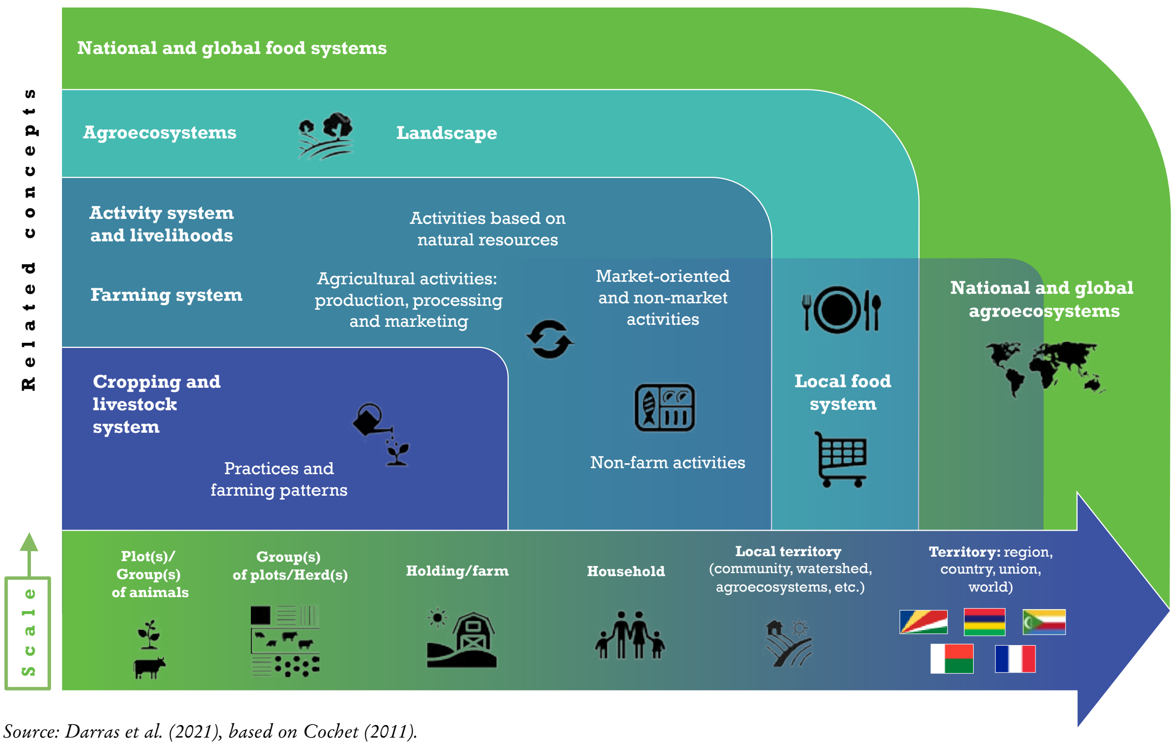
The transformational dynamics of rural families and households, farms and territories are the result of numerous factors on multiple levels.

Economic factors – for example, changes in the price of crops, such as rice, coffee, cocoa or cotton –are generally a global phenomenon (or a national one, when national regulations are in place). Climatic factors tend to be regional, but can sometimes arise at the micro-local level. Ecosystemic elements, such as soil type, are typically local level, while cultural factors generally pertain to social groups, which can be difficult to identify.

An important characteristic of the territorial approach is that each level of observation and analysis reveals certain information while obscuring others.

Thus, to understand the hierarchy and dynamics of a territory, we need to adopt a multilevel approach that can take on board as much information as possible (Veldkamp *et al.*, 2001; Verburg *et al.*, 2013). Practically however, the limitations will come from budget limitations and the capacity to generate robust information. Consequently, we need to adopt a formal, holistic approach that can handle these different elements (Conway, 1984). To this end, WAW uses concepts derived from the systemic approach to represent the interconnected levels.

Figure 6. Interconnected levels and associated concepts



Source: Darras et al. (2021), based on Cochet (2011).

A4.5. Scaling and comparability

The challenge of creating farm typologies is that they must allow data comparison between territories. They must also allow the aggregation of data for extrapolation. Certain data are often only available at certain levels, however, as they are an aggregation of microdata which have been created for reasons of anonymity.

Dealing with microdata inevitably raises problems associated with changes in scale. How do you conduct a regional analysis of topics or phenomena that are generally only observable at plot, farm or household level? Scaling usually reveals emergent properties, as what is observable in a large unit is more than the aggregation of what is happening in local units (Gibson *et al.*, 2000; Dumanski *et al.*, 1998). Therefore, the opposite is also true: a factor can be obscured when analysed on a specific scale, although it would become more obvious on other scales (Lovell *et al.*, 2002). Consequently, explanatory variables may change when the scale changes (Gibson and al., 2000). This implies that environmental performance and natural resources management practices cannot be explained in precisely the same way if we would look at farms or landscapes without taking into account their interactions.

A major challenge is to glean data that allow extrapolation to territories of meaningful size in development terms. This is true not just for sampling techniques, but also for the quality of data collected. The next chapter delves into these issues in detail.

Producing quality farm data using the WAW analytical framework

B

B1. Designing a survey

The primary aim of surveys conducted using the WAW methodology is to represent a given population. This chapter is devoted to their design. Nonetheless, surveys that do not aim to be or which cannot be representative, as they target a particular group (such as members of a cooperative, households that farm a particular crop or use a particular livestock system, or vulnerable populations) or are not based on nominal survey samples, can be associated with WAW and use elements of its methodology.

B1.1. Units of observation

The preferred units of observation for WAW surveys are households and farms. WAW's main objective is to characterize the diversity of farm types, be they family farms, family business farms or industrial and commercial enterprises. However, as family farms account for the majority of the world's agricultural holdings, issues associated with household management and activities are closely tied to decisions on the farm, and vice versa. Hence, while the WAW unit of analysis is still the farm, the farm household and the individuals in it are considered additional observation units.

Considering the household as a unit of observation also allows us to capture farms missing from conventional survey samples, which sometimes only classify activities that meet minimum thresholds associated with physical size (for example, landless farming, very small farms or pastoral farms), economic size or level of market integration. Chapters B1 and B2 provide an overview of survey design tools. For more, see the UN's Designing Household Survey Samples: Practical Guidelines (UNDESA, 2008).

B1.2. Survey sample

WAW surveys should ideally be based on formal, nominal and comprehensive samples. However, even agricultural censuses are not systematically comprehensive and can be based on surveys in countries that do not have sufficient resources to reach the entire population (FAO, 2015). As mentioned, the choice of observation unit will also inform the choice of sample. The most dependable national databases are listed in Table 6.

Box 2. Fundamental Principles of Official Statistics and data privacy

WAW's analyses build on resolutions adopted by the UN Economic and Social Council in 2014 on the Fundamental Principles of Official Statistics. In particular, the privacy policy governing individual data will be strictly enforced and "individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes" (ECOSOC, 2013).

Table 6. Common sources of national statistical data

File type	Scope/frequency	Comments
General population census	Comprehensive/ around every 10 years	Entry point via households; additional work required to identify agricultural populations
General census of agriculture	Comprehensive or survey-based/ theoretically every 10 years (though often longer, especially in sub-Saharan Africa)	Not conducted in all countries; very small farms are sometimes not recorded
Structural surveys	Survey-based/no set frequency	In theory, conducted between two agricultural censuses; sometimes replaces census
Agricultural registers/ chambers of agriculture	Partial/updated periodically	Few countries in the Global South have registries and data are incomplete
Membership lists of professional organizations	Partial/updated for membership; varies from one organization to another	Very small and biased survey sample

Source: Authors.

In the absence of sufficiently recent and freely available databases, a survey sample can also be compiled from geographic information system (GIS) data. A list of geographical areas (districts, villages, etc.) can be gleaned from population census data and used as the primary sampling unit, as we discuss later in this guide. Areal surveys are also based on this principle of combining territorial sampling units with lists of observation units (households or farms).[6]

Satellite imaging can be used to establish a reliable and up-to-date survey sample, as very small plots and vegetable gardens that are not counted by statistical agencies can be identified from photos. A random sampling plan can also be conducted by selecting clusters of data points. GIS offers the possibility of checking data provided by farmers, for example, on the surface area of their plots.

B1.3. Survey sample size

The size of the survey sample should be set based on the desired margin of error (typically 5 percent) and the confidence interval (typically 95 percent). The margin of error is the potential amount of random sampling error in a given survey. (For example, if 50 percent of farmers surveyed say they have an irrigation system, with a 5 percent margin of error, somewhere between 45 percent and 55 percent will actually have such a system.) The confidence interval is the probability that a sample of interviewees will contain the true mean of the population (selection bias). With a 95 percent confidence interval, for instance, we will see identical results in a different population sample in 95 percent of cases.

6 An areal survey is a probabilistic survey in which the last-stage sampling units are areas called "segments" and the probability of selection is proportional to the surface areas of the latter. The measurement used to select the segments (sampling units) is generally a function of surface area, the most common being total area. The segments must not overlap and must cover the whole area being analyzed. "Segment" also refers to the land associated with the sampling unit or group of units.

To calculate the sample size, we also need the sample proportion, or the expected proportion of successful responses if the survey was based on a single criterion (such as access to irrigation or the prevalence of food insecurity). Under the WAW framework, surveys are based on a number of criteria. By default, therefore, the sample proportion will be 50 percent. There are numerous websites that can help to calculate sample size.

Calculations involving more than 20 000 individuals generally yield similar results. Using standard variables – a margin of error of 5 percent and a confidence interval of 95 percent – 384 surveys are sufficient to extrapolate the results to the general population. However, it is usual and advisable to increase the sample size by a percentage corresponding to the expected rate of non-response, to ensure that the number of people actually questioned in the survey is as close as possible to the ideal sample size. Increasing the sample size also reduces the margin of error and allows the analysis of a geographic area or particular type of farming with a high degree of accuracy.

B1.4. Sample type

Sampling is essentially about generating information from a fraction of a large group or population in order to draw conclusions about the population as a whole. The goal, therefore, is to select a sample that is representative of the population and that will reproduce its characteristics as closely as possible. Under the WAW framework, we prefer sampling based on probabilistic techniques, in particular, stratified random sampling. Stratification can be based on the primary typological criteria common to all of the countries studied. The strata should ideally be as different from one another as possible. Consequently, the heterogeneity of the strata, as well as their internal homogeneity, must be the main characteristics sought in conducting this type of sampling.

However, this technique requires a reliable sample and a certain amount of key information for stratification, so is not always easy to put into practice. For this reason, we suggest a number of sampling techniques, including some based on non-probabilistic samples (convenience sampling).

