

The Food Systems Decision-Support Tool

Application in the case of the Sahel

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Acknowledgements

We gratefully acknowledge the time and insights shared by the key informants, who contributed to the analysis of the system dynamics. We are grateful for the contributions of our KIT and WUR colleagues who contributed to the work. The views and recommendations expressed in this report are those of the authors and do not necessarily reflect the view of the Ministry of Foreign Affairs.

Summary

In December 2018, the Ministry of Foreign Affairs organized a stakeholder exchange on food & nutrition security in the Sahel region (notably Burkina Faso and Niger) as part of its initiative to develop of a new Sahel program focusing on food and water. Wageningen Economic Research and KIT were contracted to provide a descriptive overview of the food systems in Burkina Faso and Niger to support this policy process, through the partial application of the Food Systems Decision Support Tool. The descriptive analysis is based on secondary data and key informant interviews.

In both countries, food and nutrition security has improved in recent years as stunting levels among children under 5 years old have decreased. However, large parts of the population remain under the poverty lines and consumption patterns show a consistent trend of insufficient intake of nutrients (e.g. vitamins through fruits and vegetables, protein, calcium). Both countries are in the bottom 10 of the Human Development Index. High population growth, in combination with climate change and land degradation, continues to put pressure on the natural resources. The increased rate of conflicts further raises the concerns for the food & nutrition security and stability in the Sahel region. The two major agricultural production systems –rain-fed cereal production and pastoralist livestock production– are increasingly competing for the same land and water resources, contributing to local outbursts of violence. However, there are also pockets of synergy where local initiatives of farmer-managed natural regeneration and reforestation has restored degraded landscapes while improving productivity.

The ecological capacity for agricultural production in the Sahel region is limited due to the low annual rainfall and low level of soil fertility. Changing rainfall patterns affect the routes and seasonality of the traditional practice of transhumance while customary tenure regimes have been weakened, resulting in localized disputes over land use. Pastoralists are increasingly stigmatized which is thought to facilitate radicalization of marginal groups. This results in an increase of migration flows within the region, and a decrease in investments in the agri-food sector, consequently restraining the agricultural productivity and employment generation. State services have also been weakened over time, negatively affecting the required agricultural support services. Lack of economic prospect in rural areas encourages youth to migrate to urban centres.

Economic, social and ecological resilience is key in a fragile, risk-prone region like the Sahel. Interventions should thus seek to strengthen diverse and complex livelihood strategies. There is a strong plea among the key informants and practitioners to strengthen the civil society and look for grassroots technical and social innovations by working with local CBOs, NGOs and local groups representing youth and women. Restoring the 'contract social' between local governments and communities, strengthening local institutions, sustainable management of land and water resources, and strengthening household resilience are thought to be important intervention points for the envisioned Sahel program.

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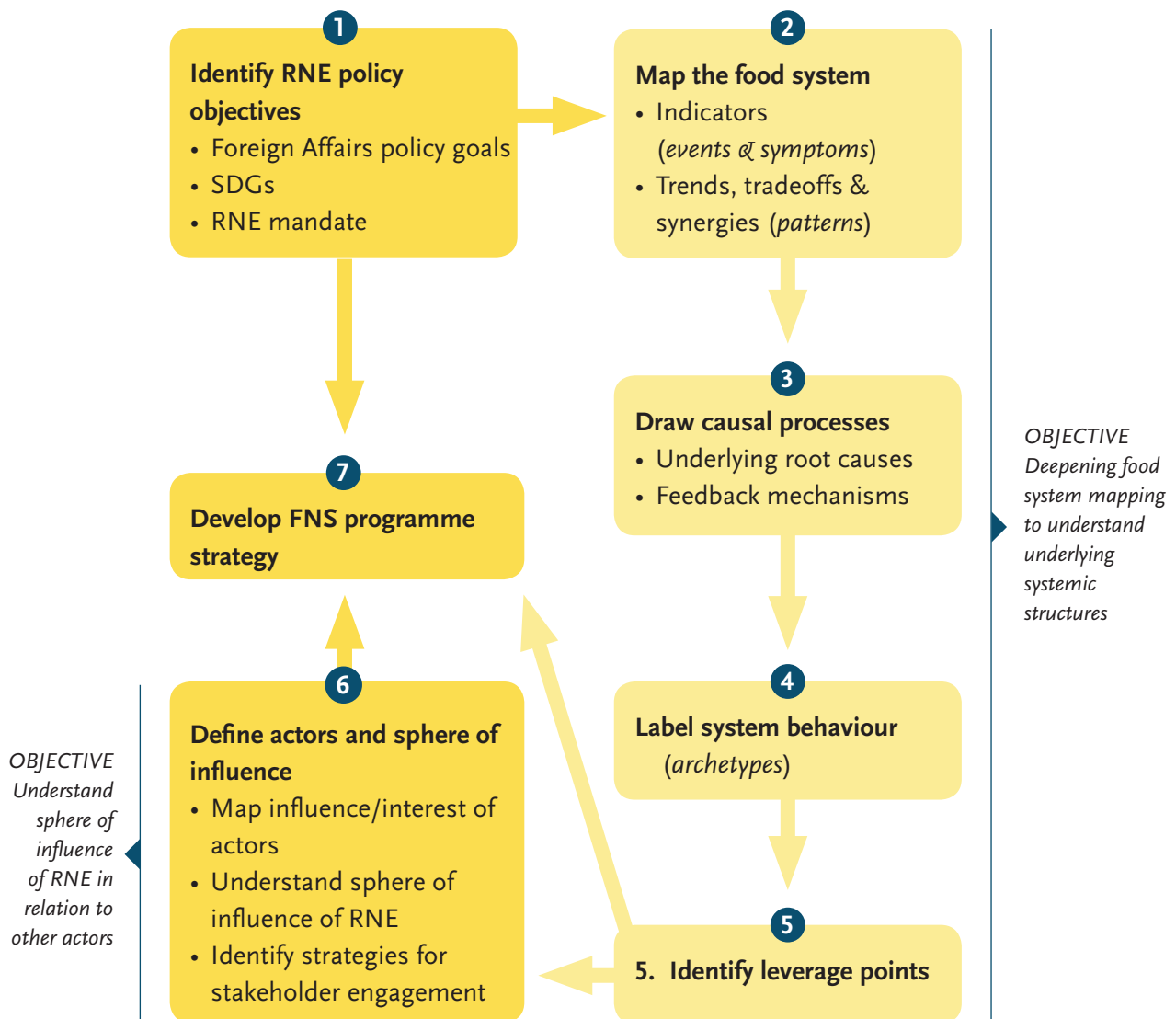
Introduction

This report presents the outputs of a small assignment of the Dutch Ministry of Foreign Affairs (Inclusive Green Growth) with the objective to support the policy process of FNS programming for Burkina Faso and Niger. The WUR-KIT Food Systems Decision-Support Tool has been applied in part to provide a quick analysis of the food system and identify leverage points for improving food & nutrition security outcomes.

The Food Systems Decision-Support Tool (Figure 1) consists of seven steps:

1. Defining the policy objectives of the Embassy applying the FS tool
2. Mapping the food system relevant to these policy objectives
3. Identifying the causal processes underlying the food system
4. Determining archetypes in system behaviour of the food system
5. Identifying actionable leverage points within the food system
6. Defining relevant actors and their influence and interest to address leverage points
7. Developing RNE FNS strategy based on leverage points, RNE objectives and relevant actors.

Figure 1. Food Systems Decision Support Tool



The application of the WUR-KIT Food Systems Decision-Support consisted of the following main activities:

Data collection and interviews

Recent literature and data was reviewed to map the current food systems of Burkina Faso and Niger. Additionally, interviews were held with key informants in the Netherlands that have experience in the region. The following key informants were consulted: Gerard Baltissen (KIT), Maja Slingerland (WUR), Han van Dijk (WUR), Arno Maatman (IFDC), Niek Thijssen (Agriterra), Ron Delnoije (Oxfam-Novib), Stefan Schüller (Both Ends), Frank van Steenbergen (Meta meta), Rik Overmars, Alfons Fransen, Caroline te Pas (SNV).

