



# Identifying farm-level pathways to household food security in West Africa: a qualitative case study in Côte d'Ivoire

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## ABSTRACT

### GALLIFA L. Identifying farm-level pathways to household food security in West Africa: a qualitative case study in Côte d'Ivoire.

**Background:** Despite the large recognition of important linkages and challenges between food security and agriculture, there is little evidence that proves farm-level relationships between agricultural production and food security. Furthermore, malnutrition remains a major issue in rural areas of West Africa. Understanding the multiple linkages between agricultural livelihoods, nutrition, health and wealth in their complexity is needed to identify policy levers.

**Objective:** This research aims at embracing livelihoods complexity by *Identifying farm-level pathways to household food security*, using a people centred and qualitative approach. First, by understanding *what key assets influence farm-level pathways to household food security*. Since agricultural livelihoods are strongly embedded in its larger context, it secondly explores *how key contextual elements influence farm-level pathways to household food security*. Finally, this research investigates whether the complexity of *farm-level pathways to household food security can be identified discussing farmers livelihoods*.

**Methods:** For data collection the Sustainable Livelihood (SL) Framework was used to operationalize the research questions and develop data collection tools. Data was collected in four villages in the department of Taabo, south-central Côte d'Ivoire. Data was obtained from 14 individual semi-structured interviews, 4 focus group discussions, 4 key informant interviews, 8 dietary diversity questionnaires and 10 structured interviews. Participants were farmers from two different ethnic groups (Baoulé and Dioula) as well as representatives of the health sector, a rural development agent and the head of a cocoa cooperative. Interviews were recorded, transcribed and later coded based on content analysis using the SL categories, while pathways were deduced in a second step.

**Results:** Interviewed farmers are largely self-sufficient but rely on the market on a regular basis. Two main farming systems coexist in the region, based on farmer's cultural preferences. The variation of income and food stocks depends strongly on the farming system, which implies different perceptions of the lean period. Consequently, this also translates in a different diet.

Women are responsible for subsistence crops and use the income from selling surplus to buy additional foods. Men rely on cocoa for their income, which represents a relatively high share of total household revenue. Latter is used to cover non-food expenditure such as education and health. When women engage in a more remunerative activity, they use the income to support child education. While a diversity of service providers which support small-scale farmers growing cocoa exists, subsistence crops under women responsibility are completely neglected.

Difficult access to health services due to high costs paired with traditional beliefs and lack of awareness are elements that prevent farmers to seek support in case of bad health conditions. Still, farmers have identified health and climate change as being the major threat to their fields' productivity. Every single farmer is concerned about climate change. Since they are strongly relying on rainfed agriculture, changes in rainfall patterns have tremendous consequences on their farming system. Furthermore, low social cohesion and conflicts at various levels are restricting activities that could lead to an improvement of farmers livelihoods.

**Policy implications:** Based on the results of the present study, to improve farm-level food security special attention should be given to the following areas:

- *Policies should promote good nutritional practices and consumption of locally produced nutritious foods*
- *More policy support for subsistence farming lead by women could improve food availability and access*
- *Policies for food security should pay special attention to gender roles, intra-household dynamics and mental accounting*
- *Improved access to health and education for women could improve food utilization*
- *Policies should focus on sustainable and climate-smart agriculture and tackle land-use conflicts*
- *Policies need to translate into action*
- *Livelihood approaches help to prioritize policies and determine key milestones that can be measured in order to monitor changes and/or identify leakages along the impact pathways*

**Key words:** Agriculture, Food security, Smallholders, Livelihoods, West Africa

# 1 Introduction

Freedom from hunger is a basic human right, acknowledged in the 1948 Universal Declaration of Human Rights (FAO et al. 2018). This commitment has been reiterated by the Sustainable Development Goal (SDG), stating as SDG 2 “ending hunger, achieve food security and improved nutrition and promote sustainable agriculture”. Furthermore, target 2.1 focuses specifically on access to nutritious food “By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round” (FAO 2017). This is especially vital in West Africa where food insecurity has increased over the past years (FAO et al. 2018). With 32,4 per cent children under five suffering from stunting and 9 per cent from acute malnutrition, food security is a major issue in West Africa (Brochard 2017). Local agriculture is the main source of food and income for about 65 per cent of the working population in West Africa (ibid.). The agriculture sector has therefore a major responsibility in alleviating malnutrition (Egal and Lopriore 2006). There is a growing consensus that to achieve food security, agricultural interventions must be nutrition sensitive (FAO 2017). While food security is often mentioned, especially in the context of agricultural research and development, interventions are widely focusing on a narrowed understanding of food security.

At farming-household level, agriculture is both an important source of food and income. There is a growing acknowledgement that agricultural development provides an obvious and needed entry point for improved nutrition (FAO 2013). Agricultural interventions should be aware of the final objective, depending on its aim (e.g. income, productivity, diversity, environment, poverty reduction, women empowerment) and consistent food security indicators should be used accordingly (Nicholson et al. 2019). Agricultural intervention and farming system research have been largely focused on enhancing productivity and profitability of crop and animal resources without emphasis on better nutritional outcomes (Das et al. 2014).

Linkages between agriculture and nutritional outcomes are multiple but relatively indirect (Headey et al. 2012). This dynamic complexity implies that improved economic or agricultural conditions might not translate into better nutrition (ibid.; World Bank 2007; Arimond et al. 2011; FAO 2013; Das et al. 2014; Dillon et al. 2015). Despite the large recognition of important linkages and challenges between food security and agriculture, there is little evidence that proves farm-level relationships between agricultural production and food security. (Arimond et al. 2011; IFPRI 2011; Le Cuziat and Mattinen 2011; Gillespie et al. 2012; Girard et al. 2012; FAO 2013; Carletto et al. 2015; Dillon et al. 2015; Nicholson et al. 2019). Hence, to maximize the impact of any third-party intervention on nutrition at household level, the complex linkages between food security, livelihoods, nutrition and health need to be better understood (Arimond et al. 2011).

This research paper aims at embracing livelihoods complexity by **identifying farm-level pathways to household food security in the department of Taabo, south-central Côte d’Ivoire**. Therefore, the author has singled out three main questions:

- *What **key assets** influence farm-level pathways to household food security?*
- *How do **key contextual** elements influence farm-level pathways to household food security?*
- *Can farm-level pathways to household food security be identified discussing farmers livelihoods?*

## 2 State of knowledge

### 2.1 Conceptual framework and pathways linking agriculture to food security

#### 2.1.1 Food security

Food security is an evolving concept. The current accepted definition is “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” (UNICEF 1991; FAO 2009).

The concept of food security is articulated around four dimensions; availability, access, utilization and stability (FAO 2009). Food security is achieved when the combination of the four dimensions results in an adequate nutritional status (Hwalla et al. 2016). Food security is thus the result of a long sequence of interlinked events (Arimond et al. 2011). Furthermore, the concept of food security can be discussed at different levels, individual or intrahousehold, household, regional, or global. Today more emphasis is given to the household and intrahousehold level, due to the clear evidence of persistence of malnutrition despite regional availability of food (Hoddinott 2001). African women of reproductive age and children are the most vulnerable population and are heavily affected by micronutrients deficiencies, particularly anaemia and vitamin A, iron, zinc, folic acid and iodine deficiencies (Brochard 2017).

In the last decade more attention has been paid by governments and the development community to the potential of agriculture for nutrition and health sectors to work together, in order to enhance nutritional outcome (Fan et al. 2012; FAO 2013). Sustainable Development Goal 2 “Zero Hunger”, is indeed linking the food system, nutrition and sustainable agriculture under the same goal.

### 2.1.2 Conceptual framework of malnutrition

UNICEF (1991) has developed the first multisectoral strategy and conceptual framework of malnutrition. The framework presented by UNICEF does not express exact relationships but offers a guide of what to look for, in order to identify the causes of the problem in a particular context (UNICEF 1991). The framework shows that inadequate dietary intake and health issues are the most important immediate causes of malnutrition. The dietary inadequacies might be caused by either an inadequate supply of food, or an incapacity for women to prepare food and feed their children (ibid.). Low health status might be due to inadequate water supplies or a lack of sanitation and hygiene. The underlying causes can be numerous and interlinked. Most of the underlying causes of malnutrition are the result of unequal distribution of resources in society, which is described as a basic or structural cause (ibid.; Headey et al. 2012).

Linkages between agriculture and nutritional outcomes are multiple but relatively indirect (Headey et al. 2012). This dynamic complexity implies that improved economic or agricultural conditions might not translate into better nutrition (WB 2007; Arimond et al. 2011; Headey et al. 2012; FAO 2013; Das et al. 2014; Dillon et al. 2015). However, there are also reasons to believe that there is a big potential to use synergies between the agricultural and other sectors of importance to nutrition (Headey et al. 2012).

### 2.1.3 Farm-level pathways to food security

The literature and conceptual frameworks that link agriculture with food security has been rapidly growing during the last decade. Farm-level pathways to household's food security describes the multiples ways how small-scale farming systems may translates into improved nutrition. Based on the UNICEF framework, pathways have been specified in order to generate testable hypothesis (Arimond et al. 2011; Thompson and Amoroso 2011; Fan et al. 2012; Gillespie et al. 2012; Headey et al. 2012; Hoddinott 2012; Malapit et al. 2015; Pandey et al. 2016; Fan et al. 2019). The most discussed pathways are the following:

- **Agriculture as source of food:** household's own production
- **Agriculture as source of income:** From the sale of commodities produced
- **Women's empowerment:** this pathway can be disaggregated into three thematic; Women's socio-economic status, Women's time and Women's health and nutritional status.

Furthermore, these pathways are considerably influenced by various contextual factors such as; farming systems, access to markets, taste and preferences, water, sanitation and health (WASH), climate change, management of natural resources etc. (Arimond et al. 2011; Carletto et al. 2015; Slavchevska 2015; Pandey et al. 2016; Fan et al. 2019). Contextual factors are in some studies considered as pathways and vice versa. It is also important to note that pathways are not mutually exclusive.

#### 2.1.3.1 Agriculture as source of food

The own production of agricultural households is the most direct pathway by which agriculture translates into food security (Arimond et al. 2011; Fan et al. 2012; Gillespie et al. 2012; Headey et al. 2012). There are several ways agriculture can improve nutrition:

Increasing **productivity** by improving agricultural performance may for example have a positive impact on food security by increasing food availability and generate more income (Das et al. 2014; Douxchamps et al. 2016; FAO 2017).

Participation in **sustainable agricultural intensification practices** trainings showed positive impact on food security at household level, by increasing crop yield and income (Yahaya et al. 2018). Furthermore, it has proven to decrease natural resource degradation (ibid.).

Increasing **on-farm diversity**, was mentioned to reduce seasonality of food insecurity (FAO 2013; Carletto et al. 2015), and increase household's dietary diversity (Dillon et al. 2015; Douxchamps et al. 2016). Production diversity may increase the availability of different types of food for household consumption, improving dietary quality among household members (Malapit et al. 2015). However, increasing on-farm diversity alone cannot address the issue of malnutrition, unless there is a focus on nutrition education (Das et al. 2014).

Increased production of **nutrient-dense food** is also mentioned to be a positively linked to improved nutrition (Smith et al. 2006; Pinstруп-Andersen 2012; FAO 2013; Das et al. 2014); The consumption of **animal source food** is of particular interest given their high density in protein and key micronutrients (for example, iron, zinc calcium, B12) (Carletto et al. 2015). However, the hygiene and livestock-borne diseases, or competition between humans and livestock for food might lead to a negative effect of livestock ownership on nutrition outcomes (ibid.). Small ruminants also provide insurance and a substantial source of income, and help spread income risks (Douxchamps et al. 2016). At the same time animal keeping represent a high investment for many smallholder and is linked to high risks if the animal dies or gets stolen (Asfaw and Davis 2018).

In rural areas of West African countries strategies for coping with food security includes mainly subsistence farming (Onakuse 2012; Nzeagwu and Aleke 2016). High yields and increased productivity alone may not improve food security since other factors come into play: access to market, women decision power, nutrition education, etc. (Chimwamuombe and Munsanje 2018). Most agricultural interventions that have shown positive effects on nutrition, had all incorporated human capital related components, behaviour change and communication activities targeting nutrition education and gender considerations (WB 2007).

#### 2.1.3.2 Agriculture as source of income

Income can be generated either through wages earned by agricultural workers or through the sales of agricultural production (Gillespie et al. 2012). The expansion of income can have a positive impact on nutrition, through the purchase of more and higher quality food as well as facilitating the access to health related goods and services (Carletto et al. 2015; Dillon et al. 2015).

The early literature on agriculture-nutrition linkages hypothesized that poor nutrition was mainly due to low income (Arimond et al. 2011). The assumption was that increasing income through agriculture would lead to significant nutritional gains. Today it is widely recognized that increased income alone doesn't necessarily translate into consumption pattern changes (WB 2007; Arimond et al. 2011; FAO 2013; Das et al. 2014; Dillon et al. 2015). In some cases the shift from staple crops to cash crops had negative nutritional consequences on smallholder farmers (FAO 2013; Carletto et al. 2015; Dillon et al. 2015).

The lesson learned are that agricultural income is important, but not sufficient to improve nutrition (WB 2007; Carletto et al. 2015; Slavchevska 2015). The ambiguity between income and nutrition can be explained by a chain of decision making at household level with a myriad of expenditure possibilities (WB 2007; Carletto et al. 2015). Furthermore, farmers might use mental accounting to decide on how to use income, dedicating income from a certain activity or crop to a specific expenditure (Carletto et al. 2015). The translation of increased income into better nutrition depends

thus on a series of intrahousehold factors and processes including women's socio-economic status, education, knowledge, health-related practices, income, and access to and use of health and sanitation services (WB 2007).

#### 2.1.3.3 Women empowerment

Women engage in many activities that are directly and indirectly linked to improved nutrition. Mothers directly influence their children's birth weights and postnatal development and indirectly influence households' food consumption through their activities (Headey et al. 2012).

The literature on intra-household dynamics shows that households respond differently to changes in income depending on who has control of the resources within a household (Carletto et al. 2015). Women's income and level of control over income has an important positive effect on child nutrition and household food security compared to if income is controlled by men (WB 2007). Studies have shown that when women have greater control over resources, they are more likely than men to invest in education, food, and health (Lewis 2014; Ringler and Passarelli 2016). Thus, agricultural interventions that increase women's income and their control over resources can considerably increase child nutrition and health outcomes (Roberts 2010).

Together with education on nutrition, women empowerment was consistently reported central to interventions that had a nutrition improving impact (FAO 2013). In the last decade the international development community has turned its attention to the potential for the agriculture, nutrition, and health sectors to work together to enhance human well-being (Fan et al. 2012). Agricultural productivity and health status are bidirectional, anything that affects agriculture has the potential to affect health and nutrition, and anything that affects health and nutrition has the potential to affect agriculture (ibid.). Furthermore, women's involvement in agricultural activities may affect their ability to manage childcare and feeding (Pandey et al. 2016)

In addition to documenting links between women's resources and positive nutrition outcomes, studies about women in agriculture have described a series of problems and constraints faced by female farmers in many contexts. These constraints include: weak land rights; lack of equipment and appropriate technology; limited contact with agricultural extension; lack of access to financial services, markets and information; and lower levels of education (WB 2007; Arimond et al. 2011, 48). Indeed, many studies have shown that gender inequality acts as a significant constraint to economic growth in sub-Saharan Africa (Coker et al. 2017).

#### 2.1.4 Lesson learned by the development cooperation community

International development agencies, government and non-governmental organizations have been linking interventions in agriculture and nutrition since the 1960 (Arimond et al. 2011). Here are the main lessons learned from the past experiences:

**Taking into account the local context:** Collecting information on household's food consumption pattern and nutrient intake is an essential step to gain understanding of what people eat, where they obtain food, where the gaps are in their ability to meet their dietary requirement and how this evolves seasonally and in time (WB 2007; Le Cuziat and Mattinen 2011). The identification of the major nutritional problems allow the design of a suitable agricultural intervention (WB 2007; FAO 2013; Das et al. 2014).

**Mainstream nutrition:** Agricultural interventions that aim at improving food security should mainstream nutrition consideration across the programs (FAO 2013). This means including explicit nutrition objectives and indicators into the project design (IFPRI 2011; FAO 2013).

**Incorporate behaviour change and communication (BCC):** Communication and education components that target behaviour change are important in order to translate increased income or production into better nutrition outcomes (WB 2007).

**Enable and empower women:** Gender sensitivity should also be mainstreamed as women play a central role not only in the production system but also purchasing and preparing food for the

household (Das et al. 2014). Intervention should differentiate factors that enable or constrain men and women in terms of access to resources (WB 2007).

**Consider non-farm factors:** Partnerships with different actors in the field of health and development services is central for food security (ibid.). Non-farm factors like water, hygiene and sanitation improves absorption and bioavailability (Das et al. 2017).

## 2.2 Food security in West Africa

Malnutrition in all its forms remains a major issue in most ECOWAS (Economic Community of West African States) countries (Egal and Lopriore 2006). West African women of reproductive age and children are also heavily affected by micronutrients deficiencies (hidden hunger), particularly anaemia and vitamin A, iron, zinc, folic acid and iodine deficiencies (Le Cuziat and Mattinen 2011; IFPRI 2016; Brochard 2017; Dia et al. 2017). In 2017, 4.9 million people were undernourished in Côte d'Ivoire. Which is 1,2 million more than in 2005 (FAO and ECA 2018).

West African regional nutritional policies such as the ECOWAS Zero Hunger Initiative, call for a multisectoral approach that integrates nutrition related sectors, particularly agriculture, social protection, sanitation and health and addresses key crosscutting issues such as gender and governance (UNSCN 2011). The Zero Hunger Initiative is a high-level engagement to eradicate hunger and malnutrition in the region by 2025. It has increased the promotion of the right to food, promoting nutrition-sensitive and climate-smart agriculture, gender-responsive interventions as well as social protection strategies (Dia et al. 2017). Although this is a crucial step, it is difficult to implement a top-down food security framework that lacks detailed guidelines for 'who does what' on the ground (ibid.).