Table 7. Types of sampling

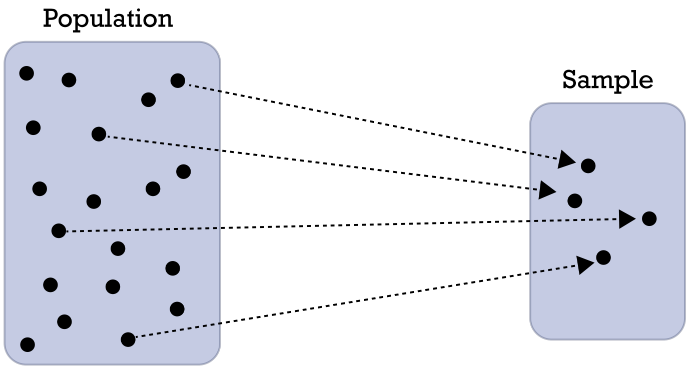
Probabilistic sampling	Simple random sampling	Based on a reliable sample, the desired number of random individuals is chosen from the total population.
	Stratified random sampling	As with simple random sampling, the desired number of individuals is selected randomly from the population, but by stratifying the initial sample into subgroups. The sample is then distributed in proportion to the size of the subgroups created.
	Cluster/multistage sampling	This is a random group-based survey (usually geographic areas selected at random). All of the individuals in these random groups are surveyed. If only smaller sampling units are surveyed within the chosen clusters, this is known as multistage sampling.
GIS sampling	Areal sampling	Sampling is based on identical territorial segments, chosen at random, in which n individuals are surveyed.
Non-probabilistic sampling	Purposive or subjective sampling	Sample selection is based on personal judgment in relation to a given characteristic.
	Snowball sampling	Sampling in which individuals recruit others from their circle of acquaintances.
	Random walk or random route sampling	Interviewers start from a randomly selected location in the study area and follow a predetermined route, surveying units (farm, household, etc.) according to randomly chosen prescribed criteria.
	Voluntary sample	Selection from a volunteer sample. This technique tends to be more representative if there is a large sample to choose from.

Source: Authors.

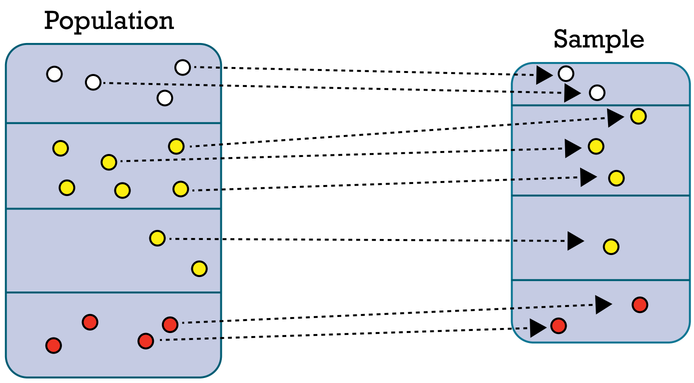
Illustrations of probabilistic sampling

Figure 7. Probabilistic sampling methods

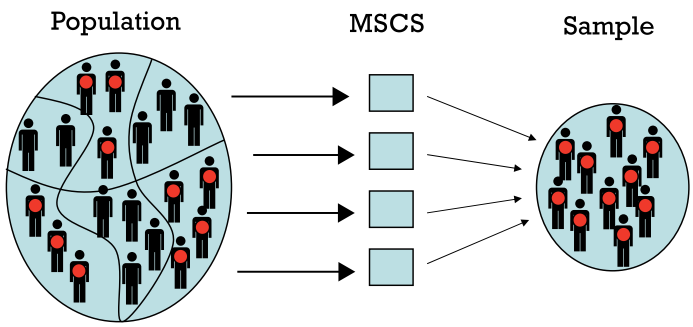
Simple random sample



Stratified random sample



Multistage cluster sampling



Source: Authors, based on Guillemin (2013).

B1.5. Sample adjustment

The WAW framework facilitates representative studies at territorial level, with a focus on specific sectors, if needed (though we view sectors as part of a system with which they interact – in a systemic approach), in order to advocate for development actions and public policy interventions. This means we can adjust a sample if it deviates from the population in question. If a sample is a stratified random one, weighting adjustments can be made based on the criteria used to create the strata.

For other samples, any adjustments can be based on criteria defined after the fact (*a posteriori*). One simply chooses a weighted adjustment criterion, such as the presence of livestock on farms.

Table 8. Example of an *a posteriori* sample adjustment

	Number of farms surveyed	Proportion of farms in the population
Breeds livestock	30	40
Does not breed livestock	70	60

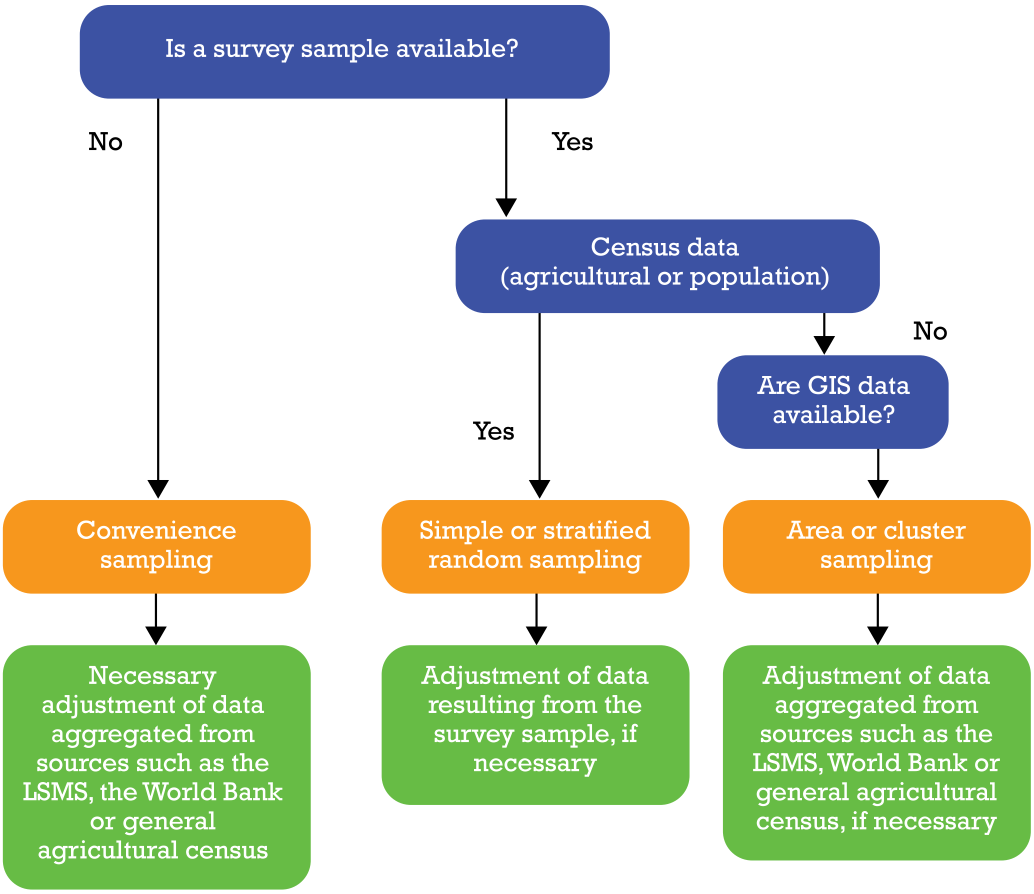
Source: Authors.

The weightings assigned to each observation are 40/30, or 1.33, for livestock farms and 60/70, or 0.83, for non-livestock farms.

When making weighting adjustments for several criteria, the same principles apply as for marginal calibration or other methods of weighting adjustment.[7]

B1.6. WAW's survey design process

Figure 8. WAW's survey design process



Source: Authors.

7 Marginal calibration is a general term for all weighted adjustment methods. For more, please see INSEE definitions, methods and quality. See https://www.insee.fr/en/information/5350385 or FAO handbook on agricultural surveys https://www.fao.org/3/ca6412en/ca6412en.pdf

B2. Principles for compiling a questionnaire

B2.1. Structure of the questionnaire

The structure of a questionnaire varies according to the objectives and scope of a study. The WAW framework, inspired by the SRL framework presented in sections A2 and A3, facilitates research aimed at better characterizing the diversity of farms and analysing changes in their structure. In addition to aiding in the development of public policy, supplementary surveys can help achieve practical objectives, such as the monitoring of reference farms.

WAW surveys are quantitative studies based on direct interviews, which allow the measurement of specific elements in order to describe a certain population. The questionnaire is designed to have as many closed responses as possible and uses context-specific methods. Closed answers help to avoid non-answers, however, the methods used and the way in which questions are posed should not be suggestive. If reliable data are lacking, a preliminary field study is recommended prior to developing the questionnaire. Either way, the completed questionnaire will need to be tested on a few respondents to see if any procedural adjustments are needed and to make sure that the wording of the questions – and, if necessary, the translation of questions into the local language – is correct and appropriate. Similarly, any units of measurement used must correspond with those units used by farmers and be consistent (for wheat sales, for example, one can use bags, kilogrammes, tonnes, etc.). Consequently, it will be necessary to do some research beforehand into local measurement units and how they correspond to universal measurement units.

Certain questions can also act as a check on answers to other questions without making the questionnaire overly cumbersome (triangulation of information). One can, for example, ask respondents to estimate their overall farm income after asking about their products and their production costs per crop and per livestock product. In some contexts, photographs can be useful for pinning down varieties of plant or seed or for estimating quantities produced.

Figure 9. Survey photo shown to small-scale oil-palm growers to help identify their produce

Source: © Tristan Durand-Gasselin

A written interview guide is important to ensure that the questions asked during the interview are traceable and relevant to the purpose of the study. The guide ensures that interviews can be replicated when carried out by different surveyors and can include definitions to remove any ambiguity as to the meaning of certain terms.

Another objective of the survey is to compare different regions of the world. Thus, care must be taken to harmonize concepts, definitions and the methods used to obtain key indicator data. As discussed in section A3, choosing variables on household capital and assets allows analysis using the SRL framework. Similarly, validated universal indicators on specific themes are preferred for comparison purposes (for example, the Food Insecurity Experience Scale (FIES) for gauging perceptions of food insecurity, or the Women's Empowerment in Agriculture Index for measuring the level of empowerment of women in farm households). The FIES index informs SDG indicator 2.1.2, for which FAO is custodian and on which FAO reports in the *State of Food Security and Nutrition in the World* reports.[8]

It is also important to make the questionnaire as simple as possible, so that it does not take too long to complete. Depending on context, the complexity of operations and the activities of the units of observation, agricultural household and farm questionnaires should not take more than 2–4 hours.

When compiling a questionnaire, WAW advocates taking a modular approach, with the farm the primary unit of analysis, similar to that of the Agricultural Integrated Survey (AGRISurvey) model of the Global Strategy to Improve Agriculture and Rural Statistics. The farm will generally be split into two observation units: the household, which can own one or more farms (as outlined in section A3), and the plot of land, defined as a geographical area in which the same crop combinations, rotations and sequences are carried out. There can potentially be several parcels of land associated with the same farm. Livestock are not generally treated as an observation unit, but dealt with in a separate module.

Within each module, the questions range from the general to the highly specific.

The modular approach allows the questionnaire to be structured in a way that aligns with the structures of the database and analytical framework used (Darras *et al*., 2021). The questionnaire can also be adapted to the local context by ramping up certain modules and diluting others, while ensuring the homogeneity of the main indicators in all surveys. This requires early planning in addition to the sampling process.

8 For the 2020 report, see FAO, IFAD, UNICEF, WFP and WHO (2020).

Box 3. Fundamental principles of questionnaire design

- Adapt the questionnaire to the target objectives.
- Adapt the questionnaire to the local context.
- Write an interview guide.
- Structure the questionnaire by module and observation unit.
- Formulate as many closed questions as possible and choose survey methods that will deter non-answers.
- Adapt and convert local units of measurement to universal units of measurement.
- Cross-reference key indicators to facilitate data control.
- Use universal indicators and concepts to allow comparison with other surveys.
- Simplify questions and make sure survey questions are coherent.
- Test the questionnaire on a small number of respondents before embarking on a mass survey.

RuralStruc Mali

Large-scale surveys were conducted in seven countries as part of the RuralStruc research programme in 2006 to 2010,[9] aimed at characterizing the structural changes in agriculture in the context of economic liberalization. The RuralStruc questionnaire developed for Mali is an example of a survey that enables the characterization of the structure and management of farms, an analysis of the combination of household activities and income streams, and estimates of the economic performance of households, particularly in agriculture.