Internal workshop

During a one-day workshop, the collected information was presented and causal processes were discussed in order to identify leverage points. The participants included:

- The project team: Bart de Steenhuijsen Piters (KIT), Helena Posthumus (KIT), Joost Neelen, Just Dengerink (Wageningen Economic Research) and Siemen van Berkum (Wageningen Economic Research)
- IGG: Jeroen Rijniers, Jan Hijkoop, Joke Baak
- Regional expert: Gerard Baltissen (KIT)

Presentation and validation at multi-stakeholder meeting (December 18)

About 50 experts (academics, practitioners and policy makers) on food & nutrition security and/or the Sahel were invited by MinBuZa to attend a multi-stakeholder meeting to have a first exchange of ideas on the Sahel program. The preliminary findings were presented and reflected upon. A separate report on the stakeholder meeting has been submitted by Joost Neelen.

In the remainder of this report, we describe the main findings of the (partial) application of the Food Systems Decision-Support Tool in the case of the Sahel, in particular Burkina Faso and Niger. Note that the FSDS tool was not fully implemented; hence the analysis ends with the identification of initial leverage points for interventions (step 5). There are no final recommendations on partnerships or FNS program strategy.

This report provides a descriptive mapping of the food system based on a literature review, expert interviews and stakeholder consultation, providing insights in possible entry points for interventions, but does not offer any definitive policy recommendations. This publication can be the start of a more in-depth analysis of food systems in the Sahel and the provision of more detailed policy recommendations in the future.

Step 1: Define policy objectives

The Dutch Government aims to renew its Sahel program in the countries Burkina Faso and Niger, as part of its Inclusive Green Growth (IGG) agenda. The IGG agenda covers four themes: climate, water, food security, and energy, raw materials and the polar regions. In its policies, IGG addresses the interests of both developing countries and the Netherlands, and

seeks to cooperate with the private sector, civil society and knowledge institutes. Although the policy framework – Multi-annual Country Strategy (MLS) – for the Sahel program was not yet finalised at the time of this assignment, the following policy objectives were already identified (Table 1):

Table 1. Policy objectives Sahel program

	Thematic result areas	Private Sector Development
Burkina Faso & Niger:	<ul style="list-style-type: none"> • Water resources management at country level • Water, Sanitation and Hygiene • Improved nutrition status • Family farming systems productivity • Ecological sustainability of farm - and common access land use (prevention of land degradation, natural resources management) 	<ul style="list-style-type: none"> • Creating employment for youth and women to tackle instability • Off-farm employment, agri-value chains, cross-border trade • Support to SMEs • Institutional strengthening (investment promotion agencies, chambers of commerce, employer organizations, impact investors, incubators)
Burkina Faso	Water resource management of transboundary basin	For youth: strengthening eco-system, better education & training, access to finance

Step 2: Food system mapping

For mapping the food system, the FSDS tool relies on the framework developed by van Berkum et al. (2018) in their report ‘The food systems approach: sustainable solutions for a sufficient supply of healthy food’, describing a way to map the relationships of the food systems to its drivers and outcomes (Figure 2). Appendices 1 and 2 provide a more detailed literature review for Burkina Faso and Niger respectively.

Overview of the food systems in Burkina Faso and Niger

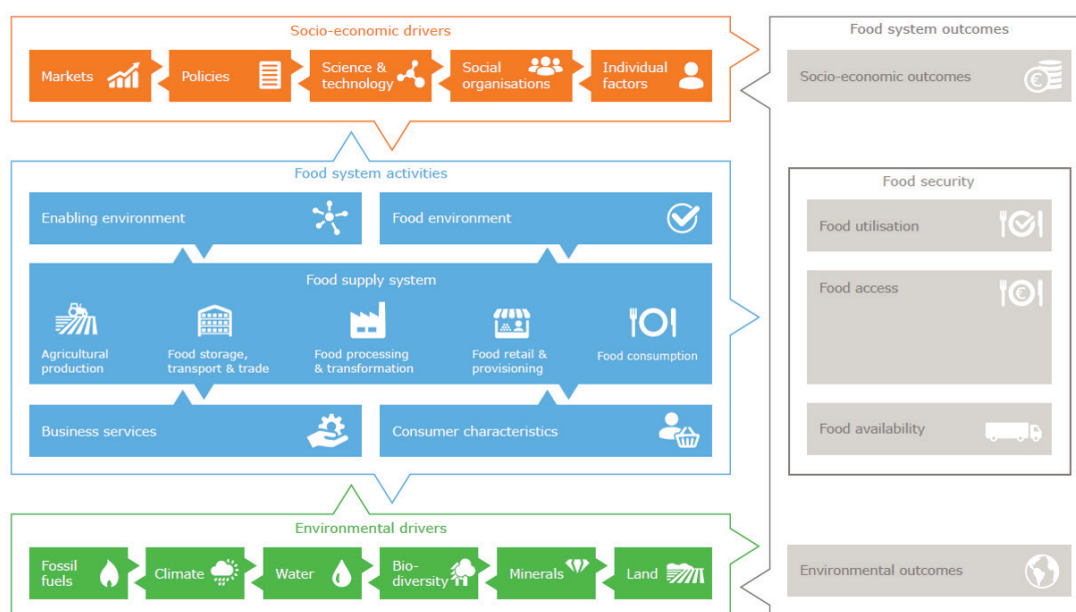
Food & Nutrition Security

Burkina Faso and Niger are both land-locked countries in the Sahel, with roughly similar population sizes (20-21 million) and poverty levels (44-45%). In both countries, the mostly rain-fed agricultural sector employs the majority (80-85%) of the population and contributes to 30-40% of the national GDP. Sorghum and millet are important staple crops, grown among sedentary farmers, while livestock is an important source of income for the pastoralist population in both countries. While cotton is an important export crop in Burkina Faso, onions and cowpeas dominate agricultural export in Niger.

Dutch interventions in FNS

While Burkina Faso and Niger are not among the fifteen strategic partner countries of the Dutch trade and development agenda, both countries host several programs to which the Netherlands contributed. For Niger, these programs are mainly in the area of emergency response, agricultural water supply and water & sanitation. In Mali, these programs are in food

Figure 2. Mapping the food system



security, water and climate projects. An example of a programme supported in both countries is the Dutch-funded Drylands Development Program (DryDev), aimed at enhancing water management, food security and rural economic development in the drylands of Niger, Burkina Faso, Mali, Ethiopia and Kenya. An overview of ongoing FNS programs is provided in the recent country profiles for these countries (Baltissen et al., 2018).

Food system outcomes

Food security (availability, access, utilization)

Total food production has followed population growth, which means that production has risen but food production per capita has stagnated. In general, the Sahel countries, Burkina Faso included, have positive grain stocks/needs balances, but this says little about local availability and market access. The Northern Sahel is by definition deficient in grains and has an excess of livestock each year that the zone is not affected by a major drought.

Besides availability, the access to food depends on terms of trade and prices: e. g. seasonal and yearly price fluctuations of livestock and feed, grains and legumes (see amongst others Nugteren and Le Côme, 2016). Especially poor people risk food insecurity (FAO, UNICEF, WFP, 2018). The households living in agro-pastoral Sahel zones have become as vulnerable as the ones in pastoral zones, as the areas are densely populated and have high pressure on natural resources. Local grain balances are precarious because of natural conditions and limited (agriculture, livestock and off-farm) options for people.¹

The development of food & nutrition security in recent decades shows a mixed picture for both Burkina Faso and Niger. On the one hand, stunting levels among children under five

¹ On vulnerability and resilience, see a. o. Gubbels, 2011, *Echapper au Cycle de la Faim, Les chemins de la résilience au Sahel*. Groupe de Travail Sahel.

Table 2. Grain* trends 2016-17

Country	Production 2016-17 (MT)	Var. re. 2015-16	Var. re. 5-year average	Availability (kg / person / year)**	Var. re. 5-year average	Balance* gross stock-consumption
Burkina Faso	4,567,000	9%	3%	234	-9%	738,200
Mali	8,850,000	10%	33%	459	16%	3,852,500
Niger	5,862,000	9%	24%	286	3%	632,600
Senegal	2,125,000	-1%	46%	148	27%	91,900
Mauretania	277,250	-18%	-11%	71	-22%	22,400
Nigeria	27,843,000	14%	17%	152	7%	-313,100

* Millet, sorghum, maize, rice, fonio, wheat; average grain consumption needs estimated at 160 kgs/pers./year.