### 2.2.1 Taabo, Côte d'Ivoire

The Taabo is in the Agneby-Tiassa region in south-central Côte d'Ivoire, about 150km north-west of the economic capital Abidjan and 60km south of Yamoussoukro. The area is predominantly rural (Koné et al. 2015). Taabo is located in the V-Baoule, where the rainforest in the south meets the savannah in the north (ibid.). The farming systems are therefore a mix between the Root and Tuber and Humid Tree farming systems. It has a humid tropical climate (*Baouléen*), with temperatures between 14 and 39 °C (Comoé 2013). It is characterized by four seasons: a long dry season (November–February), a long rainy season (March–June), a short dry season (July–August), and a short rainy season (September–October), and a relative humidity of 60 to 70% (ibid.).

In this region the population is composed of Ivorians (72%) and non-Ivorians (28%). In 2009, the main Ivorian ethnic groups are the Akan (85.6%, mainly Baoulé). The non-Ivorian population is mainly composed of Burkinabe (70.6%) and Malians (23.3%) (Koné et al. 2015).

The illiteracy rate is approximatively 72 percent. For women, this is more than 80 percent and for men, is about 60 percent (ibid.). The average household size is 6,5. Life expectancy at birth 61 year for males and 65 year for females. The risk of a child dying before completing five years of age is very high in this region (92% per 1000 live births) (ibid.). Malaria and acute respiratory infection are the main reasons of death for the under 5 years age group with respectively 24,5 and 16,6 percent (ibid.).

### 2.2.2 Farming systems

Taabo is located in the forest-savanna transition zone of central Côte d'Ivoire (Comoé 2013). The farming system are therefore a mix between the Root and Tuber and Humid Tree farming systems. Land coverage in this region goes from forest, degraded forest, savanna, thicket and wetland regions are all present and agricultural production zones. One farmer may have fields in each zone which makes the production system very diverse. The heterogeneity of the environmental conditions has a strong impact on the local agricultural systems and practices (Schärer 2018).

The Root and Tuber Crop Farming system is dominated by roots and tubers. Livelihoods are derived principally from yams, cassava, legumes and off-farm work (Garrity et al. 2012). The typical household grows maize, rice, cassava, yam, soybean and minor crops such as cowpeas, pigeon

peas and beans. These households are largely food self-sufficient and can generate income by selling surplus. Off-farm work is reasonably well developed, enabling the poorer households to engage in casual labour for larger or plantation farmers (ibid.).

Humid Lowland Tree Crop Farming Systems is an area where commercial tree crops have replaced forest (Garrity et al. 2012). The backbone of the system is the production of industrial tree crops. Food crops are interplanted between tree crops and are grown mainly for subsistence and only a few head of cattle are raised (Dixon and Gulliver 2001). Industrial tree crops were originally established by indigenous farmers through a process of annual clearance. When the family labour is not sufficient, local farmer contract immigrant farmer in exchange for the right to interplant food crops among the trees (Dixon and Gulliver 2001). This process has led to high deforestation in Côte d'Ivoire and to major land conflicts.

### 3 Background

Freedom from hunger is a basic human right, acknowledged in the 1948 Universal Declaration of Human Rights (FAO et al. 2018). This commitment has been reiterated by the Sustainable Development Goal (SDG), stating as SDG 2 “zero hunger”. This is especially vital in West Africa where food insecurity has increased over the past years (ibid.). With 32,4 per cent children under five suffering from stunting and 9 per cent from acute malnutrition, food security is a major issue in West Africa (Brochard 2017). Local agriculture is the main source of food and income for about 65 per cent of the working population in West Africa (ibid.). The agriculture sector has therefore a major responsibility in alleviating malnutrition (Egal and Lopriore 2006). There is a growing acknowledgement that agricultural development provides an obvious and needed entry point for improved nutrition (FAO 2013).

The literature and conceptual frameworks that link agriculture with food security has been rapidly growing during the last decade (Arimond et al. 2011; Thompson and Amoroso 2011; Fan et al. 2012; Gillespie et al. 2012; Headey et al. 2012; Hoddinott 2012; Malapit et al. 2015; Pandey et al. 2016; Fan et al. 2019); The most discussed pathways linking agriculture to food security are the following:

- **Agriculture as source of food:** household's own production
- **Agriculture as source of income:** From the sale of commodities produced
- **Women's empowerment:** this pathway can be disaggregated into three thematic; Women's socio-economic status, Women's time and Women's health and nutritional status.

Furthermore, these pathways are considerably influenced by various contextual factors such as; farming systems, access to markets, taste and preferences, water, sanitation and health (WASH), climate change, management of natural resources etc. (Arimond et al. 2011; Carletto et al. 2015; Slavchevska 2015; Pandey et al. 2016; Fan et al. 2019). Contextual factors are in some studies considered as pathways and vice versa. It is also important to note that pathways are not mutually exclusive. Linkages between agriculture and nutritional outcomes are multiple but relatively indirect (Headey et al. 2012). This dynamic complexity implies that improved economic or agricultural conditions might not translate into better nutrition (ibid.; World Bank 2007; Arimond et al. 2011; FAO 2013; Das et al. 2014; Dillon et al. 2015). Despite the large recognition of important linkages and challenges between food security and agriculture, there is little evidence that proves farm-level relationships between agricultural production and food security. (Arimond et al. 2011; IFPRI 2011; Le Cuziat and Mattinen 2011; Gillespie et al. 2012; Girard et al. 2012; FAO 2013; Carletto et al. 2015; Dillon et al. 2015; Nicholson et al. 2019).

This research paper aims at embracing livelihoods complexity by **identifying farm-level pathways to household food security in the department of Taabo, south-central Côte d'Ivoire**. Therefore, the author has singled out three main questions:

- *What key assets influence farm-level pathways to household food security?*
- *How do key contextual elements influence farm-level pathways to household food security?*
- *Can farm-level pathways to household food security be identified discussing farmers livelihoods?*

This study uses qualitative approach to identify key assets and contextual elements of small-scale farming systems to highlight and discuss pathways to food security. The research design is based on the Sustainable Livelihoods framework which puts people at the centre by understanding their livelihoods respecting their perspectives (DFID 2000). Qualitative methods allow exploring underlying issues of farmers' livelihoods and develop an in-depth understanding of their strategies to food security. Furthermore, the collected qualitative data allows to identify pathways' underlying mechanisms to food security in a holistic manner.

## 4 Material and methods

### 4.1 Conceptual approach

In order to answer the above outlined questions, this research is built around two major concepts, being the Sustainable **Livelihoods** (SL) framework and second the farm-level **pathways** to food security. The SL framework allows to grasp the complexity of the agricultural livelihoods and identify possible pathways to food security and their underlying mechanism. The farm-level pathways to food security then shall give a systemic view of possible causalities and indicators along the impact pathway to nutritional status. Both frameworks are multi-disciplinary and interdisciplinary and closely interlinked. Furthermore, they allow to approach food security considering its four dimensions; availability, access, utilization, stability.

The SL framework has been largely recognized and valued by international organisations to understand livelihoods in their complexity, allowing to collect data about capabilities and main factors that affect people's livelihoods and highlights relationships between these factors (DFID 1999). The SL framework is built around five components, (1) the Livelihood Assets (incl. financial, social, human, physical and natural assets), (2) the Vulnerability Context (incl. seasonality, trends and shocks) and (3) the Transforming Structures and Processes (incl. economic, policies, institution), (4) the Livelihood Strategies, (5) and the Livelihood Outcomes (incl. income, well-being, resilience, food security, natural resource management). In this study, the SL framework is used to operationalize the research questions and to develop data collection tools while the pathways are described to present and discuss the results.

To do this, a new framework has been developed that combines the SL framework with the concept of farm-level pathways to food security. The figure below illustrates these main pathways as recognized in the literature integrating elements of the SL framework. The left side of the figure shows the farming system, which is based on household livelihoods, assets, and strategies. The right side shows the Livelihood Outcome of interest in this study which is nutrition. The arrows going from the left to the right side highlight the multiple pathways. These arrows do not indicate direct causality but imply linkages with a certain level of influence. Furthermore, the figure illustrates where along the pathways different contextual elements may have an impact. Contextual elements are represented as being part of the Vulnerability Context or the Transforming Structures and Processes in which farm-level pathways to food security are embedded. Although, this study focuses on food security at household level, the figure also includes essential elements from the individual level such as health status and nutrient intake, which are central for an improved nutritional status.

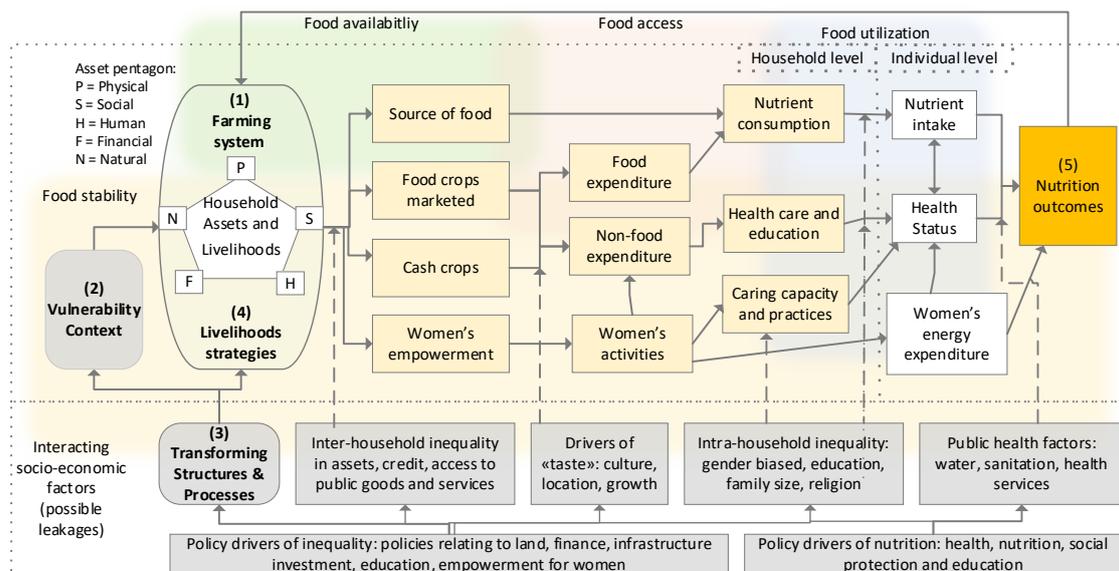


Figure 1 : Conceptual framework of farm-level pathways to food security. Adapted from Kadiyala et al. Adding key elements of the Sustainable Livelihoods Framework

## 4.2 Data collection and participants

Data was obtained from 14 individual semi-structured interviews (II), four focus group discussions (FGDs), four key informant interviews (KII), eight questionnaires to measure dietary diversity (WDDS) and ten structured interviews (SI) (Table 1).

The selection of the participants was based on a convenience sampling approach designed with a special attention to maximize demographic diversity, involving farmers from both gender and ethnic groups. Key informants from the health sector and rural development sector were chosen to better understand health issues and farming systems in the region. The head of a cocoa cooperative was also interviewed since cocoa is central for household's wealth. Furthermore, the selection of participants and the interviews' focus were adapted in a staged way, meaning that after a first round of analysis, key insights could be discussed with participants.

IIs, KIIs, FGDs were conducted between February and March 2020. The WDDS and the SIs were conducted between May and June. Data was collected in the region Agneby-Tiassa in south-central Côte d'Ivoire, in four villages Taabo, Zougoussi, Bringakro, and Kotiéssou.

Table 1: Overview on qualitative research methods used and the participants for the present research

Qualitative method	Interviewees	Sex	Location	Ethnic group	Number
Individual interviews	Farmers (II)	Male	Zougoussi	Baoulé	4
		Male	Bringakro	Baoulé	1
		Male	Kotiéssou	Baoulé	1
		Male	Kotiéssou	Dioula	1
		Female	Kotiéssou	Dioula	1
		Female	Kotiéssou	Baoulé	3
		Female	Zougoussi	Baoulé	2
		Female	Bringakro	Baoulé	1
<b>Total II</b>					<b>14</b>
Key informant interviews (KII)	Head of hospital and nurse (KIIH) Rural development agent (KIIA) Head of cocoa cooperative (KIIC)	Male	Taabo	Dioula	2
		Male	Taabo	Baoulé	1
		Male	Taabo	Baoulé	1
<b>Total KII</b>					<b>4</b>
Focus Group discussion (FGD)	Farmers (FGDW)	Female	Zougoussi	Baoulé	1
		Female	Kotiéssou	Baoulé	1
	Farmers (FGDM)	Men	Zougoussi	Baoulé	1
		Men	Kotiéssou	Baoulé	1
<b>Total FGD</b>					<b>4</b>
Women Dietary Diversity score (WDDS)	Women in reproductive age	Female	Kotiéssou	Baoulé	5
		Female	Kotiéssou	Dioula	3
<b>Total WDDS</b>					<b>8</b>
Structured interviews (SI)	Farmers (SI)	Male	Zougoussi	Baoulé	3
		Female	Kotiéssou	Baoulé	3
		Male	Kotiéssou	Dioula	3
		Female	Kotiéssou	Dioula	1
<b>Total SI</b>					<b>10</b>

Semi-structure interviews with individual farmers were conducted at farmers' home or in their fields and lasted between 20 to 80 minutes. Participants' age ranged between 25 and 50. Interviews were facilitated and translated when needed by locals. Interviews with women were especially difficult due to a low level of French and constant interruptions from villagers and family members. It was particularly difficult to reach Dioula households, due to language issues and their poorer social network.

The KIIs were conducted by a Swiss agronomist without translation needed. They lasted 30 to 50 minutes. Participants' age ranged between 30 and 60.

The FGDs took place respectively in Zougoussi and Kotiéssou. Participants in the FGDs were respectively women and men farmers (mostly Baoulés). The FGDs lasted from 40 to 90 minutes. The FGDs were facilitated by two researchers (sociologist and agronomist) and two translators (Dioula and Baoulé). Participants' age ranged between 25 and 50. It was particularly difficult to involve Dioula's in the focus group discussions.

The structure of the discussion for IIs, KIIs, FGDs were based on the operationalization scheme derived from the SL framework (annex 10). The questions were not clearly predefined, key topics were used as conversation guide. Furthermore, participatory rural appraisal tools were used such as the seasonal calendar (annex 8) and the daily activity clock (annex 5). Directive and non-directive probing was used in order to get more specific, personal or clearer information.

For the dietary diversity score, women in their reproductive age were selected. The individual dietary diversity questionnaire and the indicator used is called Women's Dietary Diversity Score (WDDS). These questionnaires were applied by a young Ivorian agronomist. The questionnaire follows the FAO guideline on WDDS for data collection and analysis (FAO 2010) (annex 4). Finally, ten structured interviews (SI) with farmers were conducted, farmer ranked the pathways previously identified through the IIs, KIIs, and FGDs as well as the perceived threats (annex 7).

### **4.3 Data analysis**

Most interviews conducted by the Swiss agronomist were audio-recorded, except for few cases due to technical issues notes were taken. The audio recorded material was transcribed following sociological rules, which aims to transcribe exactly what is said, without modifying or correcting the language.

Data was coded using MAXQDA. The analysis of the transcripts was based on content analysis using a direct approach (Hsieh and Shannon 2005). The coding system was based on the predefined categories of the SL framework as described above. Specific relevant sub-categories were created under the broad themes taken from the SL framework. In a second step pathways were deduced from the sub-categories.

First, transcripts were carefully reviewed to organize the text into the five main components of the SL framework. Then, relevant sub-categories were coded. Finally, the coded text was used to deduce the important farm-level pathways and related threats. Evidence is further described using selected verbatim quotation from participants.

Finally, all the data collected, IIs, FGDs, KIIs, SIs, WDDS, were triangulated and assessed using qualitative research methods. In the results, the source of the information is kept visible when possible by using the methods short form, and adding a letter, M or m for men and W or w for women. Capital letter correspond to the Baoulé and in small letter Dioula.

### **4.4 Ethical consideration**

The study participants were given detailed information about the purpose of the study, the background of the data collectors and the scope of their involvement. Informed consent was obtained before the start of each interviews or FGDs. It was explained that participation was on a voluntary basis without compensation, individual could withdraw from the study at any time, statement would be anonymized, to prevent possible attribution to individuals. All participants were adults that signed or fingerprinted the consent form.

## 5 Results

First, the analysed farming systems and Livelihoods assets will be presented. Second, this paper will outline the vulnerability context in which household are embedded. Then the transforming structures and processes will be presented as well as the livelihoods strategies. Finally, results will be synthesized to highlight the key farm-level pathways to food security that represent intervention and policy leverage to improve food security at household level.

### 5.1 Farming system and livelihoods assets

#### 5.1.1 Farming systems and natural capital

The villages in this study are located in the “V-Baoulé”, which is a specific vegetation zone. The climatic setting is between humid forest as natural vegetative zone and Guinea savannah. The heterogeneity of environmental conditions has a strong impact on the local agricultural practices. Both forest and savanna climatic conditions are coexisting in the different villages studied. Farmer’s lifestyle is strongly structured by the rainfall pattern.

In V-Baoulé two main ethnic group coexist, the Dioula and the Baoulé. The Dioula are immigrant farmers englobing different ethnic groups from the north of Côte d’Ivoire and neighbouring countries. The native farmers are part of the Akan meta-ethnicity, locally they are called Baoulé. All interviewed households consider agriculture as the main source of food and income (II,SI). This is also true for Dioula’s although they are rarely field owners.

The Baoulé's major food crops are plantain, yam and cassava. The Dioula on the other hand mainly cultivate rice, beans and maize. In addition, women from both ethnic groups use residual space within and between major crops to cultivate vegetables such as tomatoes, eggplants, okras and chilies (II, FGD). Fruits and wild palm trees are also present in the fields (II, FGD).