9 The RuralStruc programme on the "structural implications of economic liberalization on agriculture and rural development" was a joint initiative of the World Bank, the French Development Agency (AFD), the French Ministry of Agriculture and Fisheries, the French Ministry of Foreign and European Affairs, CIRAD and the International Fund for Agricultural Development (IFAD). It was led by the World Bank. The surveys covered 8 000 households in seven countries and 26 regions. For more, see https://microdata.worldbank.org/index.php/catalog/670

Table 9. Structure of the RuralStruc project questionnaire - Mali, 2008

Observation unit	Module	Variables
Household	Household	• Identification of households associated with the farm • Residency, dwelling, living conditions • Detailed inventory of household members and their activities (including those who have migrated) • Aid received (public or private transfers) • Membership of a producer organization
Farm	Farm	• Materials and equipment • Real-estate assets (livestock buildings, etc)
Farm	Herd	• Inventory and livestock sales • Inventory and processed product sales
Plot	Land	• Inventory of land • Types of cultivation and production • Supply of agricultural inputs
Farm	Labour	• Permanent external labour • Seasonal work • Non-farm household income
Household	Food consumption/ other expenses	• Donations • Perception of food insecurity • Types of product consumed • Other expenses • Credit

Source: RuralStruc.

It should be noted that while the main indicators of the RuralStruc surveys are comparable, the same questionnaire was not used in the seven countries surveyed (Kenya, Madagascar, Mali, Mexico, Morocco, Nicaragua and Senegal). In addition to marked differences in approach to each country's farming and livestock systems, questionnaires were adapted to national contexts to take into account local and sociocultural specificities (such as insecurity in Madagascar and multiple wives in Mali).

Monitoring reference farms in Tunisia (Albouchi and Karoui, 2017)

From 2015 to 2017, WAW-FAO led a project in Tunisia and Senegal aimed at “Strengthening the capacity to monitor the diversity and transformation of farms to improve policy formulation and agricultural advice” (FAO, 2019c). Based on a typology compiled from structural surveys conducted in 2003 (similar to those developed for the RuralStruc project), a reference-farm system was trialled in two areas of the country. The surveys also had a highly practical objective: the implementation of support actions for farmers.

In this questionnaire, although there are household-related questions, there is only one observation unit. One household equals one farm and there are no details on individual household members. What's more, the crops in question are tied to the farm, rather than the plot, as is usually the case.

Table 10. Structure of the 2003 FAO-WAW follow-up questionnaire in Tunisia

Observation unit	Modules	Variables
Farm	Farmer identification	• Sociodemographic status of the farmer and the household • Local organization or institution
Farm	Farmer identification	• General information • Membership of typological groups • Location • Workforce • Buildings/materials • General expenses
Farm	Crop production	• Structure of tenure • Irrigation systems and equipment • Costs per crop • Products per crop
Farm	Livestock production	• Livestock inventory • Costs per livestock category • Products per livestock category

Source: Authors.

B3. Administering the questionnaire and managing the data

B3.1. Selecting interviewees and interviewers

Administering the questionnaire is a fundamental step in conducting a survey. The WAW framework analyses multiple observation units (see sections B1 and B2). It should be noted that the head of the household and the farm manager may be different people. Sometimes, you may need to interview a number of people within the same observation unit to obtain information, for example, when certain tasks are performed on different plots of land, or when members of the household other than the farm manager are responsible for certain jobs. Similarly, when it comes to household topics and issues related to food, the person who holds the purse strings may not be the person who prepares the meals. Limiting surveys to a single member of the household can lead to collection errors. Preliminary qualitative work and testing the questionnaire can help to identify or confirm the correct interviewees.

In some situations, where both men and women need to be surveyed, it is preferable to have a team of male and female interviewers, so as to avoid any difficulties that might arise from dealing with the opposite sex (Fig. 10). In addition, where possible, the interview team should comprise people from the field of study and/or people familiar with the local environment.

Figure 10. A survey being administered face to face on paper questionnaire during the Heveadapt ANR project in Thailand

Photo: Benedicte Chambon Cirad

B3.2. Survey monitoring and supervision

Agricultural surveys can be cumbersome to administer due to the intricacies of farm operations, as well as the difficulties of collecting data in accordance with complex sampling plans. The need for day-to-day monitoring and supervision is essential to ensure the smooth running of the survey and to make sure deadlines are met. Regular reporting can avoid such difficulties. Reports should contain the following information:

- the number of surveys completed, the number of surveys outstanding, the number of refusals, the number of available households remaining in the survey plan;
- the average time taken to conduct the questionnaires and any difficulties encountered on certain issues or themes; and
- an updated sampling plan, especially if it is stratified.

Interviewers must first undergo training, so that they know the objectives of the study, the concepts and definitions used, all of the elements contained in the questionnaire and the types of responses expected. A user manual should be created in parallel to avoid misinterpretation.

B3.3. How to administer a questionnaire

How you administer a questionnaire will influence all subsequent data-processing phases, namely, data entry, control, cleaning and analysis. The preferred interviewing method for individuals in the Global South is face to face, rather than by telephone.

Computer-assisted questionnaires, administered by computer or tablet, are becoming more and more common. Studies have actually shown that information recorded electronically is generally of better quality than that written down by hand (MacDonald *et al.*, 2016) once the questionnaire and the input mask have been calibrated and tested. Questions can be managed to ensure that the correct people are surveyed, while easier consistency checks make computer-assisted surveys more reliable. These consistency controls can be used for both qualitative information (links to previous answers) and quantitative questions, whereby answers can be set within specific parameters. While input errors are still possible, such automatic controls do away with many of them. The organizational requirements for a computer-assisted survey are the same as for a paper one, namely, proper structuring of the questionnaire and a written interview guide. Compiling the questionnaire can sometimes take a little longer and require basic computer skills.

Another advantage is the significant time saved on entering responses. Computer-assisted administration does away with separate data entry and significantly reduces the potential for error when the person entering the data is not the person who conducted the interview. While double entry is commonplace with paper questionnaires, with computer-assisted surveys, post-questionnaire monitoring is sufficient to minimize errors.

Survey software for computer, tablet or smartphone currently on the market also enables additional information to be recorded, such as the global positioning system (GPS) coordinates of respondents and the time taken to conduct the interview, as well as the use of images to facilitate interviewee response. The ability to take photographs or make audio recordings is a further advantage.

Lastly, computer-assisted solutions allow direct results analysis and tie-ins with other software enabling database development or geographic mapping.

Figure 11. Example of a software assisted survey (tablet)

Photo: Bénédicte Chambon/Cirad

However, computer-assisted questionnaires also have disadvantages. We have already noted the need to ensure that the questionnaire is properly compiled, from its structure and format to consistency checks using multimedia features (photo, video, grid coordinates). The optimization of the questionnaire is even more important when it comes to computer-assisted surveys. This tends to take longer than for a paper survey, where the interviewers have greater discretion in entering the data.

The use of tablet computers or mobile phones can sometimes be misconstrued when surveys are conducted in very poor areas. This can lead to difficulties in establishing a bond of trust between the interviewer and interviewee. Furthermore, the financial cost of buying a tablet or computer to conduct a survey can also be a hindrance.

When it comes to software solutions, many free, open-source and easy-to-use solutions have emerged in recent years. Comparative studies are also available to help you choose the most appropriate solutions. For more, please see UNHCR and Tdh (2017).

B3.4. Some free online and open-source survey solutions

Table 11. Examples of paper and mobile survey solutions

Media	Benefits	Disadvantages
Paper	• Easy communication with the interviewer • No technical problems during use	• Requires digital data entry after completion
Computer	• Allows the use of any software offline, including data-entry forms created from a database • Saves input time, facilitates the creation of input consistency checks	• Less flexible than paper in capturing additional qualitative information • More difficult to use in very poor areas
Tablet/mobile phone	• Ease of use for closed questions • Saves input time, facilitates the creation of input consistency checks • New software allows offline use • Easy to use for GPS positioning	• Less flexible than paper in capturing additional qualitative information • More difficult to use in very poor areas

Source: Authors.

B3.5. Data control

As we have seen, online data control facilitates input checks. Whatever the medium, data control remains an indispensable and essential step in any survey.

B3.5.1. Consistency checks

Computer-assisted surveys are generally constructed in such a way as to facilitate consistency checks, sometimes within the questionnaire itself. In paper-based surveys, consistency checks on closed questions have to be carried out after the fact. Questionnaires are generally structured in such a way as to ask a preliminary yes-or-no question in order to identify whether an interviewee is qualified to answer more specific questions on a given topic. An individual for whom a question is not relevant is not qualified to answer it. Any such inconsistencies must be identified quickly, ideally before data collection is complete, so that some of the individuals in question can be re-interviewed, if necessary.

B3.5.2. Checking quantitative variables

The most common measurement errors in agricultural surveys relate to surface area (there are no land registers in many countries), agricultural output and farm working hours. When it comes to surface area, the introduction of tablets and smartphones as a measuring tool has significantly improved the margin of measurement error, but requires time to be spent on each plot. Even so, these tools do not have the precision of specialized GPS tools and sometimes need to be paired with computer-assisted survey software to achieve better results.

Figures on agricultural production and working times are subject to high seasonal fluctuations and are difficult to gauge precisely on an annual basis. Close attention should, therefore, be paid to such data when administering the questionnaire and controlling the data. Providing interviewers with crop-yield benchmarks and crop schedules can enable them to guide the respondent (without being excessively suggestive) and avoid reporting errors.

B3.5.3. Data cleaning

To automate data controls, standard formulas are generally used to verify that a figure is between the median and more or less four times its standard deviation. This should be carried out on variables that mean the same thing (you cannot compare quantities produced of different crops, for example, but you can compare yields per hectare of the same crop over time).

B4. Principles of organizing a database

B4.1. Database objectives

Surveys conducted using the WAW framework should be updated regularly, be it on the same sample (panel) or a different sample in the same area. Whatever the monitoring and evaluation methodology chosen, the aim is to compile information that furthers our understanding of the transformation underway in all types of farm structure. Building a database allows a data-lifecycle process to be put in place and facilitates data use.

The creation of a database must be accompanied by an accurate description of all variables, or metadata, to make the database interoperable, in other words, compatible and usable with other database management systems (a relational database management system). To describe the data in a standardized way, we rely on international repositories, such as Dublin Core, which offer a core set of variables, with which you should familiarize yourself.