** FAO norm for grains = 200-250 kgs/pers./year (without other calorie sources).

Source: Réseau de Prévention des Crises Alimentaires, 2017, OECD, Paris, France.

have declined between 2000 and 2016 from 41.4 % to 27.3 % in Burkina Faso and from 53.5 % to 42.2% in Niger, Moreover, the share of underweight children aged 5-19 has reduced significantly over the same period. On the other hand we see levels of overweight among children and adults rising, Where 17.5% of male adults were overweight in Burkina in 2000, this share has risen to 29.2% in 2016. In Niger, these overweight levels increased from 18.2% to 29.7% in the same period (Global Nutrition Report, 2018)

Socio-economic outcomes

In Burkina Faso, average annual GDP growth over the decade 2007/08 to 2017/18 has been fluctuating between 4 and 8 per cent. Cotton and gold are Burkina's key exports and the country's economic growth heavily depends on the production levels and global prices of these two commodities. Other important export crops are sesame seed and cashew nuts. Agricultural GDP growth has been negative in several recent years (e.g. 2011, 2015, 2017) due to dry seasons and severe heat.

Niger's GDP is growing by 4.9 per cent; the agriculture value added is 40 per cent of the GDP. Another important source of income is the extraction of minerals, such as uranium, petrol, gold and coal. It is unclear how some of their revenues are reinvested in Niger's economy.

Burkina Faso ranks 183rd, and Niger ranks 189th out of 189 countries on the UN Human Development Index (UNDP, 2019). While close to half of Niger's population (44.5%) continues to live under the \$1.90 USD poverty line, there has been a major decrease in poverty over the past decades, with 78 per cent of the population living under the poverty line in 1990 (World Bank, 2018).

Environmental outcomes

In both Burkina Faso and Niger, high population growth and the resulting increase in food demand are putting increasing pressure on land and resources. Both countries increasingly feel the effects of climate change on water availability: The increasingly short rainy seasons are marked

by an extremely erratic pattern of rainfall and interrupted by several relatively long dry spells. Land degradation is a major issue in both countries. Top soils predominantly comprise an erodible texture such as sand-clay-loam, loam, and sandy-loam. Land degradation results from climate change, farming practices, and pressure on land due to an increasing population and animal stocks. Pastoralism is thus under pressure: exploitation of in principle productive Sahel pastures in the rainy season can only take place through the existence of refuge areas in the dry season (Grain de Sel, 2017). Most of such areas can be found in river valleys and southern rangelands, typically coveted by farmers as well as land speculators.

The three main threats to biodiversity in Burkina Faso and Niger are increased rates of deforestation, reduction in freshwater bodies and wetlands and decreased yields from agricultural systems. Drastic droughts, together with harmful human activities, have greatly contributed to the degradation of agricultural soils (CBD, 2018). Studies show that in the Sahel region, farmer-managed natural regeneration of woody species can be an economically attractive strategy to restore degraded landscapes, add to biodiversity and can lead to more drought-resilient farming systems by reforestation (Reij and Garrity, 2016; Reij and Winterbottom, 2015).

Food system activities

Food supply system

Agricultural production in both Burkina Faso and Niger is dominated by three farming systems. First, small-scale production of grains and legumes is carried out by sedentary farmers. Second, the production of meat and dairy is organised in pastoral production systems, in which migrating pastoralists rear camels, goats, sheep and cattle and sell them to local markets or to traders. Finally, there is a third production system focused on the export market, with cowpeas and onions being key export crops in Niger and cotton as a main export crop in Burkina Faso.

Enabling environment

The enabling environment of food production is challenging in both countries, while some conditions for agricultural development have greatly improved in the past decades. Farmers in Burkina Faso and Niger have low access to electricity: In Niger, 5.4 per cent of the rural population is connected to the grid, while in Burkina Faso only 3 per cent of the rural population is connected. Meanwhile, in Niger the population with a mobile phone doubled and the population with access to internet quadrupled in the period between 2000 and 2016 (World Bank, 2018). Over the last decades, major investments have been done by the World Bank and other donors to improve the transport infrastructure and expand the access to water and sanitation services.

In both countries, population growth and increasing pressure on scarce arable land has led to increased competition and conflict between sedentary farmers and pastoralists. Recent efforts to introduce new regulations on land tenure in both countries have opened opportunities for reducing conflict, but the implementation of these new laws has proved to be challenging (Hughes, 2019)

Food environment

Most food in Burkina Faso and Niger is traded and purchased at informal markets. The food retail marketing channels are underdeveloped or use food from these markets. Due to lack of enforcement, the food system in both countries is not impacted by food safety or health standards and regulations. Given the low income levels only a small number of consumers can afford to pay higher prices for better quality.

Business services

In both Burkina Faso and Niger, agricultural extension and support is provided by both the government as well as through a variety of programmes offered by multilateral donor programmes. However, access to finance remains a key constraint to improving the productivity of farmers. The main constraints on access to credit for agricultural and livestock sector stakeholders are the lack – or inadequacy – of physical and financial collateral, and the lack of synchronization between loan payment schedules and farmers' income cycles.

Consumer characteristics

With large parts of the population remaining under the poverty line, the population of Burkina Faso and Niger are struggling to provide their families with the right dietary diversity. The prevalence of chronic undernutrition remains very high in both countries, due to poverty, low access to health care, low environmental hygiene and the lack of micronutrients in the food supply. Apart from children, also women of childbearing age are affected by undernutrition. In the urban areas, a different trend is emerging, with overweight and obesity on the rise.

Consumption patterns in both countries show a consistent picture of insufficient intake of fruits and vegetables, a lack of access to proteins from milk, fish or meat, low consumption of whole grains and insufficient calcium intake. On the other hand, intake of legumes is more than sufficient. The high level of salt and sugar-sweetened beverages in both countries is worrying however (Global Nutrition Report, 2018).

Environmental drivers

Climate

The persistent recurrence of droughts and related famines undermines agricultural productivity and food security in Burkina Faso and Niger. The already low agricultural productivity is anticipated to decrease even further due to climate change, as it affects the length of droughts and the intensity of rains. The impact of climate change is going to be strongly felt in both countries in the coming decades, bringing with it desertification, increased droughts and increased flooding (WUR, 2018).

In all scenarios temperature is on the rise, but different scenarios exist for rainfall: the 200mm-600mm isohyets (1970-2000 compared to 1950-70) have moved southwards, but the 1950-60s were particularly 'wet' in the Sahel. In the long run the western part of Sahel will become drier, while the central part might remain stable or become more humid. The current trend is higher variability and more unpredictability. Some scenarios predict a major drought before 2040 (See amongst others CILSS, 2016).

Water

The vast majority of people in Burkina Faso and Niger depend on rain-fed agriculture for their livelihoods; frequent droughts in the region often reduce crop and livestock yields, leading to food shortages. Both countries increasingly feel the effects of climate change on water availability. The increasingly short rainy seasons are marked by an extremely erratic pattern of rainfall and interrupted by several relatively long dry spells.

Half of the rural population in Niger does not have access to drinking water and 80 per cent of the population does not have access to sanitation (WUR, 2018). Meanwhile, there is an increasing pressure on water: annual freshwater withdrawals have increased from 14 per cent to 28 per cent of internal resources (World Bank, 2018). Recent studies show that migration in Niger is also strongly linked to lack of access to (drinking) water availability (WUR, 2018).

Land, soils, forests, pastures

Land degradation is a major issue in both Burkina Faso and Niger. Top soils are predominantly of an erodible texture such as sand-clay-loam, loam, and sandy-loam. Land degradation results from climate change, farming practices, and pressure on land due to an increasing population and animal stocks.

Moreover, there is high pressure on cultivated lands, which shows two different pictures: a general tendency of land degradation: felling of trees, decreasing soil fertility, degradation of grass pastures and erosion, reduction of fallows. At the same time we find in some areas genuine efforts towards (farm-) land and water conservation, combined or not with adapted inputs (new seeds, fertilisers) (see amongst others Reij and Winterbottom, 2015).

Biodiversity

The three main threats to biodiversity in Burkina Faso and Niger are increased rates of deforestation, reduction in freshwater bodies and wetlands and decreased yields from agricultural systems. Drastic droughts, together with harmful human activities, have greatly contributed to the degradation of agricultural soils (CBD, 2018).

Socio-economic drivers

Demographic factors

Both Burkina Faso and Niger face very high population growth. Niger is currently witnessing a high population growth of close to 4 per cent per year. Niger's population has more than doubled since 1990 and is expected to triple by 2050 (WUR, 2018). The population of Burkina Faso is also rapidly growing by an annual average of 3 per cent during the last two decades.