Every year in March a new piece of land is cleared (by men) to establish food crops. After the first rain, farmers (men and women) prepare the fields and establish the main staple crops. Women intercrop vegetables within and between fields which is important for the sauces that accompany staple crops. Women are responsible for the first weeding, while men are occupied with harvesting cocoa. Men are responsible for the second weeding between June and August, which corresponds with the harvest time of women’s crops and cereals (maize and rice). Finally, between October and December it is the main cocoa and yam harvest. Both harvests are work intensive. The seasonal calendar developed participatively with farmers can be seen in annex 9.

The farming systems are rather extensive, with no use of fertilizers. However, fertilizers and pesticides are used mostly in the cocoa fields. Slash and burn methods are used before field establishment. The fallow period has considerably reduced and is now between 3-5 years while in the past this was up to 30 years (KIIA). Soil fertility and productivity are therefore decreasing (KIIA). Pests and diseases are not identified or problematic in subsistence crops according to farmers.

Only few households raise livestock, mostly chicken, goats and sheep (II). Wealthier households sometimes own cattle (in this study none of the farmer had cattle). Furthermore, hunting remains a relatively important activity and source of food.

Dioulas and rich businessmen use irrigation methods during the dry season. Dioula families try to rent fields along water courses and/or dig small wells to cultivate off season vegetables. Furthermore, some private investors from Abidjan have developed large irrigation schemes for various cultures. Local farmers are not familiar with irrigation.

*“We don't have the means to do like the big guys who irrigate their fields to be able to water every time. We don't have the means. We have to look up in the sky each time to see if it's going to rain or not. We only look at the sky.” (IIM, 2020)*

In summary, farming system and crops cultivated depend strongly on farmer's cultural background. Although Dioula have a more difficult access to land, both ethnic groups see themselves as being largely self-sufficient.

### 5.1.2 Social capital

A households' social capital considers aspects such as beliefs, gender relation and social network.

Traditional beliefs remain very strong, bad spells are believed to be the cause of many deaths in the region. In general people have more trust in the local shamans to seek protection and healing than in the government and hospitals (KIIH, II).

The gender division of labour, decision making and control over income and land is relatively well defined. Control over income depends mostly on the type of crop and partially also on land ownership. The income generated by cocoa is managed by men. Women on the other hand control the money they generate through marketing the crops they traditionally cultivate (staple crops and vegetables). Regardless of land ownership, women are always in charge of selling food crop surpluses and managing the income generated thereof. Women are also allowed to intercrop secondary crops wherever, again regardless the actual land ownership. Apart from the just mentioned exceptions, the decision-making power depends on ownership. If a woman inherits a field from her family, she owns the decision-making power and can decide what to cultivate. Furthermore, if she managed to grow cocoa, she will also be able to join a cooperative and manage the income. More detailed information on the production system and gender perspectives can be found in annex 1.

In general income and benefits are not shared between men and women. *"My husband makes millions with the cocoa. But this money is not for me. He says that he doesn't have enough to pay the house and the school..."* (IIW, 2020). Despite a weak mutual support, women win in autonomy and respect when they start their own family (IIW). Polygamy is a norm in the region. Large households composed of several wives seemed to be wealthier. This pattern was only observed within the Baoulé's households.

The importance of social networks was observed through the membership in cocoa cooperatives. Which is important not only for technical and marketing support but also as a social safety net, as cooperatives may give credits to farmers in need. The extent of this support however seems to depend on the quality of the relationship between farmer and the cooperative's executives' members. Mistrust in the cooperatives is an important issue as farmers fear that they might never get paid. Nevertheless, most farmers are still part of a cooperative as it remains safer than dealing directly with intermediaries.

Women cooperatives for food crops also exist. However, none of the women interviewed were part of any women organization. The interviews showed that women generally have a very low bargaining power (KIIA). Also, the women interviewed prefer to work individually.

*"In other villages women are organized in small groups and have bought a motorized grinding machine. Here we are producing individually. As individual we cannot afford a grinding machine. Here we have discord between the women, I would not have the courage to talk to the other women to buy together a mechanized grinding machine. Each one does its own thing individually here".* (IIM, 2020).

### 5.1.3 Human capital

Concerning the human capital, health aspects were discussed with farmers and key informants from the health sectors (KIIH). Skills and education were deduced from farmer's activities and ability to speak French or sign the informed consent.

The most important health issues, according to the KIIH, are malaria and anaemia. While malaria is less directly related to people's diets, anaemia on the other hand is (KIIH). According to KIIH, Anaemia can be prevented by eating certain leafy vegetables (KIIH). *"What we eat is what gives us health, when you don't eat well you get sick. When you eat well you avoid many illnesses (KIIH, 2020)".* However, on the other hand, the interviewees also said that *"at the same time the products*

*we eat are also a source of disease. Because there is no hygiene.*" (KIIH). Other important health issues are typhoid fever, schistosomiasis and diarrhoeas which are related to drinking water, hygiene and sanitation issues (KIIH). Many health issues in the region are linked to hygiene. *"The lack of hygiene is killing us in Côte d'Ivoire"* (KIIH, 2020). The nurses have mentioned the fact that children in Dioula's families are more prone to diarrhoea and zoonoses. The reason mentioned is that they live closely with animals, rely much more on animal-based food and lack hygiene practices.

Farmers have mentioned the cold and dusty wind coming from the north (Harmattan) as the main factor of illness. Bringing meningitis, headache and malaria. This is during January and February (KJ, FG, Ph, ALB). The data shows that during this period a lot of children get sick (FGMZ). Concerning childcare, women have mentioned some traditional cures such as purges with traditional roots and chilies. Despite these rituals, they say that babies can get sick any time. *"You never know when or why they will get fever and diarrhoeas"* (IIM, 2020).

The health status can also be jeopardized when money is lacking (IIW). In these cases, farmers don't go to the hospital when injured or sick. This has in turn an important impact on the field's activities. *"Health problems prevent the successful completion of the field's activities"* (IIW, 2020). After the drought, farmers consider bad health as second major threat to their field productivity.

Regarding labour capacity, large families can better cope with high labour periods. When a household cannot absorb the workload, it compromises the fields' productivity. Only few wealthier households can cope with shortages by hiring temporary workers.

Illiteracy was proven to be very high especially among interviewed women; only few could speak French. Households' skills are developed within their respective households, based on the family's cultural background. Women active in processing cassava have learned it from their mothers and sisters. Dioula women have special skills for cultivating rice and vegetable along the water courses.

#### **5.1.4 Financial capital**

The principal source of income for men is cocoa. Men often say: one part goes for the education (school fees, uniform, books, etc.) one part is for health expenses and one part they keep for leisure time. They also often mentioned ceremonies and festivities as living costs. Finally, when they have enough money after paying important expenses, men invest in their houses, which is also important for the general household wellbeing.

Farmers always mention robbery as an important threat to their income. This is closely linked to the general mistrust amongst farmers. Farmers explained that they sometimes get robbed directly after receiving their salary in cash, when they take a nap in their field or walk around with money in their pockets. This is however, often related with an excessive use of alcohol (KIIC, IIM).

For Baoulé women, the major income stems from the cultivation of plantain which secures a relatively high income from September to March. Cassava fields can also be an important source of income. Cassava can be sold as a standing crop. When processed in attiéké (local couscous), cassava also generates an important weekly income. The process is labour intensive and asks for mechanized infrastructures. The production costs are too high according to women (IIM). The final product is sold to other women intermediaries which further sell it on bigger markets (FGW). *"With the cassava field, I make Attiéké. With this I make the children go to school. It's my regular job. What I do in my life is only cassava and then Attiéké"* (IIW, 2020). Hence, the money generated through this activity is mostly to support child education (IIW, FGW). The income women generate by selling surplus on the weakly market is rather low and is directly used to buy additional food, mostly fish to put into the sauces.

#### **5.1.5 Physical capital**

Housings are very simple. Families rely on a basic cookstoves using wood for cooking. Improved cookstove were not observed in the region. During the dry season women cook outside, the cookstoves should however be protected from the rain during the rainy season. Many households still have their cookstoves inside the houses, which then again causes health issues. *"When you cook inside you get a lot of smoke in your face and it can burn your eyes"* (IIW). All construction work, including the kitchen infrastructure is under men's responsibility. Women have mentioned

the fact that if the man is not investing in these minimum infrastructures, lives is more complicated for them.

Access to drinking water and electricity remains scarce for most households. Each village is equipped with several water pumps and sometimes a water tower. Nevertheless, women wake up early every morning to fetch water. There are no wastewater evacuation channels in the villages and no latrines.

As to the agricultural production, most work is done with the machete and traditional pickaxe. Some farmers own additional equipment for the production of cocoa. Sometimes cooperatives lend productive assets, such as sprayers and plant protection products or credits. For transportation most women walk with buckets on their heads. Men on the other hand usually own a bike which is used for transportation. Only few families have a motorcycle.

## 5.2 Vulnerability context

### 5.2.1 Seasonality

Seasonality influences the Baoulé and the Dioula differently, since they rely on different farming systems, which again is predominantly due to their cultural preferences. Their perception of the lean period depends on their dietary habits and income.

For Baoulé, the lean period stretches between June and August, when the stock of yam and plantain is low. Baoulé often say that the most difficult time is when they don't eat plantain. *"When there's no foutou banana, I did not eat well"* (FGW, 2020). This period corresponds as well with the low-income period for men and women, which also means also less fish in their sauces. However, it is important to highlight that cereals (maize and rice), pulses, cassava and vegetables are all harvested during this very same period. This period is also when crops cultivated on farm are the most diverse. During the dry period most vegetables intercropped in the yam fields die. As a consequence, women rely on dried vegetables and on the local market to buy additional food. For Baoulé, however, this period is not seen as problematic since they have plenty of yam, plantain and money.

*"The difficult time starts in April-May when the plantain stops producing, we have no more income, we only suffer. In July-August it is even worse. In September it starts again and in November we have joy, money, plantain and health"* (IIW, 2020).

Between June and August is when the Dioula harvest their preferred crops, rice, maize and beans. Their lean period can however not be discussed in depth, due to the little number of interviews.

### 5.2.2 Trends influencing farming systems and food security

#### **Food shortages**

Food shortages have decreased mostly due to the increased availability of food on the local markets (IIW). This seems to be due to more dynamic regional exchange including with Abidjan (KIIA). *"The market used to be only local. Now there are more women coming from Abidjan to buy banana. However, the vegetable market stays very local"* (KIIA, 2020). On the other hand, food production at household level is decreasing due to soil depletion, changing rainfall pattern, drought, land scarcity and conflicts related to livestock.

#### **Natural resources scarcity**

Important natural resources such as land and forest are getting scarce due to demographic growth and unsustainable natural resource management practices.

The demographic growth puts pressure on the land which is easily accessible and fertile. Some farmers have stressed the fact that their families are growing and that they are not sure whether they will have enough land in the future to feed everyone. *"The field I have is not enough to feed my family, but we have what is here and that's it. It is small considering that my children continue to have children's"* (IIW, 2020).

In the analysed region primary forest has completely disappeared. Some secondary forests can be found but they are rapidly replaced by cocoa or fallow land (KIIA). Small-scale farmers are not the

only ones responsible for this trend, as large forest loggers and tree crop estates have cut huge areas of primary forests. Many farmers said that since the forest is gone the rain is gone as well and the sun became too hot. Farmers also complain that they cannot find any shadow when they go to the fields (IIW). In the past farmers could find many wild animals in the forest, they could hunt buffalo's, deer's and elephants, nowadays since forests disappeared, they only find small animals. Furthermore, the disappearance of the forests also impacts their effort to find wood for cooking, since they have to walk long distances to collect wood. *"Collecting wood is always harder because the forest decreased a lot, then it is difficult to transport it back home"* (IIW, 2020).

### **Climate change**

From the people's perspective the main issue impacting the productivity of their fields is the changing rainfall pattern. From farmers' perspective the rainfall pattern has changed in the last decades, the dry period is getting longer and the temperatures higher. (KIIA, IIWw, IIMm, FGW). The rainfall is often too intensive or too scarce (IIM). Climate change is affecting the farmer's livelihoods and is an important source of insecurity (KIIA, KIIC, IIMm, IIWw, FGW, FGM).

*"Farmers rely on their traditional cultural calendar for preparing their fields. With climate change it becomes difficult for them to plan agricultural work. It is recommended that they adapt their cultural calendar to the changes. However, they have no access to weather information and forecasts"* (KIIA,2020).

The changing rainfall pattern affects the productivity of food crops as well as cash crops. The intensity of the dry period affects the length of the vegetative period, which is an issue for the productivity of all food crops. It is also problematic for the repartition of the workload, when the rain comes late, it concentrates the work that has to be done in a shorter period (KIIA, IIW, IIM, FGM). To cope with that asks for large families or enough money to punctually pay workers (IIW). Changing rainfall pattern also impacts cocoa production. Many young cocoa trees die during the dry season reducing the main household's income (FGM, FGW, IIW, IIM). *"A long time ago. In my parents' time it rained regularly. But now it's not like that. During the drought there, the cocoa dies. So, every year you renew, every year you put again"* (IIW, 2020) Furthermore, when the rainfall is too strong or too rare it affects the flowering of the cash crops, mainly cocoa (IIM). Drought has a huge impact on field productivity and thus livelihood security. This was confirmed in the last evaluation, where all the farmer (men, women, Baoulé, Dioula) have mentioned it as the most important treat for their fields.

### **5.2.3 Shocks**

From farmers' perspective the consecutive political crises have had little impact on their livelihoods. Farmer did not see these events as threatening. Small-scale farmers are also relatively confident that the covid-19 pandemic will not affect too much their livelihoods.

## **5.3 Transforming structures and processes**

### **5.3.1 Economic structure**

The villages in which the present study where carried out are located relatively close to small cities with bigger markets. Furthermore, they are close to the highway connecting Abidjan and Yamoussoukro. This is an important asset for all the households in the region, as it facilitates marketing with Abidjan and the villages can be reached by car and buses. This allows a more dynamic exchange with intermediaries and the market women from Abidjan. However, transport is limited for individual farmer's as the costs are high.

The markets in the larger villages offer a high diversity of food products, however the price can be high due to high transportation costs (KIIH, IIm, FGDW). The food crops are marketed on the local markets, or at farm gates to intermediaries. Women's marketing strategies depends on several factors such as the type of crop, the distance to the field and quality of the roads, the vehicles owned, if any etc.). To bring the harvest to the next bigger village, it implies transportation costs or long walks with heavy loads on their heads. Concerning plantain, women mentioned the Abidjan women as important intermediaries. Furthermore, some women's cooperatives were mentioned that collect small amount of different vegetables to be sold in Abidjan. Women sell their crops at very low prices. As mentioned above, women are usually not organized, and their bargaining power is very low.

For cocoa a guaranteed minimum farm-gate price is established yearly by the government. According to the farmers, cocoa is the only cash crop with a reasonable price. The price of coffee, cashew nuts, rubber trees and palm trees that are also cultivated in the region have decreased too much lately. Small-scale farmers focus thus mostly on cocoa since the price is stable and rather high (IIM). However, farmers are not satisfied as they find the price of cocoa too low to cover the hard and intensive work that it implies. They feel powerless, prone to injustice and a lack of consideration from the state (FGM, IIM).

There are several off-farm casual labour possibilities for young men and Dioula. They can work in the industrial plantations (coco, palm, rubber, etc.) (IIW). Thus, finding labour force became harder for Baoulé since the establishment of the large tree crop estates. *"It became harder to find people for the intensive labour period (March-June) since the landless farmer work for the commercial tree crop estates"* (IIW, 2020). Indeed, several Dioulas have mentioned their activity in the large plantations. Women have less possibilities to start businesses as they have lower incomes (IIm). *"If you have a piece of land it is less risky to cultivate cassava than to start a business"* (Heb, 2020). Here it is important to mention farmer's high resistance to talk about off farm activities. Although farmers were observed engaging in charcoal production, nobody has mentioned it as a source of income. Similarly, several activities were observed but never mentioned by the farmers.

### 5.3.2 Socio-political structure

When there is a conflict whitening the villagers, this is sometime discussed at the village level together with the village chief. If it can't be managed at the village level it goes at the sub-prefecture's level. Most conflicts mentioned are concerning land rights, conflict with livestock damages in the fields and thefts of all kinds (IIM, IIW). Mistrust is high at various level, within and between families, within the village, the communities, the cooperatives and the government. This limits various activities.

In the region land ownership is based on an indigenous system which often is a source of conflict **between** and **within** families (IIM, 2020). The current customary land right system makes the access particularly complicated for women, youth and immigrant farmers. All male interviewees are "owners" of their land, except for the allochthones, who rent or have other forms of arrangements such as farm labour work and sharecropping contracts.

The inheritance of land **within** family members is particularly problematic for women, as the land is first divided between the male members of the family (KIIA). When women claim a piece of their brother's land this can lead to conflicts. *"My sisters sent me in prison to get part of my land, I had to pay 25'000 FCFA to get out. Now, that they have kids they need more land, but how should I do with my own kids if I give them my land"* (IIM, 2020). However, if women in certain situations are becoming the owner of a piece of land, they also gain decision making power and control over income. This highlights the fact that it is mostly difficult land access that prevent women from engaging in cocoa production.

Land ownership is further complicated due to lack of legal papers clarifying land delimitation and thus bad enforcement of clear rules by the village chief. This leads to conflicts **between** families: *"we don't have documents that attest our ownership, if someone else claims your land you may lose it. We are scared to lose our land as it is our livelihoods"* (IIM). Once a field is cultivated by another farmer, it becomes very hard to get it back. To protect their fields from intrusions, farmers have two strategies. One is to show a lot of presence in their field (IIM, IIW, 2020). The second is to clean the fallow land and cultivate it before someone else does *"I clean and plant banana rapidly, rapidly, this way the neighbour cannot enter my field"* (IIW, 2020). Also, when farmers own forest land, they must be extremely vigilant that noone establishes his field in it (IIM).