The objectives of building a database can be summarized as follows:

- Permanent data storage
- Compilation of information for tracking developments
- Data description
- Consultation, selection, data modification
- Extracting information from content
- Multiple simultaneous access
- Data integrity
- Safety and reliability
- Confidentiality

B4.2. Building a relational database

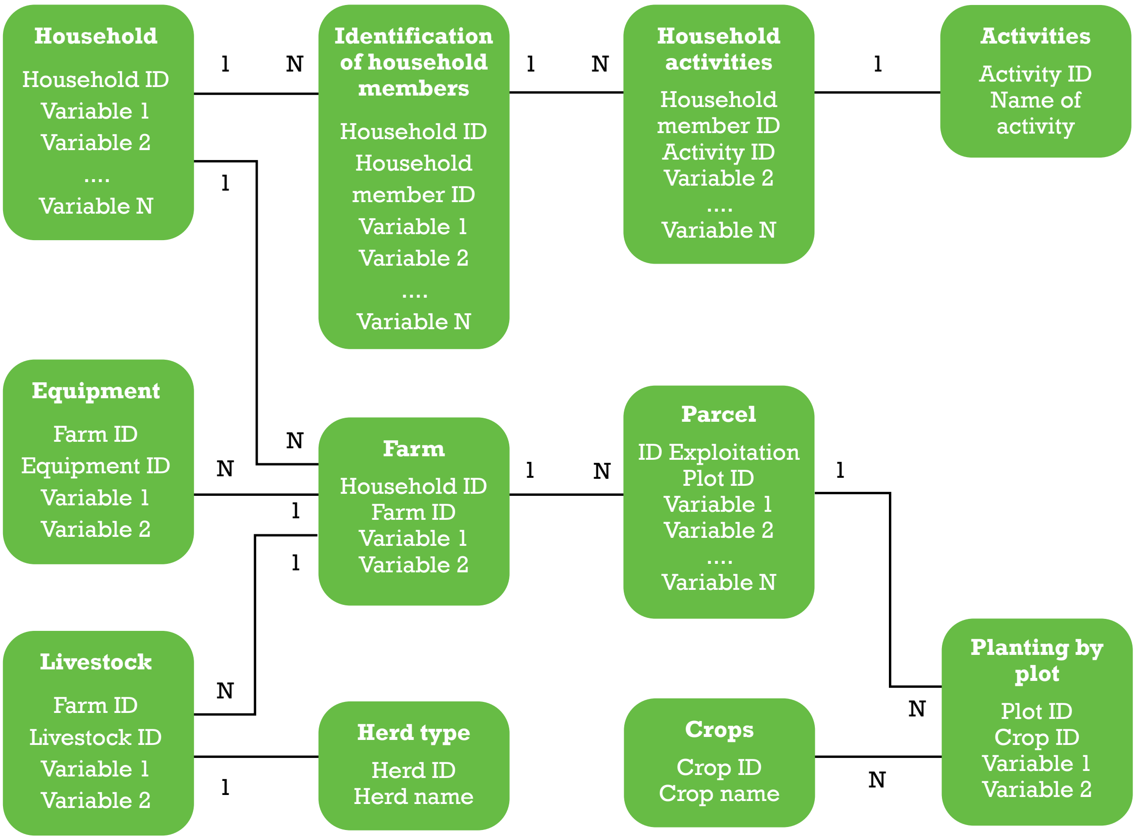
Under the WAW framework, identifying the individuals (primary key) involved in each unit of observation (household, farm or plot) will enable links to be made between the various thematic modules of the questionnaire.

As the simplified diagram in Figure 13 shows, in an agricultural survey database, each category is linked by a common identifier. The categories are based on the themes of the questionnaire (livestock, for example). Thus, we have a primary key, a farm identifier (ID) (which allows us to link the category to a particular farm) and a foreign key (the livestock ID), which allows us to link one category to another by herd type. This makes database calculations far easier. The herd category can also accommodate regrouping. For example, detailed herd data (number of cattle less than a year old, number of lactating female cattle, etc.) can be included in the questionnaire and the corresponding livestock category can re-aggregate the data to obtain the overall number of cattle.

Relationships between categories must also be defined in the database. In the following example, each household has one or more members and each member can have one or more income-generating activity. This relationship is denoted by *1-N*. The relationship between the household and the farm also depends on the context of the study. Here, it was decided that a household could only be associated with one farm, hence, the relationship is denoted by *1-1*.

WAW has developed a generic database prototype capable of adapting to all situations, based on an exhaustive list of variables and indicators at farm and landscape level (Darras *et al*., 2021).

Figure 12. Example of a logical data model



Source: Authors.

B4.3. Database or data files?

Adding to the aforementioned list of objectives, you should also be able to link the database directly to a data-entry form (through Access, for example) and it should allow such a form to be created. Conversely, if you want to use computer-assisted survey tools on tablets or smartphones, there are currently no apps with tools to help build a database. Developing the database will thus take time, in addition to building the online questionnaire and exporting various files to the database.

The process of creating a database that allows the aggregation of data is very straightforward. However, analysing a global file (to create a typology for econometric analysis) requires the data to be grouped, which can be a long and arduous process, depending on the size of the survey and the number of files in question.

Depending on the objective, it is, therefore, necessary to weigh the use of so-called flat files against the creation of a database. WAW plans to update its analyses and its common indicators on a regular basis. The creation of a survey-related database is, therefore, advisable.

B4.4. Building an information system

Creating a survey database is an important step in building an information system. WAW's goal is to create a public policy decision-making tool based on both project survey data and the data collected from the major agricultural surveys available. The various surveys, if stored on a database, could be linked (based on a core set of indicators) and relayed to an information system. Similarly, the various sources and layers of additional information would inform the data gathered in surveys.

B5. Information system and webcast

The aim of the WAW platform is to promote understanding of the diversity of the world's farms and the ways in which they are changing. Based on various data sources, this collaborative platform will provide a useful information system for guiding investment in family farming.

B5.1. A collaborative digital platform

WAW is developing a collaborative platform initiative as part of its Mapping Family Farming project to capture, aggregate and publish data on rural farms and households around the world (FAO, forthcoming).

It involves building a common vision of the diverse forms of global agriculture and documenting local transformational dynamics with a view to informing the political debate and helping to guide investment strategies for family farming. WAW will share the governance of this open-source, collaborative digital platform with its partners. The management structure of the platform will be based on the analysis framework set out in this document. Due attention will be paid to ownership and access rights.

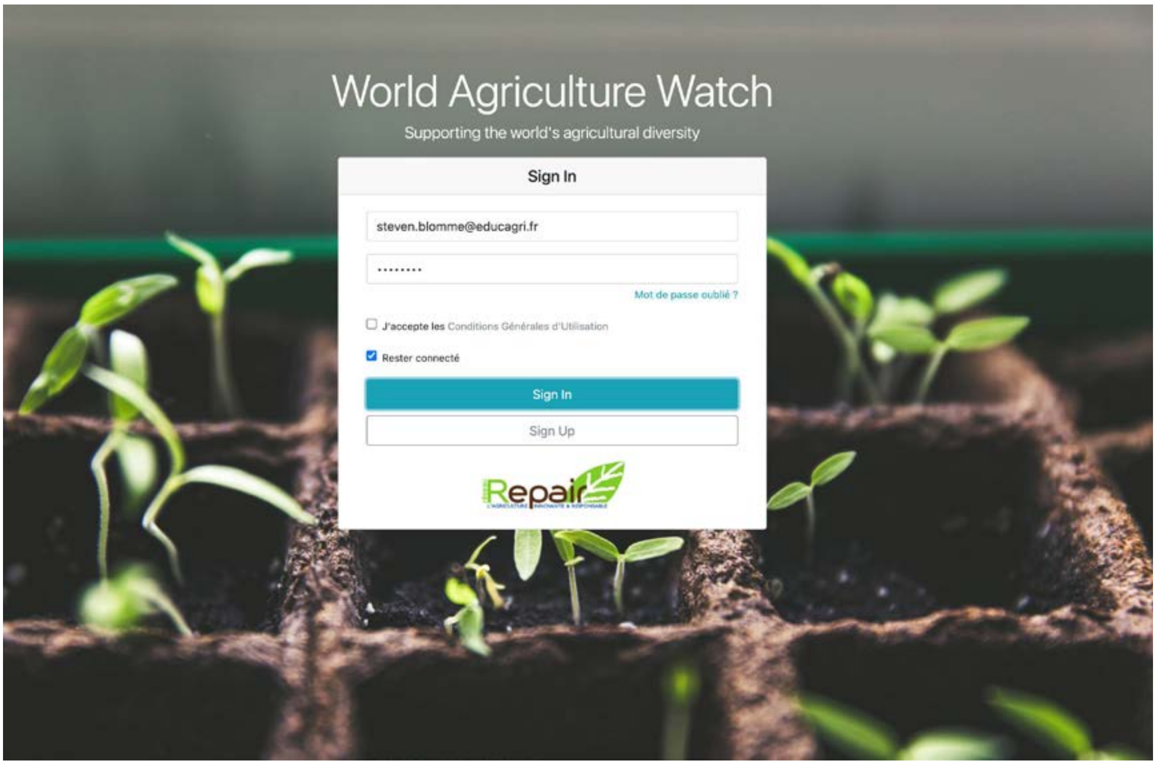
B5.2. Functions of an information system

The WAW platform is an information system with three main aims:

- Providing a synthetic and dynamic view of farms and rural households in different territories to allow comparison;
- Assisting in the implementation of investment strategies for family farming; and
- Encouraging collaboration between WAW’s partners.

An information system can be defined as a set of resources – be they human, tangible or intangible – for collecting, storing and processing data to build a body of information and, potentially, disseminate that information to make it more widely available.

Figure 13. Model account-creation interface on the WAW platform (in progress)



Source: Authors.

B5.2.1. Collecting data

Collecting data for an information system involves recording it **in a way that it can be processed.** The information collected will generally be broken down in a structured way to facilitate storage and processing. It will respect the principles of database organization set out in section B4. This information can come from two distinct sources: internal or external.

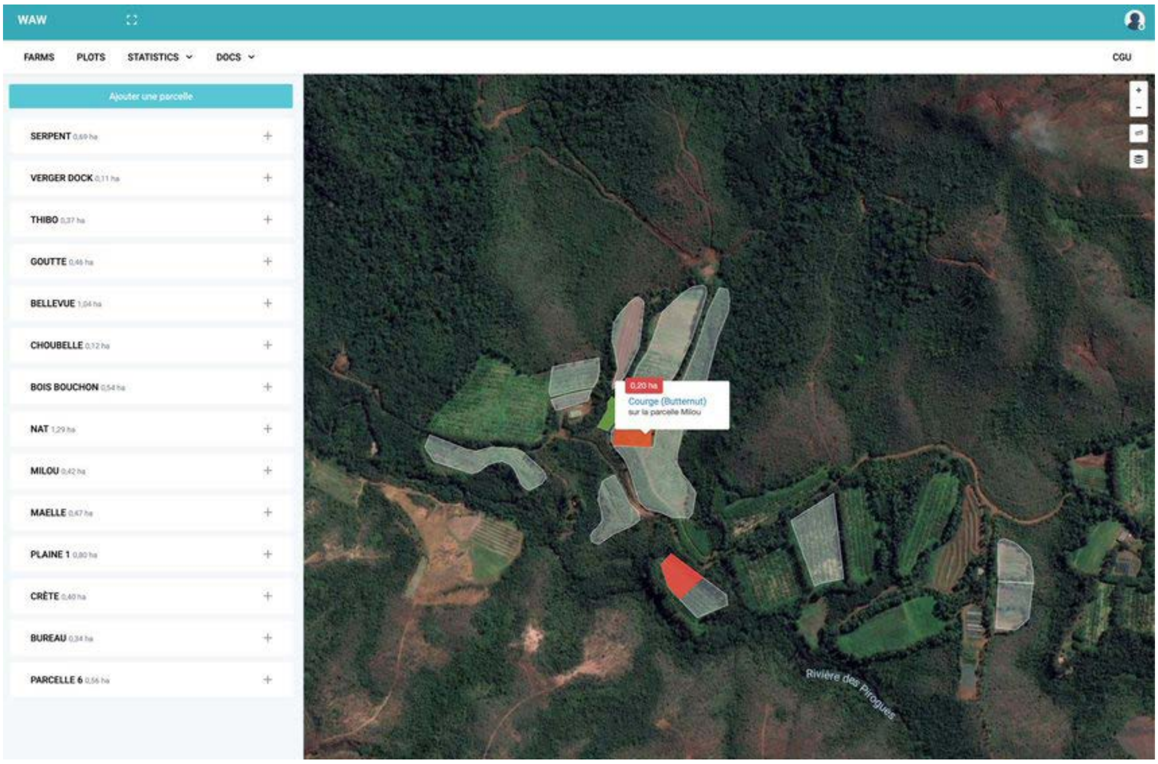
Internal origin

This is the flow of information generated by entities within an organization, for example, survey data captured directly on the platform by one of WAW's partners, or indicators already compiled and available on the platform.