Migration and conflict

The Sahel has experienced an expansion and intensification of armed conflict in certain areas, disrupting basic social services and livelihoods, hindering access and delivery of assistance, negatively impacting trade flows and triggering displacement, as well as economic and pastoral migration – there are more than 760,000 internally displaced persons and refugees in Burkina Faso, Chad, Mali, Mauritania and the Niger. In cross-border areas of Burkina Faso, security measures and new legislations have negatively affected trade and transboundary movement of people and livestock. (FAO, UNICEF, WFP, 2018).

Markets

Burkina Faso and Niger share a common currency, the CFA franc, and a common central bank, the Central Bank of West African States (BCEAO), with six other members of the West African Monetary Union. Market prices typically show significant inter (seasonal) and intra-annual price variability, with price differing among areas in the country depending on surplus-production or deficit areas (see Few's Net 2017 for seasonal price fluctuations of Burkina Faso's major crops).

On the other hand, movements in the prices of imports from international markets are driven by world prices, pricing policies, and exchange rates (USD/XOF), with all trade conducted in U.S. dollars. The lack of a regular trade monitoring mechanism precludes a good assessment of these cross-border trade flows. Spot market trade dominates; contract farming hardly exists in the country.

Both countries have seen a recent increase in food imports. Burkina Faso has more than doubled its food imports from 173 million USD in 2000 to 407 million USD in 2015. Meanwhile, Niger's food imports have more than quadrupled, from 115 million USD in 2000 to 502 million USD in 2015. Food exports have also increased in both countries, although this trend is much stronger for Burkina Faso than Niger. Burkina Faso has increased the value of its food exports from 113 million USD in 2000 to 670 million USD in 2015, while in Niger food exports increased from 87 million USD in 2000 to 113 million USD in 2015 (FAOSTAT, 2019)

Policies (governance/tenure/conflict)

Burkina Faso's agricultural development strategy is formulated in its second National Rural Sector Program, 2015-2020. Agricultural sector development is promoted in order to achieve increased food security and reduce poverty, with environmental governance, promotion of sustainable development and management of natural resources as key elements of the programme. Investment priorities are sustainable production systems (climate-smart-agriculture) and irrigation infrastructures.

Niger has an active policy environment around food security, water and climate change. Its main policy on food security is the Nigeriens Nourish Nigeriens (I3N) initiative for food security and resilience. This constitutes the general framework for food and nutrition security for Niger. The most important strategy within this framework is the National Multi-sectoral Nutritional Security Policy, focused on improving the nutrition situation of the Nigerien population (WUR, 2018). Niger is trying to install early warning systems for disasters and climate events.

Both Niger and Burkina Faso have multi-sectoral comprehensive nutrition plans, and actively support their population with vitamin A supplements (60-63% coverage) and iron supplements (7-12% coverage). Moreover, the majority of women giving birth received iron and folic acid during their most recent pregnancy, with 81% coverage in Niger and 93% coverage in Burkina Faso (Global Nutrition Report, 2018)

Science & Technology

In both Burkina Faso and Niger, the research and technology infrastructure is relatively weak and very dependent on donor and development bank funding. The international research community is highly engaged in supporting both countries' fight against the impacts of cli-

mate change. For instance, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has initiated several projects in Burkina Faso to promote food security under a changing climate. In Niger, the World Bank's Solar Electricity Access Project helps to increase access to electricity through solar energy in rural and peri-urban areas of the Republic of Niger through the market development of stand-alone solar systems and service-based solar hybrid mini-grids.

Food systems mechanisms

Existing food systems studies on the Burkinabé context have a strong focus on describing the food system, while indicating the most important trends in different parts of the food system. Less attention is paid to the dynamics between different elements of the food system. While some attention is paid to trade-offs and synergies between parts of the system, as will be described below, feedback mechanisms, catalytic effects and key leverage points receive very little attention.

Trade-offs

Agricultural production in both Burkina Faso and Niger is organised in two different systems: cereals and other crops are produced in rain-fed agricultural systems by smallholders, while livestock is reared by migrating pastoralists. With increasing pressure on land, these competing agricultural systems are an increasing source of conflict. Supporting one of these agricultural systems and helping to expand production has the potential to aggravate the pressure on the other agricultural system and contribute to the risk of conflict.

With increasing population growth and a changing climate, water is becoming a potential source of conflict in Burkina Faso and Niger. The expansion of irrigated agriculture for more staple food production (rice) increases the pressure on the scarcely available water resources. At the same time, irrigation does not offer enough potential to cover possible food shortages. Attention to irrigation might happen at the expense of investments in dryland agriculture and livestock.

The food security situation is most acute in border areas, which are faced by conflict and insecurity. Repeated outbursts of violence cause development organizations to temporarily withdraw support from some of these regions, putting the most marginalised groups in the country, often refugees, in an even more vulnerable position.

Synergies

Integrated programming could help address different challenges simultaneously. Agricultural and agro-pastoral development projects focussing on livestock-crop association, agro-forestry, gardening and fisheries have the potential to address environmental challenges related to soil degradation and water depletion, while also increasing nutritional diversity and increasing the economic resilience of farmer households.

Interventions in the field of climate-smart agriculture and agricultural diversification have the opportunity to address two large development issues in Niger at the same time. These projects could reduce the impacts of climate change by making farmers more resilient in

their adaptation to climate change, while also improving the diversity of their diets, thereby improving their nutrition and health situation.

There is a potential synergy between more diverse diets and more resilient ecosystems. Studies show that in the Sahel region, farmer-managed natural regeneration of woody species will not only add to biodiversity but can also be an economically attractive strategy to restore degraded landscapes, and can lead to more drought-resilient farming systems by reforestation (Rey and Garrity, 2016; Rey and Winterbottom, 2015). Felix et al. (2018) highlight that woody perennials can have overall positive effects on soil characteristics and often improve the crop yields of annual crops. In explaining the benefits of tree-based systems as pathways to boosting resilience in dryland areas, Cervigni and Morris (2016) portray trees as key providers of biomass for energy and of medicinal products, and fruit and vegetable foliage as important merchandise and seasonal food sources for people living in the drylands.

Step 3: Identify causal processes

Based on the key informant interviews, the main causal processes underlying the food and water system were identified (Figure 3). These causal processes cover land, water and climate; natural resource management and landscape planning; conflict resolution and stability; private sector development and youth employment; and household resilience and nutrition.

Land, water and climate

There is a general consensus among key informants that climate change results in increasingly erratic rainfall patterns, resulting in localised water shortages or excesses. This affects agricultural productivity directly, but also indirectly through erosion and land degradation processes. Local initiatives (driven by CBOs and civil society) for greening and regeneration result in pockets of improved micro-climate and nutrient concentration that increases agricultural productivity at local scale. It was noted that the ecological capacity of the Sahel region is limited, and (agricultural) productivity should be understood and addressed within the Sahel-specific ecological context.

Natural resource management and landscape planning

Population growth results in an expansion of the agricultural area, causing a reduction in fallow practices (exacerbating land degradation) and fragmentation of land use (agricultural land vs common grazing land) and consequently a declining access to grazing corridors for pastoralists. In addition, there is an increase in private speculation in land which results in increasing land prices. The changes in rainfall patterns also affect the routes and seasonality of the transhumance in the region, where pastoralists move their herds to the southern zones earlier in the cropping season. In combination with increasing herd sizes (linked with population growth and private investors buying into cattle), there is an increasing problem with overgrazing, linking back to land degradation.

Conflict resolution and stability

There is a general impression among practitioners that the customary tenure regimes – which used to govern the regulation of user rights of land and water resources – have been weak-

ened. Although there are ECOWAS governance agreements, these are not implemented due to weakened state services and institutions. The weakened regulation of user rights for natural resources (resulting in exclusion of marginal groups incl. pastoralists), fragmented transhumance corridors and changing seasonality of the transhumance results in disputes and conflicts over land use between local communities and pastoralists. In addition, pastoralists are increasingly stigmatised, marginal groups are radicalising and local groups are arming themselves, all resulting in escalating local armed conflicts.

Private sector development and youth employment

The escalating conflicts and declining security result in refugees, increased migration and reduced investments in the agribusiness sector. Migration has been an important economic activity insofar as the remittances from the diaspora is an important income source that improves household resilience. Current European anti-migration policies, however, constrain the migration movements within the Sahel region. The weakened state services also negatively affect the services (including education, public and private services sector, infrastructure) for the agricultural sector. The lack of investments and support hampers the development of the agricultural sector, thus restraining the agricultural productivity and the employment creation in rural areas. Lack of future prospects encourage youth (in particular young men) to migrate to urban centres and/or other countries. Key informants indicated that short horticultural value chains close to peri-urban centres provide the best opportunity to develop a services sector and create income opportunities for youth. It was noted that young men and young women have different interests, opportunities, knowledge and skills.