Finally, exchanging land for money goes against traditional rules. Usually farmers consider land as sacred and thus mention that exchanging land for money is prohibited. However, during the last decades, private investors have bought huge superficies of land in exchange of money and gin (IIW, KIIA).

Livestock is also an issue at various levels. It was decided at the governmental level that the cattle should not enter the cultivated fields. Herders are asked to keep their animals in pens. Thus, when farmers see animals in their field, they can press charges to the village chief. However, in the village of Kotiéssou, for example, the village chief himself owns cattle and has therefore no interest in solving the conflicts. Farmers, both men and women, feel powerless in this situation. The cattle can destroy an entire field in a few hours and disappear. This is a serious issue for farmers as their source of livelihoods might be destroyed overnight. Cattle owners are the wealthier people, they hire herders from the north (Fulani) to take care of their animals. It is, therefore, difficult to know to whom the cattle belong and to follow up on the complaints. Furthermore, owners tend to blame the herders for their mismanagement.

*“Well, there are people in the village who may have cattle but given the abusive destruction of the crops they lay law. It is not clear whether it is the owners’ responsibility or the herders. Finally, in the village you don’t know who your enemy is. If you decide to invest somewhere you don’t want enemies getting in your way, you prefer to keep quiet about livestock issues.” (IIM, 2020).*

The topic is sensitive for the farmers as they may get into trouble if they complain too much. However, if they catch the animal and find the owner, they can ask for damage compensation.

*“The natives have oxen that the Fulani watch over, when they do damage to your field and you complain to the chieftaincy it doesn’t lead to any solution.” (IIM, 2020)*

In addition, many families stopped rearing animals (chicken, goats, sheep) due to too frequent theft (IIM, IIW). Robbers as well as the poorer people in the villages are often described as; *“lazy people who don’t feel like going to the fields, they rather stay in the villages instead of working.” (IIW, 2020).*

### **5.3.3 Access to rural services**

The basic rural services to produce cocoa are covered by governmental organizations, the private sector (technical support, financial), cocoa cooperatives (technical, marketing and financial) and NGOs (sustainable cocoa production and certifications). While a diversity of services providers exists and support small-scale farmers growing cocoa, the subsistence crops are completely neglected.

From a farmers’ perspective, the research undertaken by the ministry of agriculture is not adapted to their farming systems and economic reality. The cocoa varieties newly developed are very productive only under specific conditions (irrigation and fertilizer), farmers however prefer more resistant varieties (KIIC).

Rural development agents from the public and private sector provide support mostly for P&D diagnostic and advises concerning possible treatments (IIM). The private sector sometime also gives credits to the farmers (IIM).

Cooperatives are important service providers. In addition to the technical and financial support, cooperative also play the role of intermediaries. Cocoa generates a lot of money for farmers and cooperatives. There are mutual interests between the two actors. Farmers try to find cooperatives that are reliable and supportive. While cooperatives try to keep their members happy, they also try to collect as much cocoa as possible *“It is important to be nice with the producers so that they don’t sell their product to someone else at the end” (KIIC, 2020).* Some cooperatives and NGOs are active in the development of sustainable production practices and certification of the cocoa beans (KIIC)

Except for the support in the production of cocoa, small-scale farmers and especially women receive little help and attention. There are no services provided by any organizations targeting food crops, which are under women’s responsibilities. The rural development agent interviewed has very well summarized important constraints faced by rural women;

*“Women face many issues. First access to land, because the land is divided between the male members of the family. Second, women in their activity, they have no technical assistance. They have rudimental cultivation practices; they have no access to improved seeds. Thus, they constantly face difficulties in their activities. Third, women also face issues marketing their products on the market. They rely on the local markets and because they are not organized, they sell at very low prices” (KIIA, 2020).*

These constraints seem very relevant and can be read between the lines when talking with farmers. However, women have never directly talked about any of these barriers.

#### **5.3.4 Access to health care**

For the villages studied, the health services are relatively close, thus accessible. However, partly due to high service costs farmers rely more on traditional healers (KIIH, farmers). General knowledge about health, hygiene and care behaviour is very low.

In cases of health issues, farmers tend to wait very long before they go to the hospital, partly because they are afraid of the high costs it will entail (KIIH, IIMm, IIWw).

*“when people have health problems, they first go to the traditional healer and only if it becomes very bad, they go to the hospital. Sometimes it's already too late. Traditional healers prescribe herbs and sometimes drastic diets. When people arrive at the hospital they are slimmed down. Their health issue might even be worse than when it started” (KIIH, 2020).*

Furthermore, KIIH deplore the fact that malnourished children are not brought to the hospital. They consider peoples' care behaviour not being adapted.

*“In case of diarrhoea they come when it is already very serious, this is only when the child stops playing. People usually don't go to the hospital for malnutrition. Here if the child is walking or playing there are no problems. Here we are only concerned when the child can't stand up anymore” (KIIH, 2020).*

Although the prevalence of malaria is very high in the region and insecticide-treated bed nets are distributed for free, they are not used correctly. The nets are often used for other purposes, for example in the vegetable garden as pests' protection nets (KIIH, observations). Furthermore, people have strong believes that sickness, including malaria, is linked with the sun.

*“People think that malaria and fever come with the sun, since their body is hot like the sun, they link it with the sun. But no, it's by mosquitoes. If you have the wastewater next to the houses, the open gutters, then that's where the mosquitoes develop” (KIIH, 2020)*

In general, access to information about health and nutrition is lacking. This is especially true for young women (KIIH). Nutrition information are sporadically disseminated in health centres and hospitals. In some villages NGOs are also active for sensitizing about, hygiene and nutrition (KIIH, FGM). In the hospital they recommend increasing their diet diversity. KIIH say that people tend to eat yam at every meal which does not favour a rich nutrient intake. According to the KIIH, enough variety of food is available in the region to have a healthy diet. They consider that the issue of malnutrition is due to the lack of money, awareness about good nutritional practices and hygiene (KIIH). KIIH also deplore that they have very little budget to implement any useful program.

*“There is one thing that must be highlighted. Women and especially young women they have not enough access to information. Since, health and nutrition depend a lot on the women this is a big issue. We would have ideas on how to provide help, but we don't have the money nor the infrastructure” (KIIH, 2020)*

Vaccination campaigns usually come with a nutrition service. At this occasion parents receive guidance and recommendations concerning hygiene, health and nutrition. When stunting is obvious parent receive more detailed information, however there is no follow-up in the villages (KIIH). Farmers also mentioned the fact that they receive nutrition advises when they go to the hospital (FGMZ).

The illiteracy rate, which is especially high among women, and the diversity of dialects is seen by the hospital as the first barrier to the sensitization of people about health, sanitation, hygiene and nutrition. From their point of view, the first step to food and nutrition security is to fight against illiteracy and poverty.

*“How can I give advises if we don’t even speak the same language? If they could read or write, everything would be easier for us. This is the first Barrier; people must be able to read and write. (...) First, we have to fight against illiteracy, and then poverty” (KIIH, 2020)*

**5.4 Livelihoods strategies**

Every farmer interviewed, mentioned the main objective being to increase their income. This is achieved by covering as much land as possible with cocoa (IIM, IIW). Only when the soil is not good enough, then it is used for other crops or left as fallow land. This is justified by the fact that they lack money to cover basic needs, such as education and health.

Baoulé, tend to have enough productive assets (land and money) to cover their food needs all year round. Food security and nutrition is thus not their main preoccupation as it seems to be secured. The subsistence crops are considered as intermediate and logical steps until cocoa establishment. The proportion of food crop marketed depends on the household’s assets (size of land owned and family) and the stage of their cocoa fields. They are usually self-sufficient with staple crops and rely on the market for fresh vegetables during the dry period and fish all year round.

For Dioula’s the difficult access to land reduces their livelihood security. Men engage in agricultural wage work for local farmers or for private companies. They also depend on cocoa as main source of income. They seem to be more self-sufficient than the Baoulé by trying to optimize their food stock throughout the year. To cultivate their main staple crop and rice, they rent land in the bas-fond, which stay uncultivated by the Baoulé. Dioula women rely more on animal production but less on banana and cassava compared to the Baoulé women. Women engage in dry season gardening when they are able to rent a piece of land.

**5.5 Farm-level pathways to food security**

This chapter highlights how the key contextual elements and assets are linked with food security at household level. Four pathways and corresponding contextual elements are presented: (1) Source of food, (2) Food crops marketed, (3) Cash crops and (4) Women’s empowerment. Theses pathways and key results are drawn in figure 2.

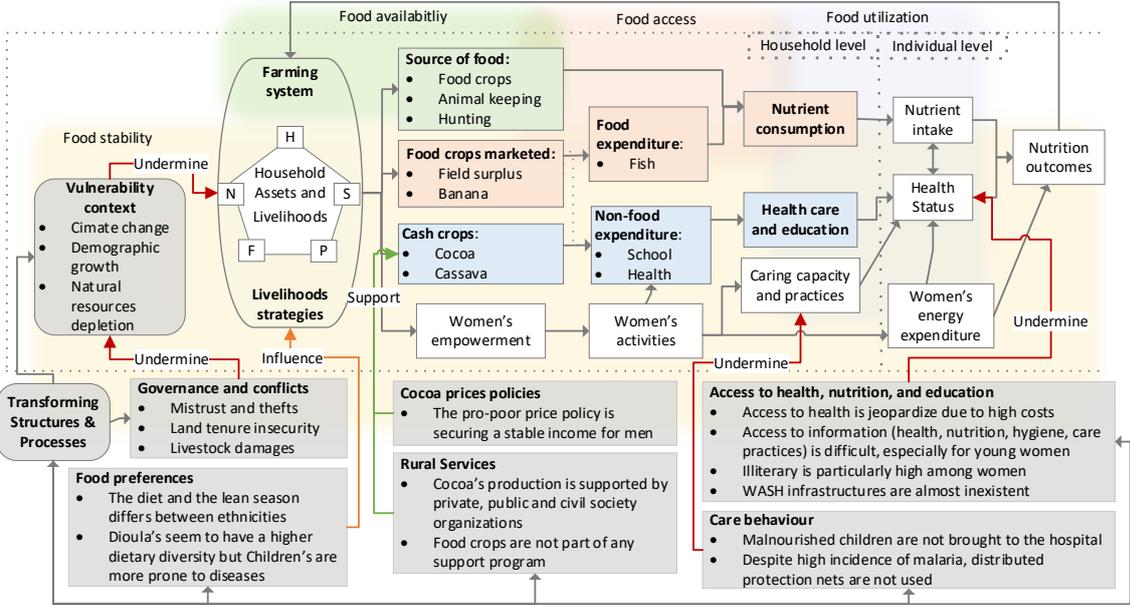


Figure 2: Populated framework of farm-level pathways to food security

### 5.5.1 Source of food

Both ethnic groups see the household's production as the most important source of food. Women have high responsibilities when it comes to food crops. In addition to the main staple crops managed in collaboration with men, women intercrop vegetables in the fields, which are essential for the sauces that complements meals. *"The food coming from the field is very important, because it reduces the expenses for the purchase of food."* (SIW, 2020)

For the Dioula, animal husbandry is the second most important source of food. It allows them to reduce the amount of food purchased on the market. Both Dioula and Baoulé complain about the regular animal thefts, which reduces their animal-based food consumption. Households consume more regularly purchased fish than purchased meat. *"Everything comes from the field except the fish and other things the women buy for the sauce"* (SIM, 2020).

Hunting is very common in the region and is seen as a relatively important source of food, which allow to reduce expenses on fish. As mentioned in the trends, the wild animal population is decreasing which consequently reduces the availability of this food source. *"The bushmeat allows us to reduce the expenses on the purchase of fish and meat"* (SIM, 2020)

Farmer's cultural background plays a central role. It defines the major staple crop cultivated which influences directly their nutrient consumption. The following dietary diversity pattern can be described from the 10 WDDS undertaken. However, the small number of WDDS undertaken do not allow to draw exact conclusions but it gives a hint about their habits. Both ethnic groups consume daily starchy crop, fish, fruits, vegetables and red palm oil. Both ethnic groups eat sporadically dark green leafy vegetables. Dioula households tend to eat more regularly legumes and milk products which increase their dietary diversity by two food groups compared to Baoulé. Nonetheless, Dioula children are more prone to diarrhoea due to difficulties with milk hygiene and the close cohabitation with animals (KIIH).

Hence, agriculture as source of food is the most direct and straight forward pathway to food consumption. This pathway is represented in the upper part of figure 2. It mostly informs about the *availability* and *stability* dimension of the household's food security. According to the KIIH, enough variety of food is available in the region to have a healthy diet. From the KIIH perspective, the issue is that people are not aware of good nutritional practices and lack money for a healthy diet.

### 5.5.2 Food crops marketed

Women use the little income generated from selling food crop surplus on the weekly market to purchase complementary food, clothing and soap. Women's income thus influences greatly the possibility to buy fish. *"When money is lacking the sauce is without fish"* (IIW, 2020). Field surplus sold on the market are mostly, plantain, vegetables and fruits. Generally, the sale of the surplus yields very low prices. However, during the plantain season, women generate more income, since the surplus can be relatively high. Hence, they say this period is their favourite time of the year.

For Baoulé, the market is the second most important source of food. From July to September until the next yam and plantain harvest, they depend more on the market and less on the field. *"The stock of the field is currently exhausted (July), the only recourse to get food now is the market."* (SIM, 2020). Baoulé's perception of the difficult period coincides with the harvest time of rice, maize, beans and fresh vegetables. This shows the strong importance of cultural preferences and the importance of yam and plantain for their food security. For Dioula women, it is less clear how they generate income in said season.

Since women use their income from selling field surplus to purchase complementary food, food crops marketed are the second most direct pathway to household's nutrient consumption highlighted in figure 2. Field surplus are thus a central element securing access to additional food.

### 5.5.3 Cash crops

Households' principal source of income is cocoa and is managed by men, which secures them a high income during the main cocoa harvest (October to December). The money seems to start lacking

from July and does so until the next cocoa harvest in October. A decreasing price is the biggest threat to the farmers' livelihoods (II, SI)

Cocoa is a less direct pathway to food security as the income is not used for food purchases. However, it is an important part of a households' financial capital and plays a major role in keeping a certain livelihood security. Men usually declare that the money generated is used to support school expenses and health. The resilience of the household seems thus to depend partly on the men's ability to manage well the high income generated from cocoa. One common and terrible mismanagement of this high income happens when farmers celebrate the cash payment and get robbed the very same day.

It was also observed that when women engaged in a more remunerative activities such as processing cassava, they use the money generated to send their children to school (IIW, FGW). Women have never mentioned leisure activities.

The money generated from cash crops - cocoa for men and cassava for women - is used to cover important expenses such as health and education, which are major drivers of the individual health status. The health status in turn is central for nutrient intake, which again is an important aspect of the utilization dimension of food security.

#### **5.5.4 Women empowerment**

Women bear the main burden for producing, procuring and preparing food for the household. They play thus a decisive role in the food consumed at household level. Women are not only a major vector to food availability and access but have also an important role to play in child caring activities and practices which is central for the women and children health status.

In their daily activities, women cumulate 6h of productive and 5h of reproductive work (see daily activity clock in annex 5). Men on the other hand are only involved in productive work (9h). Before going to the field women sweep the kitchen, fetch water, prepare breakfast and clear the dishes from the night before and prepare food for lunch. They walk to the fields with the food and work a few hours before returning to the house to prepare the next meal and take care of the children.

The high costs of health services and drugs, the cultural preferences for traditional healers, the lack of awareness and information about health, nutrition and hygiene implies a negative impact on household health status. This is especially problematic for young women, who have limited income and access to knowledge (KIIH).

Furthermore, the health status affects considerably the household's labour capacity, which is the second most important threat identified by farmers to farming productivity. Farming productivity then impacts their self-sufficiency and their possibility to generate income. This is the most obvious feedback loop identified by farmers. Furthermore, health expenditures were mentioned by both ethnic groups as an expense that tend to reduce money available for food purchase.

## **6 Discussion and Policy Implication**

Based on the pathways defined above, this section contextualizes these key findings and discusses possible policy implications for increasing food security through farm- (or household) level interventions.

### **6.1.1 Source of food: *Policies should promote good nutritional practices and consumption of locally produced nutritious foods***

In the region studied, the heterogeneity of environmental conditions favours a rich diversity of crops, cultivated and growing wild. The seasonal calendar allows to harvest a variety of crops all year round, which is further favoured by a low pests and diseases pressure. This could indicate that malnutrition is therefore not directly related to seasonality. Cultural preferences seem to be one of the major factors determining farmer's farming systems which in turn impact income variation and food stocks differently. These differences have to be considered to address their specific needs.

Any kind of support should be careful not to favour one ethnic group over the other. However, the different livelihoods of the coexisting ethnicities highlight the potential and diversity of the agro-ecological zone (Garrity et al. 2012). The rich diversity contrasts with the relatively low individual dietary diversity (Galli 2018). This gap shows the potential of policies that promote good nutritional practices and consumption of locally produced and available food. FAO has demonstrated that nutrition education tends to increase consumption of own produced nutritious foods (2013). Indeed, it was largely recognized that behaviour change and communication (BCC) targeting nutrition education is central in any intervention that aims at improving households' dietary quality (World bank 2007; Das et al. 2014; Galli 2018).

This research suggest that animal rearing in the region seems to increase dietary diversity, which highlights the potential for policies to support mixed farming systems (WB 2007; Girard et al. 2012; Hoddinott 2012; Das et al. 2014; Carletto et al. 2015). However, the proven risks that animal rearing implies were also mentioned by KIIH. Policies supporting animal husbandry as diversification strategy would therefore need to carefully consider and monitor eventual negative impacts (Ruel et al. 2018). Furthermore, since hunting remains an important source of food for households, laws against poaching might affect negatively households' dietary diversity and quality.