These data will be collected primarily through online forms, potentially doing away with the need for paper. Support functions will be designed to minimize data-entry time. Initial consistency and validation checks will be carried out automatically at this stage (see section B3 for more).

Data can also be entered by batch upload, which enables data collected by partners (in Excel files, for example) to be uploaded directly into the information system. WAW can provide templates to simplify the process, thus doing away with hours of data entry and the risk of significant error. We will provide more information on this in the WAW platform user guide when it is published.

Figure 14. Model of a farm- and household-level form-based data-entry interface (in progress)



Source: Authors.

External origin

This is the flow of information generated by other participants, for example, Web Map Service data (from FAO's GAEZ programme, the European Space Agency or others). It includes all of the Living Standards Measurement Survey-Integrated Surveys on Agriculture (LSMS-ISA) data hosted on the World Bank website, along with agricultural censuses appropriate to the WAW platform. It may also include data from WAW partners, such as the International Land Coalition's (ILC) Land Matrix[10] and tools. These data are already stored in partners' own information systems and there is no point in duplicating them internally.

Consequently, WAW's information system must be able to communicate with other information systems (such as those of FAO, the World Bank and ILC) through interfaces. This "interoperability" is technically possible through application programming interfaces (APIs).[11]

The Global Partnership for Sustainable Development Data (Data4SDGs) initiative has a comprehensive guide to implementing interoperable information systems (Morales and Orrell, 2019).

Similarly, some of the data produced by WAW can be disseminated through an API interface.

10 https://www.landcoalition.org/en/explore/our-work/data/land-matrix/

11 An API is a relationship between two computer systems that allows them to communicate and exchange information. The most popular API format meets Representational State Transfer (REST) standards.

B5.2.2. Storing information

Once collected and entered, the information is **stored** in a **sustainable, stable** and **secure** manner, so that it can be used later.

Every operation performed on the storage system is time-stamped and recorded in a specific file. This file, known as a "log", enables debugging if there is a problem. It also ensures precise traceability, consistent with the legal requirements on data security in many countries.

There are technological and organizational tools available to manage the storage of information, include **archiving, version control, back-up, anti-piracy** and tools to prevent the **destruction** of data (the replication or redundancy of data, or soft-delete tools that only deactivate certain data).

Personal or sensitive information can be stored in an information system. For this reason, WAW advocates encrypting this sensitive information using a bcrypt-type algorithm and encourages the systematic use of secure information exchange protocols (Hypertext Transfer Protocol Secure, or HTTPS, authentication and robust authorization systems). The information is, therefore, collected and stored on a hosted **relational database. To maintain statistical confidentiality, the shared data are aggregated.**

B5.2.3. Processing information

Once the data have been collected and stored, they are ready for **processing.** Data processing produces new information from existing data using computer programs or manual processes.

Data processing can take four different forms. We can:

- **View:** The simplest process, this involves accessing the data as recorded by authorized staff, in line with the rules and regulations governing statistical confidentiality.
- **Organize:** This process involves structuring the information according to specific criteria. For example, it can involve grouping information by territory, by farm structure, by livelihood or by many other criteria.
- **Update:** This process involves taking previously recorded information and updating it.
- **Produce new data and information using** existing data.

Certain processes can be conducted manually on digital data sets. Other processes can be automated in the information system. Statistical algorithms (coded using R statistics, for example) can be used on some data sets. This ensures that certain processes are replicable, that data set processing is homogeneous and that processes are up to date.

B5.2.4. Disseminating information

Regardless of where it comes from or what it represents, information is only valuable if it is communicated to the right recipients at the right time in a usable way.

WAW envisages multiple user interfaces for disseminating the information collected and produced:

- syntheses (targeted indicators and qualitative comments) for farmers whose holdings belong to an observatory and for their communities;
- indicator tables (aggregated data) on different types of monitored farm systems;
- toolkits based on local data benchmarks (yields, input and product prices, labour costs, etc.), as well as technical and economic data (production routes, gross margins, etc.) to inform rural development advisory services and other initiatives;
- synthesized case studies of monitored farm types, with models describing the technical, economic and human equilibria of these systems and their results to allow prospective simulations (estimated impact of lower market prices or yields due to weather or health events, etc.); and
- other thematic analyses of data (SDGs, etc.).

Thematic reports can be based on data that are shared on the platform. The various observatories whose data are captured can serve as case studies. Observatory comparisons can also be the basis for reports, such as the “State of Family Farming” envisaged by WAW and its partners. Workshops and cross-analysis will increase the scope of the data produced by the information system.

For more information on the WAW platform, please see the preliminary study on Mapping Family Farming (Lehoux and Bosc, 2019).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Using the data to promote investment

C


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C1. Using data from agricultural censuses and surveys – value and limitations

WAW plans to conduct complementary analyses to those already carried out using existing data sets, such as agricultural censuses or LSMS-ISA-type household surveys which are two different and separate exercises (origin, scope and methodology differ). It will place particular emphasis on types of labour to define farm meta-categories. Depending on stakeholders needs, WAW will also produce data from new surveys. While there are many benefits to using existing data, there are also limitations, most notably rights of access and usage, in particular, the right of access to individual data and data obsolescence.

C1.1. Data sets

Different data sets can be used at different stages of the WAW process:

- sampling, especially if it is randomly stratified (see section B1)
- sample adjustment at the end of the survey (see section B1)
- assessing representation and the confidence interval (see section C2)
- characterization of identified farm types (see section C3).

However, data sources differ in terms of the indicators they provide, their frequency and availability.

C1.1.1. Agricultural censuses

Agricultural censuses are an essential tool when it comes to refining our knowledge of the agricultural realities of a given territory. They allow for the characterization of the structure of farms, as they try to be comprehensive (see section B2). Their data span farm status, crops and surface area, types of livestock and herd composition, equipment and infrastructure, but also the farm manager (age, training), the type of workforce (family, waged labour), etc. By way of illustration, see the questionnaire of the 2010 French General Agricultural Census (in French).

Such surveys are generally based on FAO guidelines for conducting agricultural censuses. The various modules are presented in the World Programme for the Census of Agriculture 2020 (FAO, 2015).

Census data focus on the economic and sectoral aspects of agricultural activity. The observation unit (the household), its activity systems and livelihoods are documented in different ways in different countries. The diversity of income sources and household strategies (such as diversification, specialization and migration – see section A3) are not documented.

C1.1.2. Structural surveys

In addition to these censuses, some countries conduct periodic agricultural surveys using stratified random sampling. Similar to the Farm Structure Survey conducted in European Union member states, these surveys can be used to update national agricultural census data in a statistically representative way when the sample is large enough (see section B2). The Irish Farm Structure Survey is a good example, as is the corresponding questionnaire (in English).

The frequency of these surveys helps to fine-tune the understanding of the evolutionary dynamics of farms.

C1.1.3. LSMS-ISA surveys

LSMS-ISA surveys focus on household composition and income (agricultural and non-agricultural). They are, therefore, household based, in contrast to other types of surveys, which are farm based.

The surveys are inspired by the LSMS-ISA operational guides. However, these guides have been adapted by the countries that use them. As a result, the available data are not homogeneous and are difficult to process.

C1.1.4. AgriSurvey

FAO's recommendations on the duration of agricultural survey cycles have evolved with the development of the AgriSurvey project (GSARS, 2018). The new recommendation is for a 10-year cycle, plus a succession of annual survey modules and intermittent questionnaires.

Table 12. Recommended timing of AgriSurvey modules (year)

	Years	1	2	3	4	5	6	7	8	9	10
Core module	List of holdings	O	O	O	O	O	O	O	O	O	O
	Agricultural production: crops and livestock	O	O	O	O	O	O	O	O	O	O
	Other key variables	O	O	O	O	O	O	O	O	O	O
Rotating module 1	Economy	O		O		O		O		O	
Rotating module 2	Labour force		O				O				
Rotating module 3	Production methods and environment				O				O		
Rotating module 4	Machinery, equipment and other assets	O				O					

Source: GSARS (2018).

AgriSurvey data, collection and processing methods aim to plug some of the gaps identified in past surveys. The new recommendations for a modular approach are in tune with WAW's approach, as set out in this document. AgriSurvey also incorporates the idea of creating typologies to guide investment in agriculture, focusing on four differentiating upstream factors:

- farm size
- manufactured products
- market orientation
- diversification.

The type of farm labour is not included in the first level of differentiation.

C1.1.5. Data4SDGs and the 50x2030 Initiative

The 50x2030 Initiative, founded by the Bill and Melinda Gates Foundation, the World Bank, FAO and IFAD, tries to address some of AgriSurvey's limitations by looking at farm activities. It recommends adding a module on non-agricultural activities to the survey cycle. Another notable advantage of the 50x2030 approach is that its indicators are tied to certain SDGs and help in their assessment (Data4SDGs, 2019).

C1.2. Common limitations

While AgriSurvey and the 50x2030 Initiative aim to bridge some of the more obvious gaps, it is worth noting that the census and LSMS data sets available to date have limitations when it comes to WAW's objectives. Indeed, current agricultural information systems suffer from a variety of disadvantages that limit their use in the policymaking process.

C1.2.1. Incompatibility of data sets

LSMS surveys and agricultural censuses cannot be directly linked. Indeed, while farms are used as the unit of observation in general agricultural censuses, the LSMS survey uses households. Their frequency varies and they are not based on comparable samples.

C1.2.2 Availability of microdata

In most countries, agricultural stakeholders also face issues when it comes to the availability of individual data for confidentiality reasons. Survey results tend to be aggregated by structural or economic size and are, therefore, difficult to use in analyses aimed at improving knowledge of farm diversity to guide investment.

C1.2.3. Estimating results and performance

The data collected in general agricultural censuses and LSMS surveys are largely structural, so do not enable us to estimate operating performance. The surveys sometimes include a specific focus area or technical theme to refine characterizations, but these do not always capture the performance and management structure of the farms surveyed. The sheer number of surveys to be carried out for these censuses means having to limit the quantity and nature of the data collected.

C1.2.4. Recurrence of and delays in data processing

Updates are pretty irregular and intermittent. Because of the way they are conducted, such surveys are costly, while the processing and dissemination of data are a lengthy process. This means that they are not always up to date with current developments.

The AgriSurvey project aims to reduce the marginal cost of data by switching to probabilistic sampling, doing away with exhaustive surveying and being conducted in modules.

C1.2.5. Lack of comprehensive data

In periodic statistical surveys (censuses or structural agricultural surveys), the paucity of qualitative information constrains our ability to understand the functioning of farms, what they produce and the factors preceding salient developments, thus limiting the potential to analyse sectoral transformation.

The collected data enable a class-based representation of the results, which can mask various agricultural realities and sometimes make it difficult to analyse the production system more closely.

For an analysis to guide investment in family farming, it is advisable to combine statistical analysis with a compatible comprehensive approach, such as a diagnostic analysis of the territory or agrarian system. This approach aims to understand the management and operation of these farms by addressing several questions:

- Who are the farmers?
- What do they do?
- How do they do it?
- Why do they do it?
- What is the outcome?

C1.2.6. Governance instruments

Representatives of farmers' organizations are often excluded from the governing bodies of such information systems and, therefore, have no input in their design, their potential outcome, their usefulness to the political debate or the decision-making process.