Step 4: Label system behaviour

Based on the key informant interviews and the mapping of the causal processes, several archetypes of system behaviour were identified. The most common archetypes are:

- Tragedy of the commons (related to degradation of natural resources)
- Limits to success (related to ecological constraints)
- Success to the successful (related to access to natural resources, and power dynamics within cereal supply chains)
- Growth and underinvestment (related to the agricultural sector and agribusiness development)
- Escalation (related to conflict)

Appendix 3 provides an overview of the different patterns and archetypes identified within the food and water system of the Sahel.

Step 5: Identify leverage points

In a fragile, risk-prone, yet dynamic region like the Sahel and Sudan zones in West Africa, resilience is key. This means agro-ecological, economic and political resilience at all levels (regional, national, local and household). The diversification and multifunctional use of resources supporting resilience thus needs to be enabled by institutional strengthening and economic development. Traditionally, local communities and traditional institutions have been well equipped to optimise resilience within this region. Interventions should thus seek to strengthen these diverse and complex livelihood strategies rather than impose external development models that may have worked elsewhere but are likely to fail in this region. There is also a plea amongst practitioners to look for grassroots technical and social innovations by working with local groups representing youth and women, and local CBOs and NGOs. It is deemed important to strengthen and empower the civil society movement, rather than the established power structures that are in place. Local contextualised interventions are recommended, rather than top-down programmes through international NGOs and/or national governments – although they have a modest role to play as well.

Table 3 summarises the most urgent system constraints and entry points for introducing interventions that would offer leverage.

Table 3. System constraints and entry points for leverage

System constraints	Burkina Faso	Niger
Lack of 'contrat social' between citizens and state institutions, poor local governance, inadequate local institutional capacities	<p>Strengthening of local democracy; services; decentralised planning, enforcement:</p> <ul style="list-style-type: none"> • Landscape planning (incl. user rights of commons, NRM) • Agricultural advisory services • Implementation and enforcement of water, land and nutrition acts • Sahel: Early warning systems for floods, drought and famine • Food policy (rural-urban supply chains, food safety standards) • Transfer of competencies and resources from central state to local government 	
	<p>Commune + Provincial/Regional level</p> <hr/> <p>Strengthening of existing citizens'/ youth organisations</p>	<p>Commune + Departmental/Regional level (note: strong traditional authorities)</p>
<p>Escalating conflict</p> <p>Niger: acquisition of pastoral resources (land and water)</p>	<ul style="list-style-type: none"> • Strengthening of emergent platforms for dialogue between conflicting parties related to use of natural resources • Strengthening of public institutions (incl. traditional authorities and users' groups) for conflict resolution/ NRM • Strengthening of independent investigative journalism and think tanks 	<hr/> <p>Strengthening of pastoralists' organisations</p>
Stagnating rural economic development & youth unemployment	<p>Asset building & protection (risk management) for the vulnerable; for example:</p> <ul style="list-style-type: none"> • Women saving groups • Destocking during drought • Farmer insurances • Development of rural services sector in/around rural hubs 	
	<ul style="list-style-type: none"> • Agricultural services (incl. finance, research & education), seed sector development • Value chain development of niche commodities (cashew, sesame, cotton) 	<ul style="list-style-type: none"> • Idem + Veterinary services • Strengthening of informal livestock value chains • Value chain development in horticulture (onion, cowpea, ...)
Degradation of land and water resources	<ul style="list-style-type: none"> • Land tenure security incl. secondary rights' holders (women, ...) • Soil and water conservation (erosion control, agroforestry, climate-smart agriculture, association livestock & crops, etc.) 	
		<hr/> <ul style="list-style-type: none"> • Land tenure security (user rights) for pastoralists • Rangeland improvement
Increasing household vulnerability	<ul style="list-style-type: none"> • Gender & nutrition • Investments in WASH and healthcare • Social protection measures (local government) 	

APPENDIX 1

Food & Nutrition Security in Burkina Faso

A food system description

1. Food & Nutrition Security in Burkina Faso

Burkina Faso is a semi-arid Sahel country with a population of about 20 million, where 44% of the population lives below the poverty line (World Bank, 2017). Around 672,000 children under five years (21 per cent) suffer from chronic malnutrition (stunting or low-height-for-age) and 10 per cent suffer from acute malnutrition (wasting or low weight-for-height) (USAID, 2018). In July 2018 about half a million people received food assistance in the framework of WFP interventions (WFP, 2018). Food insecurity stress was highest in the northern region, close to the border with Mali, due to the prevailing insecurity in the area.

The agricultural sector employs around 80 per cent of the population, and generates roughly a third of the country's GDP, but struggles to produce an adequate supply of food. Variable rainfall, land degradation, deforestation, and desertification all negatively impact Burkina Faso's agricultural efforts (USAID, 2018).

Sorghum, millet, cowpeas and maize are the main coarse cereal crops grown and consumed in Burkina Faso (FEWS Net, 2017). Rice is also an important part of the household food basket, and increasingly imported. Fruit and vegetables are largely garden produce. Livestock raising (mostly small ruminants) is an important source of income for poor households in Burkina Faso. Cotton is the country's major cash crop.

2. Overview of Dutch interventions in FNS in Burkina Faso

Burkina Faso is one of the countries with which the Netherlands ended its bilateral aid relationship in 2013, after having provided support for more than 40 years. One of the main justifications was that the existing programme did not dovetail with most of the new priorities (food security, water and sanitation, and security and the rule of law) (IOB, 2016). Yet, the decision to end the aid relation was also affected by the budget cuts on development cooperation. The 2016 IOB evaluation report concludes that as long as Burkina Faso remains a poor country and does not have the means to provide public services to the whole population at an adequate level on its own, aid can help the country to achieve development targets.

Even though the Netherlands stopped its bilateral aid programme in 2013, several Dutch actors are still involved in multilaterally funded development programmes in Burkina Faso contributing to food security, water and climate/energy projects. An overview of these activities can be found in Baltissen et al. (2018).

3. Bottlenecks in the Burkinabe food system

There is a range of key bottlenecks facing the Burkinabe food system:

- Agricultural development is hampered by a lack of financial means necessary to use productivity enhancing inputs, and to invest in storage and processing capacities that will help to reduce food losses and add value to the produce in the supply chain.
- Land degradation via soil erosion is a major obstacle for sustained and integrated socio-economic development for farmers in Burkina Faso.
- Agricultural encroachment on forest- and range-lands is another obstacle for sustained and integrated socio-economic development for several users' groups.
- In order to respond to the increased food demand due to rapid population growth intensification of agricultural practices is necessary but these will lead to further environmental pressures on the country's already limited land and water resources.
- Moreover, as claims on land increasingly compete, land use conflicts (local elites and some large agribusiness enterprises acquiring rural land for speculation or focusing on cash crops, tensions with and between smallholders and pastoralists) rise. Land ownership and users' rights are determined by a complex mix of formal regulations and customary practices.
- Effective implementation of the country's Rural Sector Programme falls short of success due to weak government institutional capacities, effective participation of rural stakeholders and the use of scientific and technical support.

4. The Burkinabe food system – an overview

4.1 Food system activities

Food supply system

Total food production in Burkina Faso has increased over the past two decades, largely by expanding the agricultural area (at the cost of forest and savannah). The agriculture-based economy is dominated by small-scale production oriented towards food stocks as well as markets, with low productivity in general (for example: around 1 tonne/ha for millet and sorghum; 1.5-2.0 tonnes/ha for maize and 2.0-2,5 tonnes/ha for rice (FAO stat)). There are two types of production systems: extensive rural and a small minority of intensive urban/peri-urban systems. Livestock production in northern regions of the country is largely based on extensive rural production systems (mostly oriented towards meat and local milk production). Burkina Faso has a livestock production surplus. Burkinabe livestock is sold throughout the region, with exports to Nigeria and other coastal states (including but not limited to Ghana and Côte d'Ivoire). Peri-urban livestock is oriented towards milk production (Dosa et al., 2015).

Storage is one of the weak links across agricultural value chains in Burkina Faso. On-farm storage systems have limited capacity and do little to help ensure good supply management in time and space (Fews Net, 2018).