### **6.1.2 Food crops marketed: *More policy support for subsistence farming lead by women could improve food availability and access***

Given the short distances to dynamic marketplaces, households partly rely on the market as source of food. Indeed, household's income is together with preferences an essential determinant of households' dietary diversity. This access to additional food depends on women's income from selling subsistence crop surplus on the market. Although subsistence farming is proven to be a central source of food and income, latter which is predominantly used to buy nutrient rich food, receives no support in the study area. Rural services from multiple providers only focus on cocoa. The need of shifting focus from commercial crops towards subsistence farming is largely recognized in the sub-Saharan African context (Onakuse 2012; Aasoglenang et al. 2013; Nzeagwu and Aleke 2016)

Since, food production, procurement and preparation are largely under women's responsibility it is central to pay special attention to women's activities in order to improve nutrition. Policies that focus on supporting food crops and diversification of women's opportunities have a high potential to improve simultaneously food *availability* and *access*.

### **6.1.3 Cash crops: *Policies for food security should pay special attention to gender roles, intra-household dynamics and mental accounting***

Income generated by cash crops are especially important for non-food expenditure such as, education and health, which is essential for individual health status (UNICEF 1990). This study showed the importance of cocoa as source of income for the households' well-being. Thanks to the price policy and the various service providers (private, public and CSO) cocoa production and marketing is relatively well organized and developed.

However, it also shows that all this support is oriented only towards men's lead activities. Households are thus very dependent on the men's willingness to invest in human capital. A shared management of this high income would probably better benefit households since women are more prone to invest in health and education (Lewis 2014; Ringler and Passarelli 2016; World Bank 2007). This highlights the importance of a gender approach strengthening equity and dialogues between the family members. Gender roles and intra-household dynamics are therefore central factors to consider when looking into farm-level pathways to food security (Malapit; Arimond et al. 2011; Carletto et al. 2015; Malapit et al. 2015; Fan et al. 2019; Shenggen Fan, Sivan Yosef, Rajul Pandya-Lorch 2019)

Women's allocation of resources shows that they use mental account, meaning that expenses depend not only on who generates and controls the income but also from which crop the income is derived. Income from surplus is allocated to food expenditure while other sources of income are strictly allocated to other expenses. This underlines the importance of carefully consider how agricultural income is disaggregated (Malapit and Quisumbing 2015)

#### **6.1.4 Women's empowerment: *Improved access to health and education for women could improve food utilization***

Women's access to health and education is finally the catalyst of any other interventions. It is only with a good health status that nutrient intake translates into improved nutrition (UNICEF 1991). Because of their reproductive responsibility women have a decisive role to play. First, women's health at birth is the first determinant of child weight. Then, women's care capacity and practices, will impact greatly child nutrition outcomes. Since, nutrition is particularly important for children under two, women's health and education are central to break the vicious cycle of malnutrition (Lewis 2014). The difficult access to health care seems to be especially true for Dioula. A recent study on stratification of social indicators by ethnic group showed that the mortality rate of Dioula's under five children is two times higher than the Ivorian average (Victora et al. 2020). Access to health care is central for food security of young women in a reproductive age. Therefore, partnerships with the health sector has a major role to play. The sporadic promotion of nutrition during the vaccine campaign is not enough to promote a locally adapted and healthy diet.

Women's difficult access to productive assets and the huge lack of support in their activities appears to be a major barrier to households' food security and well-being. This study reinforces the existing body of literature on gender related issues and highlights the multiple ways how it undermines households' food security. Although, gender inclusion in agriculture has long been discussed (Poats 1991). The lack of advances towards women's rights, might mirror a deep structural lack of willingness to challenge power relations, empower women and work towards gender equality (Esquivel 2016).

#### **6.1.5 Natural resources management; *Policies should focus on sustainable and climate-smart agriculture and tackle land-use conflicts***

The decreasing productivity together with the adverse effects of climate change shows the urgent need to invest in R&D that focus on climate-smart agriculture especially targeting small-scale farmers practices (Chimwamurombe and Munsanje 2018). Changing rainfall patterns and drought are one of the most important problems identified by farmers for their field productivity. This reiterates the urgent necessity for R&D in West Africa to provide context specific solutions, adapted technologies and skills, to improve food crops productivity without further depleting the environment (ibid.).

Land **reform** appears also as an important prerequisite for sustainable livelihood development and food security. Strong governance is needed to protect women and landless farmers that are disproportionately affected by land shortages (WB 2015; Nyantakyi-Frimpong and Bezner Kerr 2017; Yannick 2020). This also asks for a clear regulation of large-scale land appropriation (land grabbing) that exacerbate pressure on land and inequalities (Nyantakyi-Frimpong and Bezner Kerr 2017; Chimwamurombe and Munsanje 2018). Land is furthermore the root cause conflicts and unrest in Côte d'Ivoire. Good governance practices are needed to increase equitable access for women, youth and migrant farmers to productive resources such as land rights and credits (FAO 2013, World Bank 2015, Yannick 2020).

#### **6.1.6 Political environment: *Policies need to translate into action***

At the policy level, nutrition has been wisely mainstreamed across the strategic reports. Including agricultural recommendation in the "The Plan National Multisectoriel de Nutrition" (MSHP, 2016) and nutrition consideration in the National Plan for Agricultural Development (PND2016-2020). The present study highlights similar food security needs like the objectives as stated in these reports. Policy application and implementation on the ground were however not observed. This research thus advocates for an urgent focus on implementation of the policies defined in the various regional strategic reports. Brochard argues that this is due to a low political weight of these policies and inadequate funding (2017).

The same is observed in the health sector. Although the objectives stated are relevant, comprehensive and inclusive, the implementation was not observed (MSHP, 2016). On the ground access to information remains difficult. Illiteracy rates remain very high, which further hampers the access to relevant information. More investment in human capital and preventive health campaigns

could reduce incidence of infectious diseases which is one of the major direct cause of malnutrition in West Africa (ibid.). The deep lack of awareness observed regarding health issues, and especially malaria, shows the potential and urgent need to invest in preventive measures.

**6.1.7 Conceptual approach: *Livelihoods approaches helps to prioritize policies and determine key milestones that can be measured in order to monitor changes and/or identify leakages along the impact pathways***

This study suggests that SL approaches are complementary to a more systemic approach linking agriculture to household's food security. Since both approaches are multidisciplinary and multilevel, they fit very well together. While the SL approaches allows for a people centred and holistic assessment of farm-level challenges and opportunities, highlighting pathways allows to better apprehend and identify pitfalls along the pathways to food security. Indeed, understanding the impact pathways between agriculture and nutrition outcomes helps to prioritize policies and to determine key milestones that can be measured in order to monitor changes and/or identify leakages if changes are not occurring in the right direction. This research proposes therefore a solution to the general need to better understand which nutrition indicators and which target group, agricultural development in West Africa is more likely to support.

## 7 Conclusion

Agriculture as main source of food and income plays an undisputable role in food availability, access, and stability at household level. Women are central in each identified pathway therefore their responsibilities and constraints must be carefully considered to achieve food security. Local food and health systems must be sensitive and act upon these specific needs, particularly the lacking access to health, nutrition, and education.

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## Annex

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## Annex 1 : Summary table of production system and gender perspectives

The table compiles information gathered about important crops in the region, the marketing or self-sufficiency strategy, gender perspectives and dietary importance for the households. This is based on the FGD, interviews with farmers and field observation.

Crop	Production system	Marketing and/or self-sufficiency	Gender perspective			Dietary importance
			Ownership and decision making	Involvement in field activities	Control over income	
Cocoa	Cocoa seedlings are planted close to the plantain trees to benefit from the shadow and humidity, and eventually resist the dry season. The cocoa trees are productive after 3 years and can then be harvested two times a year. The major harvest takes place between October and February and the small one between April and June.	Farmers are organised in cooperatives. Cocoa represents the main income source for most households (800FCFA/kg).  The cocoa is transported to Abidjan to be shipped to the northern countries.	The cocoa field are almost always owned and managed by men. However, women have mentioned their interest in engaging in cocoa production to make as much money as the men. This is only possible if they inherit land from their parents.	Mostly men were observed in the cocoa fields, cleaning and drying the beans. Women help occasionally.	Men hold control over the income stemming from cocoa.	The production of cocoa is not directly linked to food security as the income is managed by men and rarely used to purchase food. However, as main source of income, cocoa is central for many livelihood outcomes (wealth, well-being, social status, etc.).
Subsistence crops	Small pieces of land are cleared (slash and burn) every year to establish subsistence crops.	The household's needs are covered first, and the surplus is sold on the market	In general, subsistence crops are women's crops. This means that women are responsible for marketing and control the income.			Subsistence crops represent a large part of their diet.
Yam	Yam fields are often cultivated as a first crop after a fallow period. Yam is planted in mounds, between the mounds secondary crops are cultivated (plantains, cocoyam, eggplants, tomatoes, okra, chilli). Early and late yam is cultivated in the region, but the late yam is the preferred one. Yam is THE subsistence crop by excellence. After harvesting yam, the other crops are produced until the dry season.	Yam is cultivated mainly to cover the family's needs. Consequently only a small part is marketed. After harvesting, they store the roots in barns. One part is kept for the household, one part is kept for the next seasons as planting material. Depending on the harvest, an eventual surplus is sold on the local market.	Women /Men depending on field ownership	The field work for yam is shared between men and women.	Mostly Women control the income of yam.	Favourite food of the Agnis and Baoulé (Autochthones).
Plantain	Plantain are usually intercropped with other food crops.	The plantain is mainly used for the household and the rest is sold weekly on the local market, or at farm gate to the market women from Abidjan.	Women /Men depending on field ownership	Mostly women cultivate plantain	Women	Favourite food of the Souaoulin.
Cassava	Cassava is mostly intercropped or planted on the fields' edges as subsistence crop. However, it is also cultivated as principal crop (rather at the end of the crop rotation) to be sold to Attiéké processors.	When intercropped cassava is mostly consumed by the households. When cultivated as main crop the harvest is sold as a standing crop. The price is rather good as 1/2 ha yields around 100'000 FCFA)	Women /Men depending on field ownership	Mostly women	Women	Important for all traditional dishes (Attiéké, Foutou).
Maize (Autochthone)	Maize field are often intercropped with cassava and plantain. When the maize is sown directly after	A small part is used for the households, the bigger part is marketed.	Unclear	Unclear	Unclear	Not special for the autochthones, they have almost never mentioned it as part

	mounding it can be harvested before the yam takes up the space.					of their diet or farming system.
Maize (Allochthones)	The maize is cultivated after the rice harvest, together with beans or soybeans	Mostly for the household	Men	Women	Women	Important food for the allochthone (kabato, etc.).
Rice (Allochthones)	Rice is cultivated in monoculture and is harvested 3-4 month after sowing. The weeding is an intensive task for women.	Mostly for the household	Men	Women	Women	Favourite food of the allochthone.
Tomatoes, eggplants, chillies	Are the most mentioned and observed vegetables in February. They are mostly intercropped within major crops.	For the household and the market	Women	Women	Women	Important for the sauces.
Wild plants	There are different wild plants growing in the field, which are tolerated. The most observed one is the <b>wild eggplant</b> ( <i>solanum taryum</i> )	Mostly for the household. Has nutritional, traditional-medicinal and commercial value.	Women	Women	Women	Important for health, used in case of anaemia and protects against malaria.
Wild palm tree	Are growing wild in the fields and are very appreciated.	Mostly for the household. Sometime sold to intermediaries (40 FCFA/kg).	Women	Women	Women	Is important in the daily diet. Important source of vitamin A.
Leaves from: cassava, potatoes, cocoyam, trees	Not observed (probably due to dry period), rarely mentioned.	Mostly for the household	Women	Women	Women	Important source of nutrient. Leaves are very appreciated when household have not enough ingredients to put into the sauces.

## Annex 2: Guide for Individual Dietary Diversity Score (WDDS)

Based on the FAO guideline

Primary source of food procurement:

1= Own production, gathering, hunting, fishing

2= Purchased

	Food Group	Example	Yes=1
1	CEREALS	corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products) + insert local foods e.g. ugali, nshima, porridge or paste	
2	WHITE ROOTS AND TUBERS	white potatoes, white yam, white cassava, or other foods made from roots	
3	VITAMIN A RICH VEGETABLES AND TUBERS	pumpkin, carrot, squash, or sweet potato that are orange inside + <i>other locally available vitamin A rich vegetables (e.g. red sweet pepper)</i>	
4	DARK GREEN LEAFY VEGETABLES	dark green leafy vegetables, including wild forms + <i>locally available vitamin A rich leaves such as amaranth, cassava leaves, kale, spinach</i>	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) + <i>other locally available vegetables</i>	
6	VITAMIN A RICH FRUITS - red palm product	ripe mango, cantaloupe, apricot (fresh or dried), ripe papaya, dried peach, and 100% fruit juice made from these + <i>other locally available vitamin A rich fruits</i>	
7	OTHER FRUITS	other fruits, including wild fruits and 100% fruit juice made from these	
8	ORGAN MEAT	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	beef, pork, lamb, goat, rabbit, game, chicken, duck, other birds, insects	
10	EGGS	eggs from chicken, duck, guinea fowl or any other egg	

11	FISH AND SEAFOOD	fresh or dried fish or shellfish	
12	LEGUMES, NUTS AND SEEDS	dried beans, dried peas, lentils, nuts, seeds or foods made from these (eg. hummus, peanut butter)	
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	SWEETS	sugar, honey, sweetened soda or sweetened juice drinks, sugary foods such as chocolates, candies, cookies and cakes	
16	SPICES, CONDIMENTS, BEVERAGES	spices (black pepper, salt), condiments (soy sauce, hot sauce), coffee, tea, alcoholic beverages	

*Aggregation of food from the questionnaire to create WDDS*

Food group	Number	Food group	Score
1	1,2	Starchy staples	
2	4	Dark green leafy vegetable	
3	3,6 and red palm	Other vitamin A rich fruits and vegetables	
4	5,7	Other fruits and vegetables	
5	8	Organ meat	
6	9,11	Meat and fish	
7	10	Eggs	
8	12	Legumes, nuts and seeds	
9	13	Milk and milk products	
Dietary Diversity Score			

## Annex 3: Questionnaire sur la diversité alimentaire

Objectif : Observer les habitudes alimentaires de la population de la sous-préfecture de Taabo

- Veuillez décrire les aliments (repas et collations) que vous avez mangés ou bus hier pendant le jour et la nuit, que ce soit à la maison ou en dehors de la maison.
- Commencez par le premier aliment ou la première boisson du matin.
- Notez tous les aliments et boissons mentionnés.
- Lorsque des plats composés sont mentionnés, demander la liste des ingrédients.
- Bien demander tous les ingrédients de la sauce
- Lorsque la personne interrogée a terminé, cherchez les repas et les collations et boissons qui ne sont pas encore mentionnés.

Petit Déjeuné	Collations	Repas de midi	Collations	Repas du soir	Collations

Commentaires :

## Annex 4: Results of the WDDS

	Age	30				40			30	20	
	ID	DDB1	DDB2	DDB3	DDB4	DDB5	DDD1	DDD2	DDD3	100%	
Number	Food groups	Yes: 1									
1,2	Starchy staples	1	1	1	1	1	1	1	1	1	100%
4	Dark green leafy vegetable		1						1		25%
3,6 and red palm	Other vitamin A rich fruits and vegetables		1	1	1	1		1	1		75%
5,7	Other fruits and vegetables	1	1	1	1	1	1	1	1	1	100%
8	Organ meat										
9,11	Meat and fish	1	1	1	1	1	1	1	1	1	100%
10	Eggs					1					12%
12	Legumes, nuts and seeds	1	1					1	1	1	62%
13	Milk and milk products							1	1		25%
Dietary Diversity Score		4	6	4	4	5	5	7	5		40/8=5

Global mean = 5

Baoulé = 4,6

Dioula = 5,6

IFPRI proposes to use the following thresholds:

- 6+: high = good dietary diversity
- 4.5 - 6: medium dietary diversity
- <4.5: low dietary diversity

## Annex 5: Daily activities

The daily activity clock was elaborated during the first two focus group discussion in Bringakro, respectively with women and men.

Field days: Monday, Tuesday, Thursday, Saturday

Church: Vendredi et Dimanche

Market: Wednesday

Heure	Femme	Homme
05:00		
06:00	Ballayer la cours Faire le feu	
07:00	Chercher l'eau (5x) Faire la vaisselle	Manger
08:00	Mettre l'igname et la banana sur le feu Faire la sauce et le poisson	Partir au champs
09:00	Partir au champ	Travail au champ
10:00	Travail au champ	Travail au champ
11:00	Travail au champ	Travail au champ
12:00	Travail au champ	Travail au champ
13:00	Travail au champ	Travail au champ
14:00	Travail au champ	Travail au champ
15:00	Travail au champ	Travail au champ
16:00	Retour du chamos	Retour du champs
17:00	Preparation du repas	
18:00	Laver les enfants	
19:00		
20:00	Repos	Repos

## Annex 6: Farmer's feedback on the pathways and constraints identify

This last evaluation is intended to discuss some of the results that emerged from the surveys conducted between February and March. This last evaluation will take place in June.