Furthermore, responsibility for these information systems can be shared by several ministries, hindering communication of the data.

C2. Constructing typologies

Changes in the socioeconomic characteristics of agricultural households depend largely on their production structure. To capture the wide variety of structures, operations, crop and livestock systems out there, WAW's methodology creates farm typologies. A typology is an operational analysis tool that allow for the portrayal and interpretation of complex and multidimensional facts in a simplified way. Agricultural typologies assist with public-sector decision-making on policies related to, say, investment or innovation support for the most vulnerable farming groups.

Typologies aim to differentiate farms by categorizing them into groups. These groups are defined based on one or more criteria (or indicators). The typological criteria must be chosen in a way that end users can use them to inform interventions.

Categorization by farm types allow for the understanding of the importance of each grouping, their characteristics, their resources and the livelihoods available to households. If the process is repeated over time using trajectory analysis, the data can also be used to measure changes in the structure of each group (Perrot *et al.*, 1995).

WAW's analysis framework combines a comprehensive approach for national comparison, a statistical approach and expert assessment. The typologies are linked in a hierarchical structure (each criterion corresponding to a level) to facilitate changes in scale and cross-comparison (please see our Tunisian case study in section C2.3 for more).

The indicators chosen and the resulting analyses should help public policymakers to guide investment towards strengthening the capital of agricultural households. The choice of typological criteria is crucial in this regard and should not be reduced to a differentiation based on economic size (agricultural area, income, etc.). While these size criteria (physical or economic) will not be favoured within the framework of the WAW's analyses, they will not be discarded either given their importance.

C2.1. Global approach

Our comprehensive approach is based on choosing a common typological indicator for all analyses conducted using the WAW framework. As mentioned, we differentiate farms by the type of labour they use. Establishing this primary differentiating factor is a first step in exploring the link between production management and the impact of cultivation systems on global problems. The three typological groups common to all of the countries we have studied to date are:

- Family farms without permanent employees;
- Family-owned farms with structural (permanent) salaried labour; and

- Agricultural companies that exclusively employ waged workers at various levels, from managers to labourers (industrial enterprises, for example).

The first category encompasses a wide variety of farms on which the workforce is made up exclusively of family workers (with the occasional use of temporary external labour). It also includes farmers who work on contract for large plantations. In the latter two categories, we see changes in the level of family control over farm operations. In the last category, the family is no longer in control.

C2.2. Statistical approach

The choice of variables to be included in the statistical analysis depends on the objectives of the typological construct. WAW projects have the dual objectives of assisting with public decision-making and facilitating the implementation of operational initiatives. Longer term, the objectives will include observing the development trajectories of different farm types. For second-tier indicators, farm typologies must also be a function of context.

WAW typologies draw on both the structural elements of the farm and its operations. The variables that determine the structure of a farm include all of its means of production (the land surface area, the workforce, herd size, equipment, etc.). The variables that determine a farm's operation comprise the decisions made by the farm head or manager and the head of household to achieve their objectives (management technique, household activities, inventory management, etc.).

It should be noted that indicators related to farm performance or the income of farming households more generally are difficult to use for typology purposes. Strong variations in yield (according to crop type) and income mean they are quasi-systematically discriminating variables. Establishing a typology based on such criteria can lead to a classification that is better determined by other resources (outside farming) and linked to the seasonal context. Comparisons of agricultural yields or productivity need be conducted on the same crops, so it is difficult to gather data for such indicators in unspecialized areas. Performance criteria must, therefore, be used a posteriori as outcome variables in the analysis. Farm income can sometimes be used, particularly in local typologies, where farm results are more easily comparable, to understand off-farm income-diversification and own-consumption strategies.

When building a typology, we can drill down into those cultivation and livestock system variables to a greater or lesser degree. What's more, in territories where activities are either very varied or very specialized, we must guard against the dissemination of redundant information,[12] which can cause problems in the initial phase of constructing a statistical typology. Conducting preliminary studies of correlations helps to identify variables that contain very similar information, so that we can, if necessary, eliminate some of them from the analysis. The goal is to avoid an excessive number of variables and, thus, remove superfluous information.

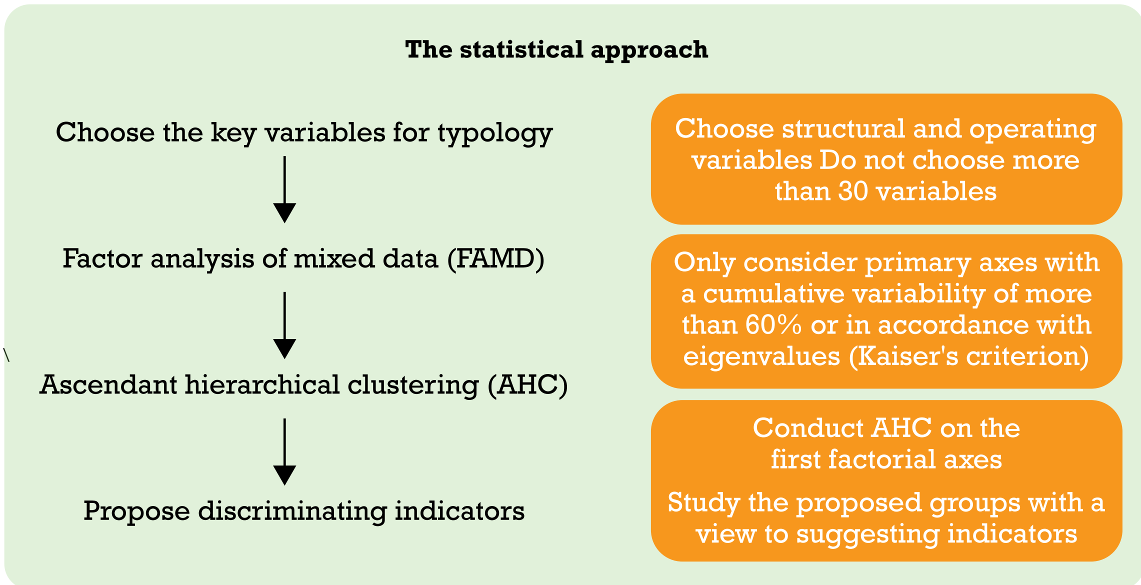
12 A cropping system allows us to characterize a rotation and/or combination of crops and all of the techniques used in a specific order. The agronomic logic of the cropping system, which is closely linked to soil, climatic and socioeconomic conditions (how to access resources), is analyzed systemically at plot level. For example, we will consider the cultivation of corn, beans and squash to be a fully fledged cultivation system if the same rotation is repeated every year in the same place. Whatever is happening at plot level, what grows there, the conditions in which it happens, the way it is done and the history of the plot all go to make up the cropping system. Equally, a livestock system is defined at herd or flock level. Landais (1992) defines it as a set of dynamic, interacting elements, managed by an individual with a view to making best use of domestic animal resources by obtaining a variety of products (milk, meat, work, manure, etc.) or to meet other objectives.

The objective of multidimensional analysis, therefore, is to determine the most discriminating variables. The principle of such analysis is to significantly reduce the number of variables while preserving the maximum variability of the sample. The new variables are factorial axes – linear combinations of the variables that make up the axis, more or less. The first axes are those with the greatest variability; by studying them, we can determine the indicators we need to create our typology. Here, we can see a "controlled loss of information". It should be noted that elements used to differentiate farms based on workforce cannot be included in the construction of these axes, as this indicator has been chosen as the primary level of the typology. To assist in the selection of indicators and, in particular, to determine the thresholds should the quantitative variables prove discriminating, we use "clustering" techniques to suggest typological groups from multidimensional analyses.

At the end of the typology, in certain groups, the variance between farms will be minimal, while the variance between groups will be maximal.

The multidimensional analysis we recommend – for the vast majority of cases in which the initial variables chosen are both quantitative and qualitative – is a factor analysis of mixed data (FAMD). Technically, this amounts to conducting a principal components analysis on transformed quantitative and qualitative data.

Figure 15. Summary of steps involved in the statistical approach



Source: Authors

Should "clustering" be required to determine typological indicators more accurately, the appropriate method for such data is ascendant hierarchical clustering (AHC).

C2.3. The expert approach

This approach allows us to validate or reject proposed typological indicators after statistical selection. An expert group can comprise local and/or international experts (in charge of the WAW-led project) in addition to other project stakeholders, such as policymakers, professional organizations or technical experts from ministries of agriculture, local agencies that oversee farms or local agricultural councils.

This step should be used to confirm that the typology is in line with initial objectives. Should the proposed indicators be deemed unsuitable, further statistical analysis will be required once the offending variables have been removed. Though this is not the approach advocated by WAW, it is sometimes the only way to compile a typology. In such cases, indicators are chosen without prior statistical analysis, based solely on qualitative information and areal knowledge.

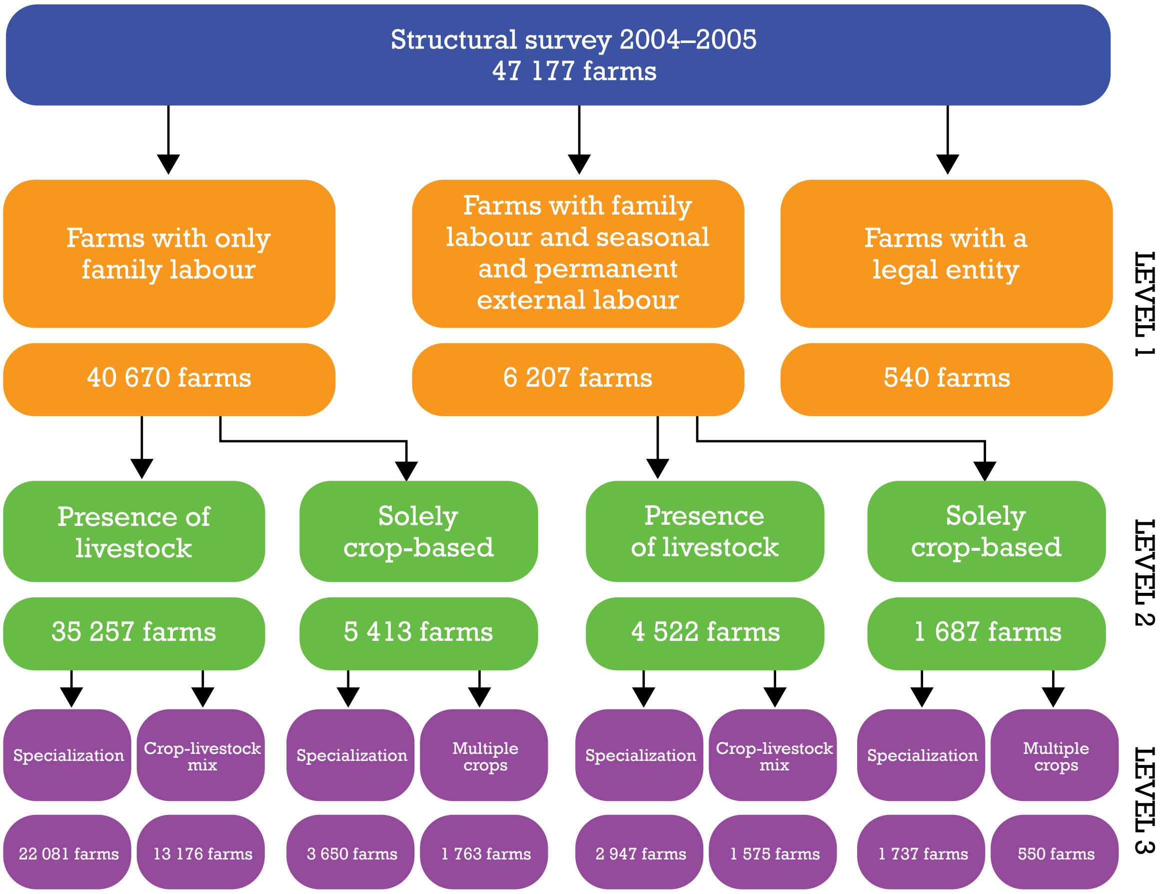
Example of WAW typology (Tunisia)

The methods used to construct this typology, along with the results, can be found in Jaouad and Gaillard (2017).