Artisanal or cottage cereal processing operations focus largely on the production of traditional dolo beer, and to a lesser degree supply informal sector eateries and meet demand

from industrial cereal processing plants. There is a relatively limited but growing demand for converting cereals into animal feed, fuelled by the increasing numbers of poultry farms. A large part of the food processing industry involves the production of edible oils, particularly cottonseed, with a few modern industrial oil mills crushing cottonseed, along with several small plants using artisanal methods to produce unrefined oils. Some livestock is processed into meat at two refrigerated slaughterhouses in Ouagadougou and Bobo-Dioulasso. Other slaughterhouses around the country lack the required capacity and/or fail to meet required standards. A considerable part is processed in informal circuits by local butchers. Few industrial meat processing plants exist, and most butchers and rotisserie or grill shops use artisanal processing methods (Fews Net, 2017).

Assembly (farmers sell to traders) and wholesale markets (traders sell to traders) are agricultural commodities' main marketing channel, connecting surplus-producing areas with deficit areas, among which are Burkina's major cities. Food retail sales are heavily weighted towards the traditional trade (on-farm sales, street vendors, open markets etc.), due to the small number of modern supermarkets in the country.

Enabling environment

With World Bank and other donors' support Burkina Faso has invested heavily in transport and urban infrastructure (including improved access to water and sanitation services) over the last decades. Currently a tarmac road network of over 3000 kilometres connects all major cities with the capital Ouagadougou, whereas the capital city has reasonable road connections with major foreign cities in the region. Yet, regional routes as well as country roads are mainly earth tracks.

Land tenure security and access to water resources are major concerns in Burkina Faso. Land pressure has led to increased competition and conflict between actors for control and land use. The duality of the two existing land tenure regimes – one based on national laws and the other on the customary land practices – leads to confusion on rights and responsibilities and can constitute a constraint on farmers' access to finance. At the same time, the cotton and maize farmers' revolution in Burkina has appeared under customary land tenure regimes. New land tenure legislation adopted in 2009 is an effort to strike a balance between respect for local practices and ambitions for removing land tenure insecurity as a constraint to development. The challenge lies in its implementation (see also Hughes, 2014).

Corruption is a widespread problem in Burkina Faso and presents business operating or planning to invest in the country with very high risks (GAN, 2018) Companies face high corruption risks when dealing with the judiciary, as the institution is perceived to be highly corrupt and inefficient.

Food environment

Most food is traded and purchased at informal markets. The food retail marketing channels are underdeveloped or use food from these markets. Due to a lack of legislation, the country's food system is not impacted by food safety or health standards and regulations. Given the low income levels – Burkina Faso is among the poorest countries – very few consumers can afford to pay higher prices for better quality.

Business services

Burkina Faso lacks financial institutions devoted especially to finance agricultural activities: bank loans to the agricultural sector account for only two per cent of their volume of lending and are mostly in the form of short-term loans (farm input credit, financing for trading activities), leaving large unmet medium and long-term financing needs for the purchasing of necessary equipment for the modernization of production systems (Fews Net, 2017). The main constraints on access to formal credit for agricultural sector stakeholders are the lack or inadequacy of physical and financial collateral, and the lack of synchronization between loan payment schedules and farmers' income cycles. On the other hand, community-based financial institutions offering grants of microloans are relatively active. The country has numerous local savings- and loans groups, often composed of women. Moreover, there is also an indirect financing mechanism currently used by the agroindustrial company Société Burkinabè des Fibres Textiles (SOFITEX, or Burkinabe Textile Fiber Company). This mechanism basically collects loans granted to cotton growers' organizations against the subsequent delivery of crops (Fews Net, 2017).

Consumer characteristics

Becquey et al. (2010) show a positive relation between socio-economic status (income levels and life-style) and a modern food intake with more animal and processed products in an Ouagadougou case study, yet also conclude that dietary patterns remain largely traditional. Next, food consumption patterns in both rural and urban communities in Burkina Faso depend on what is available and affordable during the season. In a survey covering over 10,000 (mainly rural) households Somé and Jones (2018) find that staple foods (i.e., cereals, tubers and roots) were consumed by almost all households across all seasons with no seasonal variation, yet that the consumption of vegetables varied greatly during the season and that few households consumed dairy products, fruits, or eggs in any season. Seasonal differences are largely explained by the consumption of beans and peas, and nuts and seeds during the harvest season, in addition to the four food groups that are regularly consumed by almost all households year-round (i.e. staple foods, green leafy vegetables, other vegetables, and flesh foods). Rural residents in Burkina Faso commonly subsist on a thick, cereal-based porridge eaten with a sauce made of leafy vegetables and condiments such as chili, soumbala (i.e., fermented seeds of African locust bean and dried fish (Somé and Jones, 2018).

4.2 Food system outcomes

Food security

Total food production has been able to follow population growth, which means that production has risen but food production per capita has stagnated. In general, the Sahel countries, Burkina included, have positive grain stocks/needs balances, but this says little about local availability and market access. The Northern Sahel is by definition deficient in grains and has an excess of livestock in the years the zone is not affected by a major drought. Besides availability, the access to food depends on terms of trade and prices: e.g. seasonal and yearly price fluctuations for livestock and feed, as well as for grains and legumes (See a. o. Nugteren and Le Côme, 2016). Especially poor people risk food insecurity (FAO, UNICEF, WFP, 2018). The households living in Sahel's agro-pastoral zones have become as vulnerable as the ones in pastoral zones, as the areas are densely populated, which places high pressure

on natural resources. Local grain balances are precarious because of natural conditions and limited (agric., livestock and off-farm) options for people.²

Table 4. Grain* trends 2016-17

Country	Production 2016-17 (MT)	Var. re. 2015-16	Var. re. 5y. average	Availability (kgs/p./y.)**	Var. re. 5y. average	Balance* gross stock-consumpt.
Burkina Faso	4,567,000	9%	3%	234	-9%	738,200
Mali	8,850,000	10%	33%	459	16%	3,852,500
Niger	5,862,000	9%	24%	286	3%	632,600
Senegal	2,125,000	-1%	46%	148	27%	91,900
Mauritania	277,250	-18%	-11%	71	-22%	22,400
Nigeria	27,843,000	14%	17%	152	7%	-313,100

* Millet, sorghum, maize, rice, fonio, wheat; average grain consumption needs estimated at 160 kgs/pers./year.

** FAO norm for grains = 200-250 kgs/pers./year (without other calorie sources).

Source: Réseau de Prévention des Crises Alimentaires, 2017, OECD, Paris, France.

Consequently, in several parts of the country and during much of the year a significant part of the population is short on food. FAO estimates 4 million people (21%) of Burkina's population is undernourished, with an estimated 4.4 million people severely food insecure. The percentage of stunted children under five year of age has declined from 43 per cent in 2003 to 27 per cent in 2016 according to FAO records – still dramatically high. Around 50 per cent of women of reproductive age suffering anaemia. On the other hand, only 4.5 per cent of the adult population is overweight, though the percentage is increasing.

Environmental outcomes

Food production in Burkina Faso contributes to a range of environmental outcomes. Generally, the rapidly increasing population (3.1% p.a. growth rate) is resulting in growing demand for food, thereby putting pressure on the limited land and water resources of the country, which results in environmental stress. Increasing the area of cultivation would result in the destruction of natural vegetation cover. More land area is in turn put at risk in terms of soil erosion.

Socio-economic outcomes

Average annual GDP growth over the decade 2007/08 to 2017/18 has been fluctuating between 4 and 8 per cent. Cotton and gold are Burkina's key exports and the country's economic growth heavily depends on the production levels and global prices of these two commodities. Other important export crops are sesame seed and cashew nuts. Agricultural GDP growth has been negative in several recent years (e.g. 2011, 2015, 2017) due to dry seasons and severe heat.

2 On vulnerability and resilience, see a. o. Gubbels, 2011, *Echapper au Cycle de la Faim, Les chemins de la résilience au Sahel*. Groupe de Travail Sahel.

4.3 Environmental drivers

Climate

With predominantly rain-fed agricultural systems, rainfall is one of the main climatic determinants of food production in Burkina Faso. The country has a tropical climate with two alternating seasons. The country's rainy season spans from May to October. Average annual rainfall (1980 to 2016) ranges from 250 mm in the north to approximately 1100 mm in the south. Average monthly temperatures vary from 23°C to 34°C in the north, and to 25°C to 31°C in the south. Average annual potential evapotranspiration is approximately 1875 mm and almost constant from one year to the other, thus indicating a negative water balance throughout the years (Nyamekye et al., 2018).