Four levels of linkages were identified. The first level includes the most direct links (food sources). The second level includes women's income-generating activities (mainly responsible for food purchases). The third level groups men's income-generating activities (which usually covers other expenses). Finally, there is the distribution of expenses at the household level

For each link, constraints have been identified:

Groupe de liens	Lien spécifique	Contraintes contextuels identifiées	Contraintes liées aux capitaux du ménage	Entry point for action
1 <sup>er</sup> Liens directs (Source de nourriture)	Production d'autosuffisance	- Sécheresse - Feu de brousse - Productivité - Destruction des champs pas les bœufs - Manque de soutiens à la production les cultures vivrières et particulièrement pour ce qui est de la responsabilité des femmes.	- Disponibilité de la main d'œuvre (H) - Santé des membres du ménage (H) - Mode de transport disponible au sein du ménage (P) - Basse productivité (N)	- Agriculture sensible au changement climatique - Soutiens des femmes dans leurs cultures (semences de qualité)
	Petit « élevage » d'animaux	- Vols / cambriolage - Manque de confiance dans les villages (S)	- Manque de moyen (F)	-
	Achat de nourriture	- Manque d'argent - Prix des aliments sur le marché	- Manque de revenu (F)	-
	Nourriture de brousse / forêt	- Déforestation - Feu de brousse - Loi anti-braconnage	-	-
2 <sup>ème</sup> Activités rémunératrices des femmes	Vente du surplus des champs	- Distance aux champs - Prix du transport - Prix de vente bas	- Mode de transport disponible au sein du ménage (P) - Basse productivité (N) - Manque de coopération entre les ménages (S)	- Formation de coopérative de femmes (H)
	Revenu de la transformation du manioc	- Manque d'infrastructure / matériel de transformation - Distance jusqu'au moulin	- Pas équipement de transformations du manioc (P) - Mode de transport disponible au sein du ménage (P)	- Formation de coopérative de femmes pour l'achat de matériel de transformation pour le manioc (H)
	Autres revenu	- ....	-	-
3 <sup>ème</sup> Activités rémunératrices des hommes	Revenu du cacao	- Politique du prix du cacao - Vols - Conflit pour les terres - Sécheresse - Productivité	- Accès au bonne terre (N) - Propriétaire foncier (F) - Gestion du revenu du cacao (F)	- Relation stable avec une coopérative (H)
	Autres revenu	- ....	-	-
4 <sup>ème</sup> Répartition des dépenses	Répartition des dépenses au sein du ménage	- Répartition des dépenses entre l'homme et la femme - Fiabilité de l'homme (partage du haut revenu du cacao)	- Gestion du revenu du cacao (F)	- Farmer business school

Questionnaire :

Thèmes	Dimension	Echelle	Question
Source de nourriture	Source de nourriture importante pour le ménage	Question ouverte	1.1/1.2
	Evaluation des sources de nourriture préalablement identifier	Ratio <input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	1.3
	Menaces sur les sources de nourriture (identifié)	Choix multiple	1.4
Source de revenu consacré à la nourriture	Source de revenu utilisé pour acheter la nourriture	Question ouverte	2.1
	Evaluation des sources de revenu	Ratio <input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	2.2
Partage des dépenses	Dépenses importantes pour le ménage (Qui s'en charge/Source de revenu utilisé)	Question ouverte	3.1
	Impacte de certaine dépense sur l'achat de nourriture	Question ouverte	3.2

## Annex 7: Structured interviews:

### *Farmer's feedback on the pathways identified and corresponding threats*

#### 1. Sources de nourritures

1.1 Quel sont les sources de nourritures importantes pour la famille actuellement ? (Question ouverte)

Commentaires :

1.2 Quel sont les sources de nourritures importantes pour la famille en août ? (Question ouverte)

Commentaires :

1.3 Evaluation des sources de nourritures suivante : (perceptions générale) Quelle importance a la production du champ pour nourrir la famille, et pourquoi ? (ainsi de suite)

Sources de nourriture	Evaluation	Pourquoi ?
<b>Production du champ</b>	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	
<b>Achat de nourriture</b> (Poisson, Riz, Carotte, Choux, Lait, Pain)	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	
<b>Petit élevage à la maison</b> Poulets/chèvres/moutons etc.	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	
<b>Viande de brousse</b>	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	

1.4 Qu'est ce qui menace les différentes sources de nourritures ? Plusieurs réponses possibles

Source de nourriture	Facteurs de menaces	Commentaires
<b>Production du champ</b>	<input type="checkbox"/> Sécheresse <input type="checkbox"/> Feu de brousse <input type="checkbox"/> Baisse de productivité <input type="checkbox"/> Destruction des champs par les bœufs <input type="checkbox"/> Manque de soutiens de l'ANADER <input type="checkbox"/> Disponibilité de la main d'œuvre <input type="checkbox"/> Problème de santé <input type="checkbox"/> Distance au champ <input type="checkbox"/> Manque d'équipements de production <input type="checkbox"/> Autres.....	
<b>Achat de nourriture</b> Poisson, Riz, Carotte, Choux, Lait, Pain	<input type="checkbox"/> Manque d'argent <input type="checkbox"/> Prix de la nourriture <input type="checkbox"/> Prix du transport <input type="checkbox"/> Autres.....	
<b>Petit élevage à la maison</b> Poulets/chèvres/moutons etc.	<input type="checkbox"/> Manque d'argent <input type="checkbox"/> Manque de confiance dans le village <input type="checkbox"/> Vols/cambriolage <input type="checkbox"/> Distance au champ <input type="checkbox"/> Autres	
<b>Viande de brousse</b>	<input type="checkbox"/> Feu de brousse <input type="checkbox"/> Déforestation <input type="checkbox"/> Loi contre le braconnage <input type="checkbox"/> Autres.....	

#### 2. Les sources de revenu dépensées pour l'achat de nourriture (au niveau du ménage)

2.1 Quel sont les sources de revenu importante pour acheter la nourriture ? (Question ouverte)

Commentaires :

– **2.2 Evaluation des sources de revenu utilisé pour l'achat de nourriture** : Est-ce que la vente des surplus est un revenu important pour l'achats de la nourriture ? (Ainsi de suite)

Source de revenu	Evaluation	Pourquoi ?
Revenu de la vente des surplus du champ	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	
Revenu de l'atiéké	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	
Revenu du cacao	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	
Autre revenu .....	<input type="checkbox"/> Très important <input type="checkbox"/> Important <input type="checkbox"/> Peu important <input type="checkbox"/> Pas important	

### 3. Les dépenses importante de la famille

3.1 Quels sont les dépenses les plus élevées pour la famille ? (Question ouverte)

– **3.2 Evaluation des dépenses suivantes** : Est-ce que la nourriture est une dépense élevée ? (Ainsi de suite)

Liste des dépenses	Evaluation	Qui s'en charge (homme/femme)	Commentaires (si nécessaire)
Nourriture	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Scolarisation des enfants	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Santé	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Constructions	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Cérémonies et fêtes	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Funérailles	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Eau	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		
Electricité	<input type="checkbox"/> Très élevé <input type="checkbox"/> Elevé <input type="checkbox"/> Peu élevé		

3.3 Est-ce qu'il y a des dépenses qui réduisent l'argent disponible pour la nourriture ?

- Oui  
 Non

Si oui, exemple :

3.4 Est-ce que les hommes utilisent suffisamment l'argent du cacao pour aider la famille ?

- Oui  
 Non

Si non, pourquoi ?

3.5 Est-ce que les femmes doivent souvent participer aux grandes dépenses de la famille ?

- Oui  
 Non

Si oui, exemple :

3.6 Est-ce que la femme a suffisamment d'argent pour acheter la nourriture ?

- Oui

Non

3.6 Si vous gagnez plus d'argent ou est-ce que vous l'investissez ? (Question ouverte)

#### 4. Menaces qui influencent le bon fonctionnement de la famille

4.1 Quel sont les 5 menaces contextuelles les plus importantes et pourquoi ? (Inscrire les 5 menaces les plus importante dans le tableau dans l'ordre d'importance)

- Baisse du prix du cacao
- Sécheresse prolongée
- Déforestation
- Conflit autour des terres
- Conflit avec les bœufs
- Vols/ cambriolage (cacao, animaux, etc.)
- Prix du transport (hors du champ et sur le marché)
- Manque de machines (travaux aux champs et transformation du manioc)
- Corona virus

	Menaces	Explication (pourquoi)
1		
2		
3		
4		
5		

4.2 Quel sont les 5 menaces les plus importantes et pourquoi ? (Inscrire les menaces dans le tableau dans l'ordre d'importance)

- Manque d'argent
- Baisse de la productivité
- Disponibilité de la main d'œuvre
- Coût de la main d'œuvre
- Santé des membres de la famille
- Mauvaise gestion de l'argent du cacao
- Coût de la scolarisation des enfants
- Manque d'infrastructures (Cuisine, constructions, eau, électricité)

	Menaces	Explication (pourquoi)
1		
2		
3		
4		
5		

4.3 Quel sont les menaces à adresser en premier lieu ? (Les plus urgente, les plus gave)



**Exercices 2 : Calendrier des revenus et dépenses**

- Indiquer les principales **sources de revenu** disponible pour le ménage (revenu agricole, autre revenu, envoie d'argent depuis la famille en ville/étranger)
- Indiquer les principales **dépenses** du ménage
  - o Les dépenses liées à l'agriculture (semence, produits de traitements, mains d'œuvre etc.)
  - o Autre dépenses (école, assurance, nourriture, etc.)
- Indiquer la variation des **opportunités d'emplois**
- Indiquer la variation des **prix des denrées alimentaire** en fonctions des saisons (animal et végétal)

	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Aout	Septembre	Octobre	Novembre	Décembre	Janvier
Saison des pluies													
Types de revenu													
Types de dépenses													
Opportunités d'emplois													
Fluctuation des prix des denrées alimentaires													

**Exercices 3.1 Intensité de la main d'œuvre nécessaire**

- Quel est le mois le plus chargé ?
- Quel est le deuxième mois le plus chargé, ainsi de suite jusqu'au 6<sup>ème</sup> mois
- Quel est le mois le moins chargé ?
- Quel est le deuxième mois le moins chargé ? Ainsi de suite jusqu'à couvrir l'année

**Exercices 3.2** Quel sont les problèmes de santé qui surviennent par saisonnalité ? Indiquer les problèmes de santé discuter dans le calendrier ci-dessous

	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Aout	Septembre	Octobre	Novembre	Décembre	Janvier
<b>Intensité du travail</b>													
Haut													
Moyen													
Bas													
<b>Santé</b>													
Haut													
Moyen													
Bas													

**Exercice 4 : Horloge des activités journalières**

## Annex 9: Seasonal calendar - results

The calendar has been developed during the first two focus group discussion in Bringakro. It was used in many individual interviews to encourage the discussion.



## Annex 10: Operationalization scheme based on the Sustainable livelihoods framework

*Identification and assessment of possible pathways between small-scale farming system components and household level food security in Côte d'Ivoire.*

### Research questions and hypothesis:

#### RQ: What are pathways between small-scale farming systems and household food security?

H2.1 Key contextual elements influence small-scale farming system strategies to household level food security

H2.2 Key assets influence pathways between small-scale farming system and household food security

H2.3 Pathways between small-scale farming system and food security can be identified and assessed discussing livelihood strategies

### Overview of the research strategy and phases

Initial phase - identify

- Livelihood outcome - food security
- Contexts - vulnerability context, structure and processes
- Livelihood assets
- Livelihood strategies

Second phase - Discuss and assess livelihood strategies to food security

- More in-depth exploration of how people convert assets and strength into food security (livelihood outcome)
- Identify and discuss limiting factors that hinder small-holder farmer strategies to food security (livelihood strategies)
- Identify and discuss factor that reduce vulnerability (based on the available assets and strategies)
  - Preference ranking / Matrix ranking
  - Relative importance of vulnerability factors to different groups

**Key informant:** Health sector (H), Agriculture (A), Community leader (C)

**SLA Assets:** Human capital (H), Social capital (S), Physical capital (P), Natural capital (N), Financial capital (F)

Topic	Dimensions	Indicators	Methods				SLA and PRA	Questions
			Workshop 1 Workshop 2	Key informant	Interview farmers	Literature		
<b>Outcome</b> - <b>Food security</b> (H2.3)	General	- Perception	W1	X(A,C,H)			Causal diagram	- What dimension of food security is the most problematic in Taabo? (availability, access, stability, utilization) - What are the main underlying drivers of malnutrition in the community studied? (4 dimensions, caring capacity, health services, environmental condition, WASH)
	Availability	- Small-scale production covers need all year round - Diversification	W1	X(A,C,H)	X		Seasonal calendar	- What proportion of household food needs is met by own production and what portion is purchased?
		- Transport and distribution - Storage and processing of food		X(A,C,H)	X		Physical	- Is availability of food also an issue due to transport and distribution issues? - Is storage and processing of food an issue?
	Access	- Income - Market - Food prices		X (A)	X		Seasonal calendar / Physical & Financial	- Household's diets can be complete when necessary (purchase, exchange) - What proportion of output is marketed? - At what time of year is cash income most important (e.g. school fees might be collected one or more times during the year)? Does this coincide with the time at which cash is most available?
	Utilisation & health	- Health status (intestinal parasites, malaria) - Childcare - Illness management - Clean drinking water - Sanitation & hygiene - Cookstoves		X (H,C)		X	Human	- What sources of information are open to people? How high is the quality of that information? - How good is the access of different groups to core services (e.g. education, sanitation, health)?
				X (H,C)			Physical	- SLA (infrastructure)

		Food preparation Nutrition knowledge Cultural tradition Local perception of good health/diet		X(A,C,H)	X		Human / DDS	What are the food consumption patterns and dietary intake? What is the dietary diversity pattern?
	Stability	Natural and man-made disasters Employment Livelihoods and coping strategies Disease outbreak	W1	X(A,C,H)	X		Vulnerability context / Seasonal calendar	How long and intense is the hungry period? What effect do the 'hungry period' and other seasonal natural events (e.g. the advent of the rainy season) have on human health and the ability to labour? Has the length of the 'hungry period' been increasing or decreasing? Access to health care and WASH is accessible all year round, also when disease outbreak? It there a seasonality in the disease outbreak?
Context  (H2.1)	Economical	Access to local market Exchange relation with local market and intermediaries Reliability / trust		X(A,C,H)	X		Vulnerability context	How important is the market access for farming system and HHFS? <ul style="list-style-type: none"> <li>To sell products</li> <li>To buy mean of production (seeds, fertilizer, phytos)</li> <li>To buy food</li> </ul> What are the main issues related to the market access? Quantity, quality, intensity relation with intermediaries? How is it perceived and managed by HH?
	Political	Tenure rights		X (A,C)	X			What is the nature of access rights (e.g. private ownership, rental, common ownership, highly contested access)? How secure are they? Can they be defended against encroachment?
	Local government and political structures	Policy and the policy process		X (A,C)				The effect on livelihoods of key policies (and legislation) and the way in which policy is determined (by whom, for whom and influenced by which groups?).
		Access to services (land, health, sanitation, water, energy etc.) <ul style="list-style-type: none"> <li>What services</li> <li>Who accesses</li> <li>Relevance</li> <li>Costs</li> <li>Preferences</li> </ul>	W1	X(A,H,C)	X			What are the available services? Who has access to available services? Who does not have access and why? Amongst those who have access but do not use the services what are the reasons? Are the services culturally adapted, are there linguistic barriers, do forms of discrimination exist (gender, socio-economic or ethnolinguistic groups, etc.)? Who provides which services? (What type of relations/arrangements do the different providers of the same service have amongst themselves?) What are the costs for the use of services: direct costs (fees for health services, school fees, school uniforms, etc.) and opportunity costs (time, a person needs to be replaced for his/her tasks, etc.)? How do the people assess the services, quality and relevance? When several alternatives exist in terms of service delivery for a specific need (for an illness: health centre, purchase of medication and treatment by oneself, recourse to a traditional healer/doctor, etc.), which service is preferred and why?
	Social Community relations	Social and political organisation Common property Social capital Safety net Conflict		X(A,H,C)			Social	Decision-making processes, civic bodies, social rules and norms, democracy, leadership, power and authority, rent-seeking behaviour (if any) The way in which aspects such as gender, ethnicity, culture, history, religion and kinship affect the livelihoods of different groups within a community or neighborhood. Social cohesion and conflict Perception in security and crime
	Trends	Population <ul style="list-style-type: none"> <li>Demographic aspects</li> <li>Family planning</li> <li>Unemployment</li> <li>Migrations (in and out)</li> <li>Changes in health status</li> </ul>		X(A,H,C)		X	Human / seasonal calendar / Timeline	Existing trends over time on a medium-long term perspective
		Resources	W1	X(A,C)	X		Natural / Seasonal calendar	Resource use trend Change in yields Size and land holdings Availability of natural resources and environmental changes

	Climate change		X(A,C)	X		Natural	Climatic cycles, rainfall pattern? What are the main issues related to climate change? How does it impact farming system? (rain pattern, etc.) How does it impact FS? How is it perceived and managed by HH?
	Local Economy		X(A,C)	X		Timeline	Commodity prices Subsidies Food security Employment
Seasonality	Agricultural resources	W1	X(A,C)	X		Seasonal calendar	Level of food stores across the year Crop planting, weeding harvesting schedules Crop and livestock health shocks
	Production strategies along the year Pests and diseases fluctuation	W2	X(A,C)	X		Seasonal calendar	<b>What proportion of household food needs is met by own production and what portion is purchased?</b> How important is each crop to the livelihoods of the groups that produce it? Is the revenue from a given crop used for a particular purpose – e.g. if it is controlled by women is it particularly important to child health or nutrition? Fluctuation in agricultural outputs? Are there shortages in non-harvest periods? <b>Pest and diseases seasonality and issues?</b>
	Food prices fluctuation	W1	X(A,C)	X		Seasonal calendar	What are the main issues related to food prices? What are the main characteristics? Seasonality, fluctuation • How predictable is seasonal price fluctuation? How is it perceived and managed by households? • Is it managed through more subsistence farming? • Borrowing food, etc... How do prices for different crops vary through the year?
	Employment	W1	X(A,C)	X		Seasonal calendar	How do income/earning opportunities vary throughout the year? Are they agricultural or off-farm?
	Money flow	W1	X(A,C)	X		Seasonal calendar	How does remittance income vary throughout the year (e.g. falling off at times when it is most needed because of food price rises)? Do people have access to appropriate financial service institutions to enable them to save for the future? • Does access to these vary by social group?
Shocks	Event that causes stress • Politic • Social • Economic • Environment?	W1	X(A,C)			Timeline	Historical occurrence of flood droughts, epidemics, local environmental trends and cycles Any socio-political or economic event that have impact assets and strategies of people livelihoods?
Transforming structure and processes	Perception of vulnerability due to transforming structures & process		X(A,C)				How 'secure' (against physical damage, violence, seizure by the state, natural and economic shocks, etc.) are people and their assets? How is it changing over time and whether securing change is a priority for local people?
Assets H2.2	Human Capital Health • Life expectancy at birth • Adult mortality rate • Under five mortality rate • Literacy rate • Stunting		X(H)			X	
	Health • Health/fitness status of HH members • Dietary diversity		X(A,H,C)	X			Are the HH members healthy enough to have an active lifestyle? Are health issues sometime hindering working capacity? What are the major constraints to good health? How is health perceived and managed by HH