The Tunisian typology was conducted in 2016, based on a structural survey from 2004-2005, the most up-to-date national survey available. The approach was fairly similar to that recommended in this document. Multidimensional analysis was carried out on all variables, including those relating to labour. The latter variable was deemed discriminating, in other words, strongly associated with the primary factorial axis in the FAMD, with a large contribution to the prediction of group membership. This reinforced the concept of using labour as the primary indicator. The presence of livestock, the type of farming and non-agricultural activities were among the variables used to construct the other axes. The working group, comprising national and international experts, the national coordinator and the WAW coordinator, built on the initial results to construct a primary typology. Discussions, based on various exchanges, revealed the following:

- The “organized” sector, determined by the legal form of the farms in question, had to be treated separately. It was not appropriate to use this variable as a differentiating factor; 540 farms had a legal entity, corresponding to less than 1 percent of the sample.
- Indicators were selected based on labour. Details were provided on the non-familial seasonal workforce. Where these workers were in the clear minority, the farms were classified as having exclusively family labour.
- The ministry's experts and regional officers opted to differentiate the farms by type of farming and economic size. As the presence of livestock is a discriminating variable, it can act as an entry point for constructing an indicator. As crop types are closely associated with agroecological areas, the specialization or diversification of crops was chosen as a third differentiating criterion at national level. In future territorial typologies, this criterion can be refined by the main crops present.

Figure 16. Tunisian structural survey of agricultural holdings, 2004–2005



Source: Jaouad and Gaillard (2017).

C3. Characterization of typologies and analyses

C3.1. Characterization of typologies

Following the choice of typological criteria, we can characterize or describe each group using any remaining variables not used as indicators. Differences may occur if those variables show less variability and are considered significant if confirmed by means testing. The use of statistical tests can actually be used to extrapolate trends observed on a sample to a larger population.

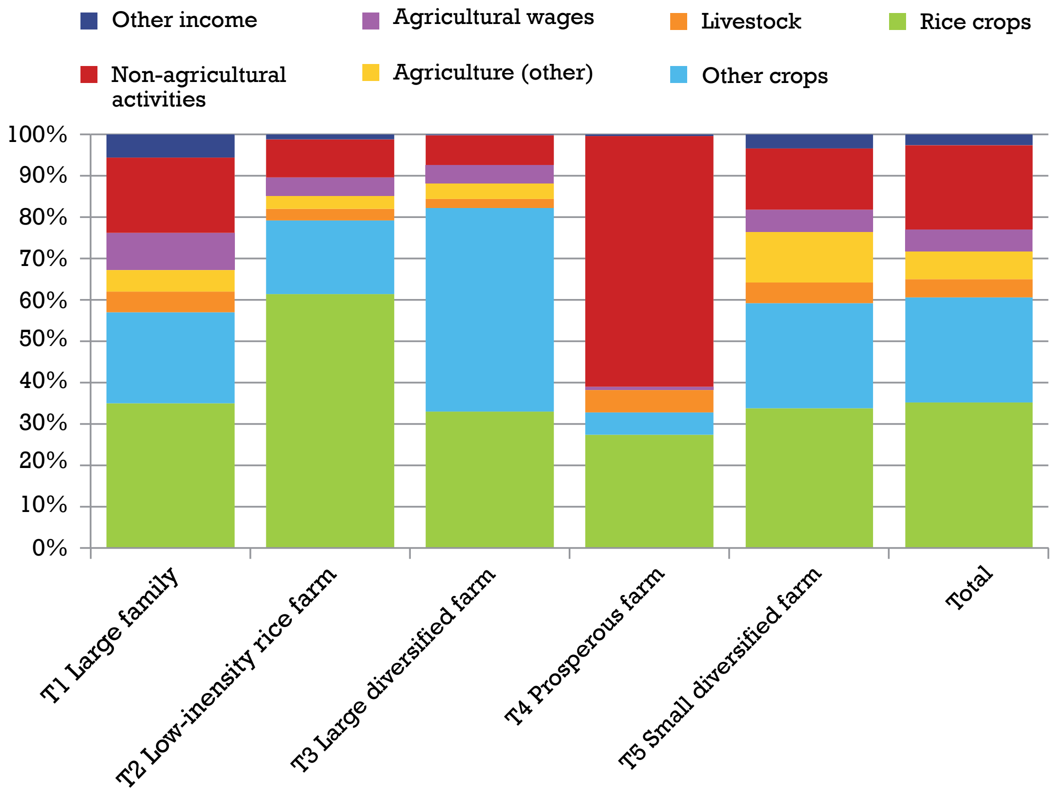
Thus, numerous elements are compared, depending on the object of the exercise. Differences or similarities in household capital resulting from livelihood analysis will help to steer public investment to different types of agriculture. Comparisons between different agricultural practices will allow better targeting of support and advisory services to farms. And comparisons of indicators associated with farm performance, which are not used to construct typologies, give us a more comprehensive understanding of the strategies used and choices made by agricultural households. These interpretations are merely a guide, however, and not classifiable as variables.

C3.1.1. Example: farm typology in the Menabe region of Madagascar

This typology, carried out as part of a WAW project based on data collected by IFAD, suggests the strong influence of crop systems in differentiating rice-based operations from other holdings, from both an economic standpoint and the perspective of household size. The characterization of this typology shows both the disparity of agricultural performance and income levels and the more homogeneous use of inputs in four of the five categories studied. Please see FAO (2017a) for the full study (in French). https://agritrop.cirad.fr/586887/1/2017_D20_WAW_Mada_2017_Synthese.pdf

In Figure 17, non-agricultural income as a share of total household income shows the dichotomy between the agricultural specialization of larger farms and the more diversified farming of smaller holdings. The share of revenue stemming from the family farm (which is lower for small farms) is supplemented with income from off-farm labouring.

Figure 17. Example of income-source analysis by household type



Source: Bélières and al. (2017).

Elsewhere, this typology has been used longitudinally, allowing us to assess changes in the demographics of each typological group, for example, a slight increase in the share of large and medium-sized farms or changes in the characteristics of each group (a slight improvement in the level of education of farm managers, a decrease in family size, a decline in aid, growth in agricultural wages, etc.). When typologies are used at different times on the same sample (panel) or on the same type of sample (based on typology), we call this trajectory analysis.

C3.1.2. Other typologies

Typology using 2014 Ghana AFRICA RISING Baseline Evaluation Survey (GARBES) data

This typological characterization, based on statistical and expert analysis, shows the average physical capital of farms based on each farm type. The types of farms are:

- **Type 1** Households led by women with low to medium staffing levels
- **Type 2** Young households with moderate resources
- **Type 3** Average or well-resourced households with livestock
- **Type 4** Well-provisioned households with high agricultural yields

The typology as synthetized in Table 14 enables us to highlight possible areas of investment to increase the resilience and productivity of the different types of households. It is clear that investing in land improvement to increase soil carbon content through tree cultivation and livestock raising increases labour productivity and sustainability.

Table 13. Types of family farm in the Lake Alaotra region (mean)*

	Share of each category (%)	Number of people in household	Surface area planted with rice [ha]	Number of draught cattle	Rice yield (t/ha)	Net margin (MGA/ha)	Fertilized area (%)	Income per person (MGA)	Share of income from rice (%)
Large rice-growing farms	4	6.31	11.34	4.77	3.38	15 379 800	42	2 950 500	92
Diversified farms	9	5.03	1.68	1.92	2.16	1 588 200	24	604 100	55
Small, poor farms	56	4.21	0.91	0.74	1.92	864 100	26	410 700	56
Very small farms with waged labour	14	4.81	0.39	0.22	0.93	336 700	31	387 400	19
Average farms with large families	17	7.33	1.85	3.09	2.67	1 903 200	23	375 900	71
Total	100	4.98	1.52	1.35	1.99	1 661 000	31	529 900	65

**Mean of 2005, 2010 and 2015 record-of-rights survey data.*

Source: Bélières et al. (2017).

Table 14. Types of family farm and their main characteristics

Types of farms	Human assets: labour and gender	Natural and physical assets	Economic performance	Social performance	Environmental performance
Type 1: Female-headed households with low to medium levels of endowment	• Relatively smaller household size • High elderly concentration • Few labour inputs • High gender equality	• Little asset ownership • **Natural assets:** bad soil quality; few conservation practices in place; small land size • **Physical assets:** few livestock, low agricultural and non-agricultural wealth, few inputs	• Low production and productivity of all major crops, also due to low input use	• High food insecurity	• Poor soil quality • No land improvement practices
Type 2: Young medium-endowed households	• Relatively small and young households with high proportion of children and relatively high levels of education • High gender equality	• Few assets • **Natural assets:** • **Fairly good soil quality but few conservation practices** • **More likely to grow vegetables than other groups**	• **Low productivity, though better than type 1**	• **Low food security**	• **Few conservation practices in place**
Type 3: Medium to highly endowed households breeding cattle	• Large households with young, married heads and many children • Low gender equality	• **Natural assets:** Serious problems of crusted soil and soil erosion against which no measures are taken • **Physical assets:** • **High ownership of cattle; some conservation practices in place; more likely to intercrop than other groups; high input use**	• **Medium to high levels of crop production and productivity** • **High wealth (agri and non-agri)** • **Large quantities of harvest going to sales**	• **High self-consumption of food**	• **High percentage of crusted soils and generally bad soil conditions** • **Some conservation practices in place**
Type 4: High-yield households with high endowments	• Very large, male-headed households composed mostly of active population members (15-65 years) • Low levels of education and head literacy rates • Low gender equality except on the wage-gap measure	• **Natural assets:** Large land size; good soil conditions and conservation practices • **Physical assets:** Extremely high asset ownership • High number of livestock units, conservation practices • High agriculture and non-agriculture asset index • High input use: fertilizer, pesticides and improved seeds	• High production and productivity of crops	• Higher levels of food security than other groups	• High input use: fertilizer, pesticides

Source: Authors, based on Signorelli, Azzarri and Haile (2016).