In all scenarios temperature is on the rise, but different scenarios exist for rainfall: the 200mm-600mm isohyets (1970-2000 compared to 1950-70) have moved southwards, but the 1950-60s were particularly 'wet' in the Sahel; in the long run the western part of Sahel will become drier, while the central part might remain steady or become more humid. The current trend is higher variability and more unpredictability. Some scenarios predict a major drought before 2040 (See a. o. CILSS, 2016).

Land, soils, forests, pastures

Land degradation is a major issue in Burkina Faso. Topsoils in most parts of the country predominantly consist of an erodible texture such as sand-clay-loam, loam, and sandy-loam. Land degradation results from climate change, farming practices, and pressure on land due to an increasing population and animal stocks.

Pastoralism is under pressure: exploitation of in principle productive Sahel pastures in rainy season can only take place through the existence of refuge areas in the dry season (Grain de Sel, 2017). The majority of such areas can be found in river valleys and southern rangelands, typically coveted by farmers as well as by land speculators. In the southern Sahel agricultural areas have become 'saturated', especially the old agricultural basins such as the 'Mossi Plateau'. There is high pressure on cultivated lands, which shows two different pictures: on the one hand, there is a general tendency towards land degradation – the felling of trees, decreasing soil fertility, degradation of grass pastures and erosion, reduction of fallows – the forest-rangelands are also degraded. On the other hand, we find in some areas genuine efforts towards (farm-) land and water conservation, combined or not with adapted inputs (new seeds, fertilisers) (see a.o. Rey and Winterbottom, 2015). The implementation of soil and water conservation measures in Burkina Faso has seen some success but increased adoption of practices depend on strengthening and re-organising institutions that aim at increasing farmers' participation in decision making and securing land ownership (Nyamekye et al., 2018).

The current agricultural belts in the Soudan area, dominated by coarse grains and cotton, show rising pressure on cultivated lands and reserves, although there are still fallows and remnants of forest-rangelands. Nevertheless, the old method to restore soil fertility is compromised and farmers are looking for additional fertilisation or plant regeneration strategies (manuring, new external inputs, association of farming-livestock). For the moment the scale of these additional practices is insufficient to compensate the risks of land degradation (Nellen et al., 2015).

Water

In recent history, droughts have had a major impact on Burkina's economy and agricultural production. One example was the unusually short rainy season during the 2004-2005 crop year: it ended in September, which prevented crops from completing their normal growing cycle. During that same year, the desert locust infestation in West Africa destroyed part of the harvest in the country's Sahelian zone. These two disasters resulted in the loss of over 25 per cent of national cereal production. Like other Sahelian countries, Burkina Faso is feeling the effects of climate change. Its increasingly short rainy seasons are marked by an extremely erratic pattern of rainfall and interrupted by several relatively long dry spells (Fews Net, 2017). The country may be divided into three agricultural zones: the northern region (Sahel) with annual rainfall below 600 mm, the central and eastern regions, with rainfall in the range of 600 to 900 mm, and the western region, with rainfall in the range of 900 mm and 1100 mm. The western region thus constitutes the region with the best agricultural potential (main products are maize and rice, next to sugar cane and cotton).

Biodiversity

Burkina's biodiversity and ecosystem services, with their great importance to the livelihoods of poor people, are under pressure (CBD, Burkina Faso country file). Among the direct causes are conversion of natural forests, grazing lands, woodlands and wetlands into agricultural land and settlement. The centre of the country – called the Mossi land – experiences a high population concentration, which led to an overexploitation of natural resources resulting in the degradation of the environment and a loss of biological diversity. The three main threats to biodiversity in Burkina Faso are increased rates of deforestation (4% per year according to the FAO), reduction in freshwater bodies and wetlands and decreased yields from agricultural systems. Drastic droughts, together with harmful human activities, have greatly contributed to the degradation of agricultural soils (CBD, 2018). Studies show that in the Sahel region farmer-managed natural regeneration of woody species can be an economically attractive strategy to restore degraded landscapes, add to biodiversity and can lead to more drought-resilient farming systems by reforestation (Rey and Garrity, 2016; Reij and Winterbottom, 2015). Felix et al (2018) highlight that woody perennials can have overall positive effects on soil characteristics and often improve crop yields of annual crops. Their message is that strategies that strengthen and use biodiversity are crucial for sustained food production and livelihoods in semi-arid West Africa (see also Cervigni and Morris, explaining the benefits of tree-based systems as pathways to boosting resilience in dryland areas).

4.4 Socio-economic drivers

Markets

Market prices typically show significant inter (seasonal) and intra-annual price variability, with price differing among areas in the country depending on surplus-production or deficit areas (see Fews Net 2017 for seasonal price fluctuations of Burkina's major crops). On the other hand, movements in the prices of imports from international markets are driven by world prices, pricing policies, and exchange rates (USD/XOF), with all trading conducted in U.S. dollars. The lack of a regular trade monitoring mechanism prevents a good assessment of these cross-border trade flows. Spot market trade dominates; contract farming hardly exists in the country.

Policies

Burkina's agricultural development strategy is formulated in its second National Rural Sector Program, 2015-2020. Agricultural sector development is promoted in order to achieve increased food security and reduce poverty, with environmental governance, promotion of sustainable development and management of natural resources as key elements of the programme. Investment priorities are sustainable production systems (climate-smart-agriculture) and irrigation infrastructures. Burkina Faso is highly dependent on financial support from donors for implementing its agricultural development strategy. One of these donors is the World Bank, which, through its Agriculture Diversification and Market Development Project (PAFASP), invests in small-scale irrigation schemes, promotes the establishment of farmers' organizations and supports micro-financing schemes targeted at non-traditional cash crops such as fruit (especially mangoes) and vegetables (such as onions, tomatoes, potatoes and beans), and the poultry meat/livestock value chain (World Bank, 2017).

Governance and tenure security

Poor governance is another bottleneck faced by farmers and livestock keepers, men and women. Land tenure (in-) security exemplifies this. In all areas rising pressure and higher land values undermine customary tenure regimes, with the risk to reduce a wide range of access and property rights to mere (private) ownership and titles. The countries have legislation (2009) which recognises different rights, common pool resources and livestock mobility, but the legislation is often not put into practice. The commons are exposed to land acquisitions, land speculation is not sanctioned and secondary rights' holders (women, pastoralists, migrants) risk being excluded from key resources. The inability of the central state to manage and protect resources is a constant factor in the past decades. Decentralisation has the potential to break the impasse and bring natural resource management back to local level control. However, until now it has not fulfilled its promise, in large part because of a lack of transfer of competencies and finances from the central government to local institutions (Hesse et al, 2013; Grain de Sel, 2012).

Increasing displacement and armed conflict

Armed conflict has become a determinant factor in Sahel livelihoods in the past decade: *"The Sahel has experienced an expansion and intensification of armed conflict in certain areas, disrupting basic social services and livelihoods, hindering access and delivery of assistance, negatively impacting trade flows and triggering displacement, as well as economic and pastoral migration there are more than 760,000 internally displaced persons and refugees in Burkina Faso, Chad, Mali, Mauritania and the Niger. In cross-border areas of Burkina, security measures and new legislations have negatively affected trade and transboundary movement of people and livestock."* (FAO, UNICEF, WFP, 2018).

Science & Technology

The Agricultural research and technology infrastructure in Burkina Faso is particularly small and weak, with poor linkages between research and extension (ASTI, 2017). The country's agricultural research is extremely dependent on donor and development bank funding. The international research community is highly engaged in supporting the country's combat against climate change. For instance, the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) has initiated several projects in Burkina Faso to promote food security under a changing climate. Next to multilateral organisations like World Bank

and FAO, international donors like USAID and GIZ are active in the country, with a main focus on strengthening national research planning and implementation capacity in the areas of sustainable agriculture, soil conservation and water.

Demographic factors

The population of Burkina Faso is growing on average by 3 per cent annually during the last two decades. Moreover, the country is rapidly urbanising: in 1990 12% of the 8.8 million were living in cities, whereas in 2018 the urban population was 32% of the 19.8 million inhabitants (www.worldometers.info/world-population/burkina-faso-population).

Individual factors

Diets mainly consist of cereals, vegetables and fats from vegetable sources in traditional dishes, and only (and slowly) the more affluent consumers in urban areas are including more 'modern' foods such as chicken meat, eggs, cheese and pastas in their diets (Becquey et al., 2010).