	Labour capacity <ul style="list-style-type: none"> <li>• HH size / fitness</li> <li>• Labour availability and quality</li> </ul>			X		Seasonal calendar	How big is the HH? Labour availability for cash crop /subsistence farming/ other activities
	Knowledge / education Access to information		X(A,H,C)	X			Highest education Nutrition education From where (what sources, networks) do people access information that they feel is valuable to their livelihoods? Which groups, if any, are excluded from accessing these sources? Does this 'exclusion' affect the nature of information available? (e.g. if women are excluded, then knowledge of traditionally female production activities may be limited.) Are knowledge 'managers' (e.g. teachers or core members of knowledge networks) from a particular social background that affects the type of knowledge that exists in the community? Do people feel that they are particularly lacking in certain types of information? How aware are people of their rights and of the policies, legislation and regulation that impact on their livelihoods? If they do consider themselves to be aware, how accurate is their understanding?
	Skills (HH strength)			X			What are the skills and strength of the household?
Social capital	Social relation / Network <ul style="list-style-type: none"> <li>• Cooperation with other farmers</li> <li>• Membership in groups formal/informal (cooperatives)</li> <li>• level of trust between network member</li> </ul>		X(C,A)	X		Access to and use of services	What social linkages or networks exist for a particular social unit? At what scale do they operate? To what extent do these links provide tangible resources and services that support livelihoods? Does affiliation to particular social networks or institutions constrain people from achieving given livelihood outcomes?
	Gender equity <ul style="list-style-type: none"> <li>• Women decision power</li> <li>• Women's time</li> <li>• Women access to resources</li> <li>• Role and control over resources</li> </ul>	W1	X(C,A,H)	X			What are major constraints women face? <ul style="list-style-type: none"> <li>• Access/control over natural resources/productive assets</li> <li>• Access to information</li> </ul> How much time women dedicate to productive and reproductive work? <ul style="list-style-type: none"> <li>• How does it impact Farming system?</li> <li>• How does it impact food security?</li> </ul>
Natural capital	Quantitative <ul style="list-style-type: none"> <li>• Yields</li> <li>• Land size</li> <li>• Type of resources available (land, water, tree)</li> </ul>	W1	X(C,A)	X	X		What are natural resources available in quantity and quality for the farming system? Which groups have access to which types of natural resources? Issues related to access? (gender perspective) Impact of natural resources available on farming system / FS?
	Qualitative <ul style="list-style-type: none"> <li>• Ecosystem function</li> <li>• Biodiversity</li> <li>• Soils</li> <li>• Use of rain</li> <li>• Trees</li> <li>• Energy</li> </ul>		X(C,A)	X			What are natural resources are causing problems? Is there enough biodiversity? Are the soils depleted? Is there much spatial variability in the quality of the resource? How versatile is the resource? Can it be used for multiple purposes? (This can be important in cushioning users against particular shocks.) Are nutrient dense foods cultivate and consumed on farm? <ul style="list-style-type: none"> <li>• Are farmers aware of Nutrient dense food?</li> <li>• Is there a NUC, important for household food security?</li> <li>• Is food gathered wild important for HHFS?</li> </ul>
	Management <ul style="list-style-type: none"> <li>• Productivity</li> <li>• Conflict</li> </ul>	W1	X(C,A)	X	X		Who decide what to plant on the fields? How much plant diversity is on farm? Is there evidence of significant conflict over resources?

							<p>How productive is the resource (issues of soil fertility, structure, salinization, value of different tree species, etc.)?  How has this been changing over time (e.g. variation in yields)?  Is there existing knowledge that can help increase the productivity of resources?</p>
	Land access		X(C,A)	X	X		<p>What is the nature of access rights (e.g. private ownership, rental, common ownership, highly contested access)? How secure are they? Can they be defended against encroachment?</p>
	Changes in the future		X(C,A,H)	X			<p>Issues related to changes?</p> <ul style="list-style-type: none"> <li>• Resource restrictions</li> <li>• Resource depletion</li> <li>• Climate change</li> <li>• Seasonality</li> </ul>
Financial capital	Income from farming activities <ul style="list-style-type: none"> <li>• Percentage of total income</li> </ul>	W1	X(C,A,H)	X		Seasonal calendar	<p>What are the main cash crops?  How important are cash crop incomes for the HHFS? Who controls incomes?  How much of the cash generated is used for food purchases, health and education? Who decides? (gender perspective)  What are the main issues related to cash crops?</p>
	Other financial resources <ul style="list-style-type: none"> <li>• Income from off-farm activities</li> <li>• Credits</li> <li>• Savings</li> <li>• Remittances</li> <li>• Relative share</li> </ul>	W1	X(C,A,H)	X		Seasonal calendar	<p>What is the main source of HH revenue?  Which types of financial service organisations exist (both formal and informal)?  Who - which groups or types of people - has access? What prevents others from gaining access?  How many households (and what type) have family members living away who remit money?  How reliable are remittances? Do they vary by season? How much money is involved?  Who controls remittance income when it arrives? How is it used? Is it reinvested?</p>
	Reliability		X(C,A,H)				Availability / access over time
Physical Capital	Infrastructure <ul style="list-style-type: none"> <li>• Access to roads, free or paid</li> <li>• Affordable transport</li> <li>• Adequate Water and sanitation</li> <li>• Affordable and clean Energy</li> <li>• Secure Shelter and buildings</li> <li>• Piped water, electricity, waste disposal</li> </ul>	W1	X(C,A,H)	X	X	Access to and use of services	<p>Does the infrastructure support a service? Market access, WASH, energy etc.  Is the infrastructure appropriate?  Can the physical capital provided meet the needs of the users in the long term? (This involves not just the sustainability of the service as it stands but an analysis of the ability of the capital to be adapted and upgraded in response to changing demand.)  Is availability of food also an issue due to transport and distribution issues?  Is storage and processing of food an issue?</p>
	Technologies <ul style="list-style-type: none"> <li>• Access to information / Communication (radio, phone, TV, internet)</li> </ul>		X(A,C)			X	How do you access information, health, agriculture, nutrition?
	Production equipment <ul style="list-style-type: none"> <li>• Machinery</li> <li>• Technologies and inputs</li> </ul>		X(A,C)	(x)			What type of production equipment do you have on the farm?
	Addressing needs		X(A,C,H)	X			<p>Satisfaction State/Offer  Perceived limitations on productivity  Necessary changes (repairs, renovations, extensions/conversions)</p>
Livelihood strategies  H2.3	Farming system strategies	Components <ul style="list-style-type: none"> <li>- Subsistence farming <ul style="list-style-type: none"> <li>▪ On farm diversity</li> <li>▪ Livestock (Nr, diversity, role)</li> <li>▪ Nutrient dense food</li> <li>▪ Picking</li> </ul> </li> <li>- Cash crop</li> </ul>		X			<p>How important is <b>subsistence farming</b> for HHFS?</p> <ul style="list-style-type: none"> <li>• Is it the main source of food of the HH?</li> <li>• Covering food needs all year round? (seasonality)</li> </ul> <p>What are the characteristics of the subsistence farming?</p> <ul style="list-style-type: none"> <li>• What crop? Why these crops?</li> <li>• What animals?</li> <li>• Dietary diversity</li> </ul>

							<p>How is subsistence farming perceived and managed by HH? Who take care of what? How much labour is needed?</p> <p>How important are <b>cash crop</b> for the household food security?</p> <ul style="list-style-type: none"> <li>Is the <b>cash income</b> used for food security related expenses?</li> </ul>
	Livelihood strategies			X			<p>Livelihood strategies adopted to achieve food security</p> <ul style="list-style-type: none"> <li>What are the main components of the farming system?</li> <li>What is the production strategy? (extensive, intensive, market oriented, subsistence oriented)</li> <li>Why are the animals not part of the agr. Sys? How important are there for the household? Income or nutrition? how big are the issues related to hygiene and livestock-borne diseases?</li> </ul> <p>What assets are used/need to achieve their strategy?</p> <p>What are the smallholder farmers strategies to secure food access all year round? (stability, availability, access)</p> <p>What is your goal? Why do you do it in this way?</p> <p>How are decisions made? (gender roles, negotiation)</p>
Food security			X(A,H,C)	X			<p>Which livelihood objectives are not achievable through current livelihood strategies?</p> <p>What factors reduce vulnerability of households (based on available assets and strategies)? Relative importance of vulnerability factors to different group, types of risk (environmental, social, economic, conflict)</p> <p>discuss limiting factors that hinder small-holder farmer strategies to food security (livelihood strategies)</p>

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## Annex 11: Guide d'entretiens avec planteurs et planteuses

Thèmes	Aspect clés	Questions
Natural capital	Sol, eau, arbre Biodiversité Sols	Observation - Disponibilité, quantité et qualité ?
System components	Activités principales Spéculations Animaux Equipement de production • Machette, vélo, etc. Intrant Services, conseil etc..	1. Quels sont vos activités principales ? 2. Quelles importances ont les différentes spéculations pour le bien-être de la famille ? 3. Quelle est la source de revenu principale de la famille ? 4. Est-ce que le revenu du cacao est utilisé autrement par exemple que le revenu du manioc ? a. Comment s'organise les dépenses du ménage ? Y a-t-il des particularités ?
Terrain	Doits aux terres Accès Fertilité	5. Est-ce que les champs que vous cultivez vous appartiennent ? 6. Avez-vous des problèmes avec la qualité du sol ?
Commercialisation VS consommation pour le ménage	Disponibilité et accès Production Route, transport, distribution Distribution Stockage et transformation Diversité des produits disponibles	7. Produisez-vous suffisamment pour nourrir la famille toute l'année ? 8. Quelle proportion de la nourriture que vous mangez vient de votre propre production ? a. Quel sont les contraintes ? 9. Quelle proportion de la nourriture que vous mangez vient du marché ? a. Quel sont les contraintes ?
	Accès au marché Quand, quoi, ou, comment, qui ? Prix Information et confiance	10. Ou est-ce que vous vendez les récoltes des cultures commerciales ? 11. Ou est-ce que vous vendez les surplus des cultures vivrières et maraîchère ? a. Quelle spéculation à qui ? comment ? quelles conditions ? b. Est-ce que les relations sont bonne / de confiance ?
Utilisation des services	Formel / informel Conseils Intrants et traitements chimiques Finance et crédits	12. Est-ce que vous avez accès à des services de soutiens et de conseil pour la production ? 13. Si vous avez une maladie dans un champs à qui vous adressé vous ? 14. Avez-vous suffisamment d'information disponible ?
Tendance et problèmes	Productivité Ressources naturelles (terre, eau, forêt) Conflit	15. Quel sont les tendances et les problèmes que vous rencontré ? 16. Y a-t-il des nouvelles opportunités ? 17. Comment réagissez-vous en cas de longue sécheresse ou de longue pluie ? 18. Discussion du calendrier composé
Calendrier des saisons	Discussion du calendrier	a. Les problèmes identifiés sont-ils similaires pour vous ? b. Quel sont vos stratégies pour résoudre ces problèmes ? c. Quel sont vos force/capacité spécial pour résoudre les problèmes ? d. Besoins/disponibilité mains d'œuvres (H) e. Quand est-ce que les enfants doivent aider ? (H) f. Période ou le stock alimentaire est bas (FS) g. Variation des revenus (F) i. Epargne ii. Opportunité de travail h. Fluctuation des prix (FS accès)
Utilisation (Capital Humain)	Santé (parasite intestinal, diarrhée, anémie, etc.) Gestion des maladies	19. Est-ce que les problèmes de santé sont récurrent ? 20. Sont-ils problématiques pour travailler aux champs ?
Social relation / Network	Coopération planteurs Association Groupement (formel/informel) Relations social	21. Etes-vous membre d'une coopérative ou d'une association de producteurs ?
	Argent Nourriture Véhicule	22. En cas de soucis, pouvez-vous compter sur le soutien de la famille ou autres relations ?
Gender - Only with women	Women decision power Time, access to resources, and control over income	22. Quelles sont vos plus grandes contraintes ? 23. Avez-vous un champ a vous ? 24. Qui contrôle le revenu de se champs ? 25. Avez-vous suffisamment de contrôle sur les ressources et les décisions prises ? (financière et aux champs)
Santé (Capital Humain)	Eau potable Sanitaire & hygiène Cuisiner sur le feu	26. Quel sont les contraintes pour la préparation des repas ?
Nutrition (Capital Humain)	Préparation des repas Connaissance nutritionnelle Tradition Diversité alimentaire	26. Au niveau de la nutrition y a-t-il des problèmes ?
Capacité de travail	Taille du ménage	27. Combien de personne mange dans le ménage à midi et le soir ?

## Annex 13: Discussion guide- Health worker

Causal diagram / flow diagram / Problem tree -> malnutrition, status nutritional

Dimension	Topic	Key aspects	Question to ask
Outcome - Food security (H1.1)	Dimensions	Diagramme de causalité - Malnutrition - Santé - Statut nutritionnel (enfant et jeune femme) - Disponible - Utilisation - Santé - Stability	<p>Quel sont les <b>problèmes de santé</b> les plus fréquents dans la région ? (Jeune femme est enfants)</p> <ul style="list-style-type: none"> <li>• Ces problèmes sont-ils liés à la nutrition ?</li> </ul> <p>La malnutrition est-elle un problème observé à Kotiéssou ?</p> <p>Selon vous, quel sont les <b>causes principales de la malnutrition</b> dans la sous-préfecture de Taabo ?</p> <ul style="list-style-type: none"> <li>• Disponibilité de la nourriture</li> <li>• Accessibilité à la nourriture</li> <li>• Utilisation de la nourriture (mauvais usage des aliments disponibles)</li> <li>• Stabilité de l'accès à la nourriture au long de l'année</li> </ul> <p>(Accès à l'eau potable, hygiène, diarrhée, maladies infectieuses, mauvaise alimentation)</p> <p>Les indicateurs suivants sont-ils mesurés ?</p> <ul style="list-style-type: none"> <li>• Cachexie (rapport poids-taille)</li> <li>• Insuffisance pondérale (rapport poids-âge)</li> <li>• Retard de croissance (rapport taille-âge)</li> <li>• Anémie</li> </ul> <p>La <b>diversité alimentaire</b> des ménages est-elle suffisante tout au long de l'année ?</p>
Assets	Human capital	Connaissance et informations Accès à l'information	<p>Est-ce que les connaissances <b>nutritionnelles</b> sont disponibles et promues ?</p> <p>Quel est la cause selon vous de l'insécurité alimentaire ?</p> <ul style="list-style-type: none"> <li>• L'éducation</li> <li>• Infrastructure sanitaire</li> <li>• Santé</li> <li>• Eau potable</li> </ul> <p><b>L'accès aux services</b> tels que l'éducation, infrastructure sanitaire, santé, eau potable etc. est-elle problématique ?</p> <ul style="list-style-type: none"> <li>• Quel sont les services de santé, sanitaire, eau, disponibles pour la population ?</li> <li>• Est-ce que tout le monde a accès au service de santé ?</li> <li>• Qui met à disposition les services de santé, services sanitaires, de l'eau etc. ?</li> <li>• Est-ce que les gens ont le sentiment de manquer d'information concernant, la santé et la nutrition ?</li> </ul>
	Social capital	Relation Égalité	<p>Est-ce que l'affiliation avec un certain groupe permet d'avoir accès à des meilleurs soins, meilleure alimentation ?</p> <p>Est-ce que <b>les femmes ont des contraintes spécifiques concernant la santé</b> ? (accès, maladie, sanitaire, etc.)</p> <p>Cela a-t-il un impact sur la sécurité alimentaire ?</p>
	Financial aspects	Gestion des ressources financière	<p>Les <b>coûts de la santé</b> sont-ils élevés pour les ménages ?</p> <p>Est-ce que le manque d'argent est une contrainte importante pour la santé ?</p>
	Physique capital	Infrastructure Technologies	<p>Est-ce que les infrastructures sont adéquates pour un maintien de la population en bonne santé dans les zones rurales ?</p> <ul style="list-style-type: none"> <li>• Route</li> <li>• Transport</li> <li>• Infrastructure sanitaire</li> <li>• Infrastructure de l'eau potable</li> <li>• Infrastructure habitations</li> </ul>
Context	Economic Politic	Access to local market	<p>Quel sont les <b>contraintes politiques</b> concernant, la santé, la nutrition, l'éducation etc. ?</p> <p>La disponibilité des aliments sur le marché, est-ce un problème pour une alimentation saine ?</p>
	Social Community relations	Social and political organisation	<p>Est-ce que la santé et la nutrition varient en fonction des <b>ethnies</b> ?</p>
	Trends	Population • Demographic aspects • Family planning • Changes in health status	<p>Avez-vous observé des changements importants au cours des dernières années (santé, sanitaire, nutrition) ?</p> <ul style="list-style-type: none"> <li>• Augmentation des naissances</li> <li>• État Générale de santé, etc..</li> <li>• Mortalité infantile</li> <li>• Malnutrition <ul style="list-style-type: none"> <li>• Cachexie (rapport poids-taille)</li> <li>• Insuffisance pondérale (rapport poids-âge)</li> <li>• Retard de croissance (rapport taille-âge).</li> </ul> </li> </ul>
Livelihood strategies	Farming system strategies		<p>Les stratégies de production des petits planteurs peuvent-elles améliorer la santé et la nutrition des ménages ?</p>
	Food security		