C3.2. Explanatory and confirmatory analysis of typology: logistic regression

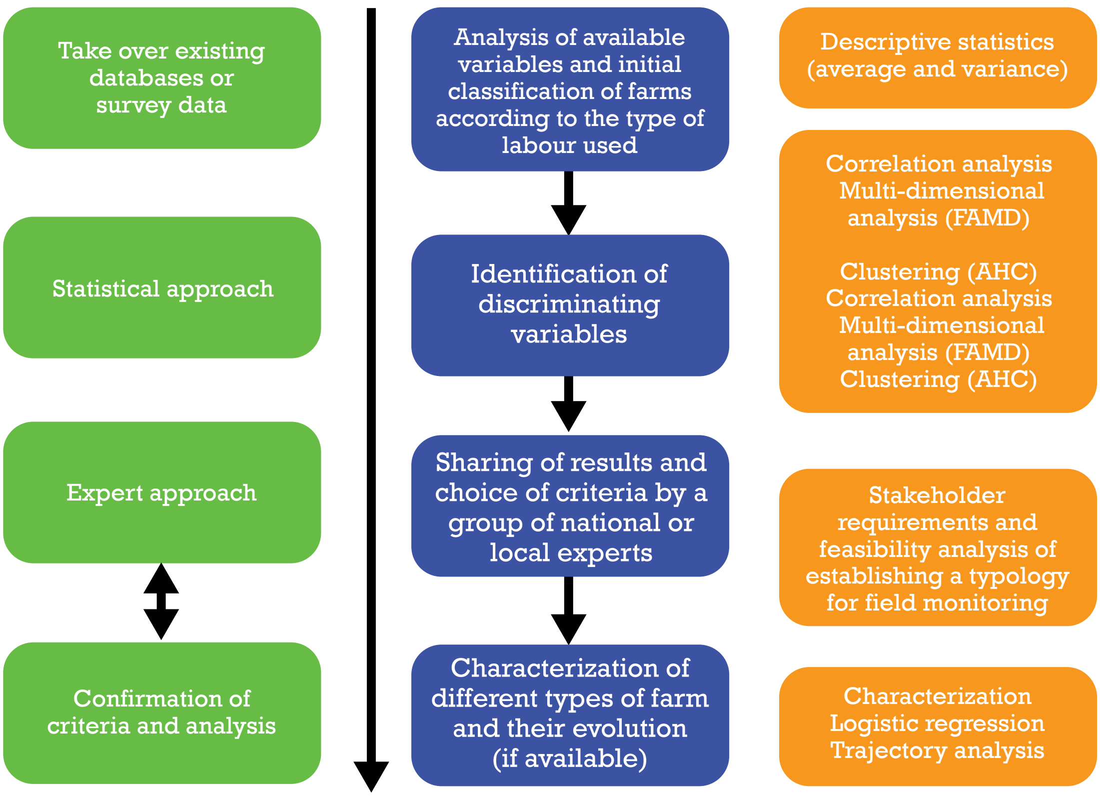
Multinomial logistic regression seeks to determine how factors influence typological group membership when more than two groups are being studied. This type of analysis can also be used to confirm the choice of criteria for a given typology. Through this combination of different factors and typological groups, we can see what proportion of the farms is poorly classified by the model. This helps the understanding of how the heterogeneity of individual farms in the same group compares with the heterogeneity of farms in different groups.

This was the approach adopted in a study based on France's agricultural censuses of 2000 and 2010 (Bignebat *et al.*, 2015). In the context of France's highly specialized crop and livestock systems, the results showed how the type of farming and economic size play an important role when classifying farms using a typology based on agricultural labour.

C3.3. Analysing the determinants of agricultural strategies and performance

Sometimes, typology may not be enough to further our understanding of the diversity of farms. A typology based on simple means testing can sometimes mask a high level of heterogeneity within groups, especially when it comes to performance elements that have been excluded from the selection process for typological criteria. To understand the factors influencing agricultural performance, income or the adoption of particular strategies (agricultural practices or the diversification of livelihoods), econometric models are often needed. WAW's goal, however, is to create a global view of the world's agriculture and to facilitate comparisons between the countries studied – and it is more difficult to harmonize such models.

Figure 18. WAW methodology to define farm types



Source: Bélières et al. (2017).

C4. Observatories and tracking systems

The second component of WAW's *Using the Evidence* programme helps WAW partners to establish a network of territorial observatories for compiling data and which act as analysis hubs where investment policy proposals can be compiled and tailored to diverse farm types (FAO, 2019a). The observatories study the dynamics of farm transformation within a harmonized conceptual framework and methodology based on the guidelines set out in this paper. They allow a contextualized analysis of the diverse forms of agriculture, which takes into account historical factors, agroecological contexts and specific socio-technical and economic elements of the territories concerned. Through a system of interconnected levels and a harmonized conceptual framework, data from territorial observatories can be aggregated on a broader scale.

C4.1. Observing diversity and transformation

C4.1.1. Building shared knowledge

WAW and its partners have identified several difficulties in characterizing farm diversity. For instance, participants that are in direct contact with farms – such as farmers' organizations, NGOs and advisory support services – find it difficult to access up-to-date data on the diversity of agricultural systems, their performance and their evolution over time (IDELE and WAW, 2016). This makes it hard to design targeted, tailored investment policies and to assess their effects.

The same applies to those charged with formulating public policies, who have to deal with scattered sectoral data (agriculture, livestock, natural resources, forestry, fisheries, etc.) and find it difficult to obtain updated data. Consequently, they struggle to develop investment policies and strategies tailored to the various types of territories, farms and rural households.

To address these challenges and build this shared knowledge, WAW has created its harmonized framework and shared methodology, in addition to a collaborative digital platform (see section B5).

C4.1.2. Territorial observatories

Farms and rural communities form unique agroecosystems in myriad geographical locations, from forests and mountains to arid savannahs and islands, shaping the diversity of the world's agricultural systems. The ability to pinpoint and characterize the diversity of their component entities is crucial to understanding the dynamics at work and to activating appropriate, targeted development levers.

To help achieve this goal, territorial observatories can be developed to provide different kinds of data in addition to data from censuses and agricultural surveys (where available) or standard-of-living surveys, such as LSMS-ISA.

These observatories also facilitate more frequent and regular updating of indicators produced from data collected on farms or from rural households. Public and private stakeholders, therefore, must act to enrich the pool of available statistical data, not to replace it.

Observatories can also serve as local platforms for the exchange of views and ideas on territorial development issues. They can galvanize territorial stakeholders into action on new, common objectives and yield new sources of data to enrich these exchanges.

WAW and the French Livestock Institute (l'Institut d'Elevage, or IDELE) have compiled an overview of current observatories and monitoring systems, available on the WAW website (IDELE and WAW, 2016).

C4.2. A knowledge capitalization tool

C4.2.1. Developing products and services to benefit agricultural and rural development stakeholders

The observatories can also be used to develop services that directly benefit the stakeholders involved in implementing them. Indeed, this is a prerequisite to ensuring the prolonged engagement of the various participants. WAW plans to implement a knowledge capitalization tool (primarily a decision-making tool) to encourage the following actions:

Producer surveys

- Posting of farm typology results directly to the online platform through workshops, including technical and economic balance sheets in liaison with farming families.
- Preparation of an agricultural campaign and identification of potential investments, etc. For example, the schemes implemented by the Federation of Non-Governmental Organizations of Senegal and the Association for the Promotion of Livestock in the Sahel and Savannah in West Africa are based on a simplified operating balance sheet and act both as a knowledge tool for family farming and as a tool for promoting operational dialogue with families and in developing investment strategies.

Other producers

- Collection of techno-economic and environmental reference points by type of production system, enabling farmers to compare their holdings and operations with similar farms and regional averages and to estimate their growth potential, making them aware of certain key indicators to monitor to optimize production and output.

Professional organizations

- Development of service tools (advice support, input supply, joint purchases, individual and collective investments, micro-credit, training, etc.) based on farm type, household diversity and territorial agroecological conditions, etc.

National professional associations

- Advocacy materials on the importance of family farming, production and income levels, the composition of production costs and investment strategies that take into account the diversity of family farm types, etc.

Public stakeholders

- Concrete elements to support deliberations on agricultural and rural development policies. The characterization of agroecosystems and farms makes it possible to scale up more targeted investment actions.
- Support public actors at the national level (ministries of agriculture, livestock, fisheries, forestry, environment, rural development and statistical divisions, etc.) and at local level (decentralized state services, regions, municipalities). The farm-based approach appears to be a powerful way of breaking down sectoral thinking when it comes to data and public policy design.

International development agencies and rural development NGOs

- Methodology for monitoring and assessing the effects and impacts of projects (issues related to territorial agroecological transition, food sovereignty, poverty reduction, vulnerability, resilience to climate change, etc.).

C4.2.2. Information feedback to stakeholders and dialogue within existing frameworks

WAW observatories must take into account existing arrangements for multistakeholder consultation and/or political dialogue. It is not a question of creating new structures from scratch to replace or compete with existing arrangements, such as family farm associations or cooperative frameworks.

All observatories should offer mechanisms for feeding back individual or collective data and for providing clearly identified services and products. Information obtained through the observatories can be shared periodically with territorial stakeholders to foster an exchange of knowledge and ideas, to stimulate debate (help with problem formulation and with individual or collective solutions) and to spur progress on suitable, common databases.

While such communication promotes and supports multistakeholder dialogue, a collective data-capitalization process and shared management of the observatory are equally important elements of stakeholder ownership.

Thus, the design and implementation of observatories can be viewed as a process to further the collective capitalization of knowledge and the integration of stakeholder skills.

C4.2.3. Multistakeholder governance

To meet diverse needs, observatories should embrace multiactor governance and implementation, bringing together various stakeholders for the provision and use of collected data, including family farmers and their representative groups, government ministries and their statistical divisions, academia, research organizations, downstream professional organizations, NGOs, funding agencies and other civil-society actors, including consumer associations.

The inclusion of producer and civil-society organizations (agricultural and rural development NGOs, etc.) is particularly crucial in order to build synergies between national and regional programmes and on-the-ground producer initiatives, as they:

- know the priority data requirements for strengthening support or business-advisory services and are able to effectively access farmers for periodic operational surveys;
- are able to mobilize outreach agents with an existing relationship of trust with producers, enabling quality monitoring (reliability of quantitative data, data capture and the capitalization of qualitative data, improving the interpretation of the results, etc.).

It is thus possible to envisage the progressive build-up of governance bodies within the framework of existing arrangements, alongside multiactor implementation, until the observatories are in a position to act as the core institutional anchor of both government agricultural departments and producer platforms. The very process of creating these observatories is important, as it enables participants to safeguard their own interests while working for the common good.

This can include the development of policy forums and strategic decision-making bodies (such as steering committees), as well as management and operating bodies (technical committees). These committees must represent the diversity of all stakeholders, with the former ensuring the legitimacy and sustainability of the initiative and the latter ensuring the organization, management and operationalization of its work.

The identification and strengthening of pre-existing committees or services should empower these bodies. This tool should help foster synergies with ongoing initiatives and avoid the creation of new bodies that merely add to the established institutional burden.

The observatory steering committee

A national steering committee, split into regional steering committees, convenes stakeholder representatives, so that the multiactor collaboration can gradually be realized and formalized.

The steering committees ensure the involvement of all participants in the decisions and approvals process associated with the various phases of observatory implementation:

- development of a shared observatory vision (goals, management, expected results, etc.), then adapting it according to experience;
- identification and mobilization of available sources of statistical information and synergies with other operational dynamics;
- decision-making on strategic issues, including the number and choice of pilot regions and subsequent expansion in the operational phase;
- identification and mobilization of the required financial and human resources and the subsequent allocation of actual resources available;
- formalization of the conditions and means of participation of the various players in the monitoring of farms and evaluation of data;

- arbitration of the operational proposals of the technical committee;
- definition of the data protection scheme to be applied to the individual data collected and the rights/conditions of access to that data by potential users; and
- monitoring and evaluation of achievements in the implementing regions.

Technical committees

National technical committees, comprising regional or territorial technical committees that form a multiactor working group, are tasked with ensuring the operational implementation of the observatory.

They also have coordination and management functions – among other things, mobilizing and liaising with various stakeholders, facilitating decision-making, recording progress made and monitoring deadlines, keeping stakeholders informed and reporting to the steering committee.

At the national level, it may be appropriate to involve research laboratories, technical and vocational agricultural colleges and institutes of higher education.

The WAW scheme is a resource hub that will facilitate the implementation of these committees and their actions through methodological support and the provision of tools.

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