## Annex 14: Discussion guide - Agricultural extensionist

Dimension	Topic	Key aspects	Questions	
Assets	Financial capital	Spéculations Revenu Crédit Épargne Contrôle	Quels sont les spéculations les plus importante pour les planteurs ? <ul style="list-style-type: none"> <li>• Spéculations vivrières et commercial</li> </ul> Quel est la source de revenu principal des planteurs ? Quelles importances ont-elles pour les planteurs (revenu, statut social) ? Qui est en charge/contrôle les ressources financières générés par l'agriculture au niveau des ménages ? Les sources de revenu sont-elles stables ? A quel moment de l'année les revenu agricole sont il les plus élevé et plus bas? Quel sont les périodes ou les travaux sont-ils les plus intense ? (nettoyage, récolte, etc.)	
	Resource naturel	Disponibilité et qualité Eau Sol Forêt Hectares Productivité et gestion	Quel sont les ressources naturelles (eau, sol, forêt) en termes de quantité et qualité disponible pour les planteurs ? Disponibilité et qualité ? Tous les planteurs ont-ils accès au même ressources naturelles ? Quelle ressource est limité ? Les ressources sont-elles dégradés ou restreinte ? Y a-t-il des conflits autour des ressources naturelles ? <b>Changement</b> au niveau des ressources, sol, récolte, taille des champs, mode de culture, disponibilité de l'eau, etc.	
	Capital physique	Infrastructure Technologies	Quel sont les infrastructure et moyen de production (machines) disponible ? Est-ce que les infrastructure (route, eau, électricité) permettent aux planteurs de mener à bien leurs activités ?	
	Accès	Transport et distribution Accès au marché Relation avec les intermédiaires	Transport et distribution Accès au marché Relation avec les intermédiaires	Dans les zones rurales, est ce que le transport des bien agricole est problématique ? <ul style="list-style-type: none"> <li>• Pour la vente de la production</li> <li>• Pour la disponibilité des biens alimentaire sur le marché ?</li> <li>• Pour la disponibilité des bien de productions (graines, intrant, phyto)</li> </ul> L'accès au marché est-il un problème ? <ul style="list-style-type: none"> <li>• Intermédiaire, qualité de l'accès, etc.</li> </ul> Les prix des biens sont-ils abordables pour les ménages ? est-ce que la fluctuation est grande ?
		Accès aux services	Accès aux services	Quel sont les services financiers disponibles ? Pour qui ? Quel sont les services de conseils disponibles ? Pour qui ?
	Human Capital	Santé Education Information	Les planteurs ont-ils les connaissance nécessaire pour faire leur travail ? (Gestion des sols, maladies etc.) Est-ce que le savoir est disponible pour augmenter la productivité des ressources naturelles ? Ou se trouvent les informations nécessaires ?	
Social capital	Coopérative	Quel rôle jouent les coopératives, par exemple de cacao ? Confiance ?		
Context	Economic Politic	Droit foncier	Quel est la nature des droits foncier dans la région ? (Stable, contesté, privé, public) Est-ce que les femmes propriétaire ont des contraintes particulières ?	
	Trends	Changement climatique	Qu'elles sont les problématiques liés au changement climatique qui ont un impact sur les agriculteurs ? Arrivé des pluies, longueur et quantité ?	
Outcome - Food security	Dimensions	Diagramme de causalité Malnutrition et production	Est-ce que la production des petits planteurs suffit à nourrir le ménage durant toute l'année ? Quel sont les principaux problèmes rencontrés par les petits agriculteurs et comment cela affecte-il leur alimentation ? La malnutrition est-elle le résultat, du manque de production, du manque d'argent, du manque d'accès au marché, d'un mauvais état de santé, causes sanitaires etc. ?	
	Disponibilité	Alimentation	Quelle proportion du besoin en nourriture est couvert par la production vivrière des petits producteurs ? Quelle proportion de la production est vendu sur le marché ?	
	Utilisation & santé	Connaissance nutritionnelle Perception de la santé	Est-ce que la diversité alimentaire des ménages est un sujet aborné en tant qu'agronome ? <ul style="list-style-type: none"> <li>• Diversité des cultures, cultures spécifiquement hautes en nutriments, l'élevage pour un apport en protéines, et la santé des planteurs en général ?</li> </ul> Y a-t-il des problèmes de santé directement lié au system de production ?	
	Stabilité		Y a-t-il des saisons ou le stock alimentaire est bas ? Cela affecte-il la nutrition et l'état de santé des ménages ? Est-ce que la longueur des périodes de malnutrition/faim à tendanciellement changer les dernières années ?	

# Annex 15 : Guide pour le 2eme focus group - Sécurité alimentaire et Agriculture

## INTRODUCTION (5')

- Bonjour, bienvenu et merci d'être là
- Présentation des facilitateurs
  - o Présentation de mon projet de master qui s'inscrit en continuité du travail de Judith, Anaïs et Samuel
  - o Présentation de Sebaga et de son projet de master
  - o Présentation de Julien
- L'objectif de la discussion est de comprendre le lien entre l'agriculture – ce que vous cultivez aux champs – et ce que vous mangez
- Au niveau de la langue il faut me dire si je parle par bien, ou bien demander à Julien pour la traduction en Baoulé et Sebaga pour la traduction Malinké
- Tout ce dont nous discutons aujourd'hui, nous garantissons la confidentialité et nous vous demandons également de ne pas communiquer ailleurs ce qui a été dit ici.
- Vous êtes libre de poser des questions à tout moment.
- Il n'y a pas de bonnes ou de mauvaises réponses, alors n'hésitez pas à partager vos réflexions.
- Si c'est en ordre pour tout le monde je vais enregistrer la discussion, ce qui me permet de me concentrer plus tard une deuxième fois sur vos explications. L'enregistrement n'est en aucun cas partagé avec d'autres personnes.
- La discussion devrait durer 1 heure environ
- Merci d'avance, est-ce qu'il y a des questions avant de commencer ?

## ACTIVITÉ DE MISE EN ROUTE (5')

- Nous allons commencer par une petite activité pour se présenter et bien se réveiller
- Nous allons former un cercle, je vais lancer mon étui à quelqu'un, la personne qui attrape doit dire son nom et deux aliments qu'elle aime beaucoup et puis lancer l'étui à la prochaine personne.
- La seconde personne doit dire son nom et deux aliments qu'elle aime beaucoup.

## DISCUTER LE CALENDRIER ÉTAPE PAR ÉTAPE (15')

Vous allez m'aider à comprendre :

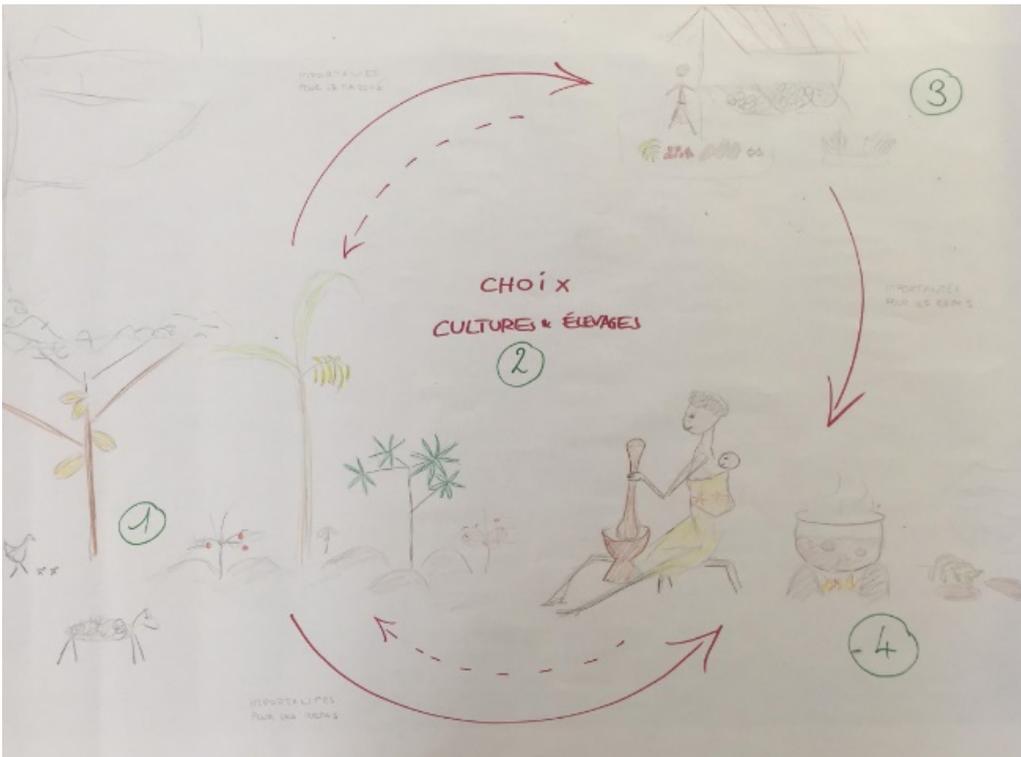
1. **Discuter le choix des cultures et de l'élevage** (en fonction de la discussion inscrire les cultures sur les posters)
  - Pour la préparation des repas
  - Pour vendre au marché
  - Autres raisons
2. **Discuter la vente des produits au marché** (en fonction de la discussion inscrire les cultures sur les posters)
  - Produits vendus en quantité importante
  - Produits vendus à un bon prix
  - Saisonnalité des revenus
3. **Enumérer les aliments importants achetés sur le marché pour la préparation des repas**
4. **Expliquer la période plus difficile entre juillet, août et septembre**

## DÉFINITION DE BONNE ET MAUVAISE ALIMENTATION (10')

- Pouvez-vous me décrire une mauvaise alimentation ?
- Pouvez-vous me décrire une bonne alimentation ?

## DISCUSSION DES RÉSULTATS DE ANAÏS GALLI (10')

- Comment et quand serait-il possible d'améliorer l'alimentation de votre famille ?





## Annex 17: Instructions for Authors

The thesis followed the instruction for authors as stated for publishing in Food Policy. The guide for authors can be found here: <https://www.elsevier.com/journals/food-policy/0306-9192/guide-for-authors>

## Annex 18: Master Thesis Project Definition

<b>Student's name and contact details</b>	Lucille Gallifa
Principal advisor <sup>1</sup>	Filippo Lechthaler
<b>Working Title of the master's thesis</b>	<b>Identification and assessment of possible pathways between small-scale farming system components and household level food security in Côte d'Ivoire.</b>
Background <sup>2</sup> and state of knowledge	<p>Access to adequate food and freedom from hunger is a basic human right, acknowledged in the 1948 Universal Declaration of Human Rights (FAO et al. 2018). This commitment has been reiterated by the Sustainable Development Goal (SDG) under SDG 2 "ending hunger, achieve food security and improved nutrition and promote sustainable agriculture" (FAO 2017). There is a pressing need to achieve this goal in West Africa where food insecurity is alarming and has even increased over the past years (FAO et al. 2018).</p> <p>In Côte d'Ivoire, 12.6 per cent of rural households are food insecure (FAO 2012). Prevalence of chronic malnutrition (stunting) is considered "precarious" (20% - 30%) (Ibid). Women of reproductive age and children are heavily affected by micronutrients deficiencies, particularly anaemia and vitamin A, iron, zinc, folic acid and iodine deficiencies (Ibid).</p> <p>Small-scale agriculture is the main source of food and income for about 65 per cent of the working population in West Africa (Brochard 2017). The agriculture sector has therefore a major role in alleviating malnutrition (Egal and Lopriore 2006). The international development sector has broadly acknowledged that, to achieve food and nutrition security, agricultural interventions must be nutrition-sensitive (FAO 2013). Despite this growing consensus, there is a recognized limitation of research that focuses on measuring and assessing farm-level relationships between agricultural production and nutrition outcomes (Carletto et al. 2015; UNSCN 2006; FAO 2013; Nicholson et al. 2019).</p> <p>This project aims at bridging this gap by assessing possible pathways between small-scale farming system components and household level food security using the case of the Taabo district in central Côte d'Ivoire. Smallholder farming characteristics of this study-region have been characterized by previous research in 2018 (Schärer 2018). Furthermore, population health and nutritional status are recorded since 2009 by the Taabo Health and Demographic Surveillance System (HDSS), which has been established in 2009 to facilitate surveillance and interdisciplinary research (Kone et al., 2015). Based on a qualitative analysis, this project aims to identify and assess linkages between small-scale farming system components and household level food security.</p>
Objective of the thesis	Assess possible pathways between small-scale farming system components and household level food security in Côte d'Ivoire.

<sup>1</sup> This must be a member of the academic staff within the specialisation programme, either a senior lecturer or a research associate with a PhD or an MSc with a minimum of three years' research experience.<sup>2</sup> If necessary include a description of the project in which the thesis is embedded in an annex

<sup>2</sup> If necessary include a description of the project in which the thesis is embedded in an annex

Expected outcomes <sup>3</sup>	<ul style="list-style-type: none"> <li>- The pathways between small-scale farming system components and household level food security (HHFS) is <b>conceptually approached and reviewed</b></li> <li>- <b>The conceptual framework</b> – between small-scale farming system components and household level food security – <b>is operationalized</b> for qualitative data collection</li> <li>- <b>Needs for primary (qualitative) data collection are identified</b> to describe pathways between small-scale farming system components and household level food security for the case of the Taabo region in Côte d’Ivoire.</li> <li>- <b>Data are collected and analysed</b> to describe/validate the relevant pathways between small-scale farming system components and household level food security</li> <li>- <b>Recommendations are derived</b> for developing future operational research and project monitoring that support agricultural interventions to improve household-level food security</li> </ul>
Research questions or hypotheses	<ul style="list-style-type: none"> <li>- What are the <b>possible pathways</b> between small-scale farming system components and HHFS as identified by the existing literature?</li> <li>- What are <b>existing assessment tools</b> to quantitatively &amp; qualitatively measure the pathways between farm system components and HHFS?</li> <li>- How to elaborate an <b>"operational framework"</b> to describe and rank possible pathways between system components and HHFS?</li> <li>- What type of <b>qualitative data</b> are required to <b>populate the "operational framework"</b> developed to describe the pathways between small-scale farming system components and HHFS in the case of Côte d’Ivoire.</li> <li>- What are the <b>relevant pathways</b> between small-scale farming system components and HHFS for the case of the Taabo region in Côte d’Ivoire?</li> <li>- What are appropriate (feasible and cost efficient) indicators to quantitatively &amp; qualitatively measure the pathways between farm system components and HHFS?</li> </ul>
Approach and methodology	<p><b>Literature review</b></p> <ul style="list-style-type: none"> <li>- Critically review existing concepts that describe pathways between small scale farming and HHFS</li> <li>- Consolidate a conceptual framework for data collection</li> <li>- Review available secondary data for the Taabo case</li> <li>- Derive requirement for primary data collection for the Taabo case.</li> </ul> <p><b>Data collection – Qualitative</b></p> <ul style="list-style-type: none"> <li>- Key informant interviews</li> <li>- On farm visit and observation of existing farming system</li> <li>- On farm visit and observation of nutritional habits</li> <li>- Explorative workshop with women</li> <li>- Follow-up interview (key informants / farmers’ HH)</li> </ul> <p><b>Data analysis</b></p> <ul style="list-style-type: none"> <li>- Deductive approach (based on operational framework derived through the literature review)</li> <li>- Content analysis</li> <li>- Triangulation of data</li> </ul>
Place(s) of research	Taboo, Côte d’Ivoire
Date of master’s thesis colloquium	06.06.2019
Language of the master’s thesis	<input checked="" type="checkbox"/> English <input type="checkbox"/> German <input type="checkbox"/> French <input type="checkbox"/> Spanish <input type="checkbox"/> Italian
Confidential master’s thesis	<input checked="" type="checkbox"/> no <input type="checkbox"/> yes ⇒ <input type="checkbox"/> agreement <sup>4</sup> has been signed
Assessment matrix	<input checked="" type="checkbox"/> standard HAFL <input type="checkbox"/> other (see annex)
Extensive application of a social-scientific method (especially surveys, interviews)	<input type="checkbox"/> no <input checked="" type="checkbox"/> yes

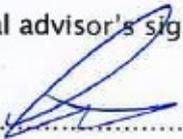
<sup>3</sup> Break down the objective into several partial objectives (expected outcomes or expected results or expected outputs)

<sup>4</sup> Student Work Agreement · Confidentiality Agreement between BFH-HAFL and student

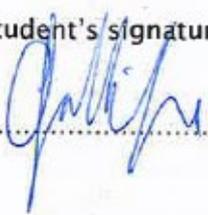
Semester in which the thesis will be submitted <sup>5</sup>	<input checked="" type="checkbox"/> Spring Semester, year 2020 <input type="checkbox"/> Autumn Semester, year This will be the 4th study semester of the student.
Comments	

Date, place: 09.07.2019, Zollikofen

Principal advisor's signature:



Student's signature:



⇒ Please send to the Head of Specialisation for approval. Deadline is at most two months after the colloquium.

⇒ The student is hereby reminded that the "Guidelines for Master's Theses" govern the writing of the thesis. The effective «Guidelines for Master's Theses» and the «Guide to Writing a Master's Thesis» as well as the templates and different forms can be found in the Intranet: Studium/Masterstudium/Master's Thesis.

## Digital Appendix

- MAXQDA project with transcribed interviews and coding

<sup>5</sup> The semester in which the master's thesis will be submitted is binding. The student is obliged to submit the thesis in one of two slots during this semester. Postponing the date to a later semester requires an application with due justification to the Head of Teaching.