Food and water-borne illness is a concern in Burkina Faso. Grace et al. (2018) show that major food-related health problems are tuberculosis related to the consumption of meat, eggs and dairy products, and listeria in processed food. Besides, groundnuts are considered a risky food product. The lack of water and poor sanitation is the major cause of food-borne illness in the country. Grace et al. claim that investment in a small number of key hazards and foods would have large benefits, and suggest a ten-step investment Road Map.

5. Food system mechanisms

Existing food systems studies on the Burkinabe context have a strong focus on describing the food system while indicating the most important trends in different parts of the food system. Less attention is paid to the dynamics between different elements of the food system. While some attention is paid to trade-offs and synergies between parts of the system, as will be described below, feedback mechanisms, catalytic effects and key leverage points receive very little attention.

Trade-offs

Food system studies on the Burkinabe context point to a range of trade-offs in Burkina's food system:

- In order to respond to the increased food demand due to rapid population growth, intensification of agricultural practices is necessary, combined with protection of the commons (mainly forest- and range-lands), but these will lead to further environmental pressure on the country's already limited land and water resources. Moreover, land use conflicts (between local elites or agribusiness enterprises, smallholders and pastoralists) will increase due to lack of transparency in ownership and users rights.
- Except for cotton and more institutionalised grain trade (with WFP or SONAGESS), farmers are poorly integrated in formal supply or value chains. Improved access to urban and export markets would provide great opportunities to farmers and other supply chain actors, yet also create business risk and dependencies (e.g. price volatility, financing conditions, contractual relationships).

- Grain trade to the big towns and -imports are still in the hands of a small group of traders, some of whom are well connected in political networks. This might hamper the lowering of prices.

Synergies

Other studies point to possible synergies in the Burkinabe food system:

- There is a widespread, mostly informal food economy wherein trade channels connect remote rural areas to a wide range of small towns. This trade is responsible for the bulk of food trade in Burkina (for grains, livestock, fruits, vegetables). Modern retail is still modest. After state withdrawal mostly (informal) trade networks took over cereal commercialisation and proved their ability to keep pace with rising food demands. The food chains are not merely 'short', since trade can have regional dimensions: livestock markets can go from the deep Sahel to coastal markets; some cereal and livestock markets already exist for long decades. Women occupy a dominant place as farmers, traders and processors. In Burkina Faso the informal economy employs 74% of the non-farming workforce and contributes to about 25% of the GDP (Traoré and Ouédraogo, 2015). On the other hand, there is little social security. Food quality or hygiene is a crucial question (in both 'formal' and 'informal' circuits). Farmers and traders cope with inefficiencies, while having little working capital. Although the discussion on which interventions are needed still varies, there is consensus amongst policy makers to look at the informal economy for improving its role in food supply and its potential as a source of employment.
- There is a potential synergy between more diverse diets and more resilient ecosystems. Studies show that in the Sahel region, farmer-managed natural regeneration of woody species will not only add to biodiversity but can also be an economically attractive strategy to restore degraded landscapes, and can lead to more drought-resilient farming systems by reforestation (Rey and Garrity, 2016; Rey and Winterbottom, 2015). Felix et al. (2018) highlight that woody perennials can have overall positive effects on soil characteristics and often improve the crop yields of annual crops. In explaining the benefits of tree-based systems as pathways to boosting resilience in dryland areas, Cervigni and Morris (2016) portray trees as key providers of biomass for energy and of medicinal products, and fruit and vegetable foliage as important merchandise and seasonal food sources for people living in the drylands.

6. Overview of trends in Burkina Faso's agricultural sectors

6.1 Cotton sector

Cotton is the agricultural sector's most important crop, as the sector provides incomes for 15-20% of the active labour force in Burkina Faso. It is composed mostly of small farms and smallholders, with a small number of large farms led by rural elite. Since independence, the Burkinabe cotton processing and marketing segment has been owned and operated by SOFITEX, a government parastatal. Cotton producers have benefited from the input supply chain, which provides them with modern inputs (seeds, fertilisers, insecticides, and animal draft power), credit, extension services, and a guaranteed pricing system that shields them from risk; these benefits were often eroded, however, by the monopsony control of SOFITEX, which left the cotton producer with only a meagre share of the world cotton price (FAO,

2018). As part of policy reforms initiated in the 1990s and continued in the 2000s, cotton farmers have become more organised, defending farmers' interest and taking up chain activities (Nelen et al., 2012).

Since its introduction in 2009, the adoption of Bt cotton already approaches 80 per cent of the total planted area, resulting in yield increases that averaged 20 per cent per year, whereas higher production combined with lower costs has raised average producer returns and improved overall household welfare. More recently, due to some stagnation (in production and supply) or to high costs, farmers as well as SOFITEX have shown reluctance to grow Bt cotton.

At the aggregate country level, higher production (as a result of the significant yield increase) has translated to greater cotton exports. (FAO, 2018). Because of the size and degree of organisation of the cotton sub-sector, the potential for up-scaling remains very high for chain improvements and development activities such as vocational training and extension (Nelen et al., 2012).

6.2 Cereal sector

Cotton-growing areas – mainly in the south-west of the country - are also major cereal-producing areas (maize, sorghum). Cereal production benefits from the equipment, inputs (such as fertilisers), and training provided for cotton production. The cereal sector also gets a limited amount of funding through the cotton financing facility (FEWS Net, 2017). There is also support for maize and sorghum production from institutions as WFP and SONAGESS which have started to purchase these grains from farmers' associations. Such support does not exist for millet, which remains a major staple food in all areas in Burkina. Rice production is on the rise, but is still behind the coarse grains.

Since the mid-1980s, land under cereal production in Burkina Faso has gradually increased up to 4 million hectares in 2017. Sorghum, maize and millet are the country's major crops. Production is highly dependent on rainfall and the occurrence of plant diseases (e.g. fall armyworm infestations), leading to harvest results that can heavily fluctuate. At the subnational level, there are large disparities in cereal availability from one province to another, resulting in regional price variations that may increase during the season. Cereal processing is limited towards producing traditional beer, with more recently increasing animal feed operations for the expanding poultry sector.

6.3 Livestock sector

Pastoral livestock dominates the country's animal sector, adding about a quarter to Burkina's agricultural GDP. Trade of livestock and related products (hides, skins, dairy) contribute significantly to local economies, tax revenues and foreign trade earnings. Pastoralism proves to be an efficient use of the regions' drylands by adapting effectively to changing temporal and spatial distribution of pasture and water resources, through their mobility and through adjusting their herd size and composition. Yet pastoral mobility is increasingly under

threat in the whole region. Expansion of agricultural land, accelerated population growth and commercialisation of resources compromises and fragments pastoral areas and limits the availability of grazing areas previously meant to be used as 'backup' during droughts. More recently, field reports indicate large concentrations of livestock and over-grazing problems in certain areas. The animals cannot access the traditional grazing areas due to the civil conflict in Djibo and Koutougou (Province of Soum) (FAO GIEWS June 2018).

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APPENDIX 2

Food & Nutrition Security in Niger

A food system description

1. Food & Nutrition Security in Niger

Niger is a land-locked Sahel country with a population of 21 million, where 44.5% of the population lives below the poverty line (World Bank, 2016). More than 2 million people in Niger are chronically food-insecure, while 4.5 million are at risk of food insecurity. A share of 42.2% of children under five are chronically malnourished (WFP, 2017). Food insecurity stress is highest in the Diffa region in the southeast of Niger and along the border with Mali, due to prevailing insecurity in these areas.

Niger's agricultural sector employs 85 per cent of the labour force, and generates 40% of the country's GDP. Its agricultural economy is largely based on staple crops (millet, sorghum and cassava) and livestock production (camels, goats, sheep and cattle). Livestock supports 29% of the population and contributes to 14% of Niger's GDP. Cowpeas and onions are grown for commercial export to Nigeria and other coastal countries, and Niger produces small quantities of garlic, peppers, potatoes and wheat, as well as rice, groundnuts and cotton.

2. Overview of Dutch interventions in FNS in Niger

Whereas Niger is not one of the fifteen strategic partner countries of the Netherlands, there are quite a few Dutch actors involved in development programmes in the country. In 2017, the Netherlands had committed USD\$2.96m towards emergency response projects in Niger. Additionally, the NL Enterprise Agency spent USD\$337,000 on agricultural water supply projects and USD\$21,000 on water and sanitation projects (WUR 2018). The Netherlands supports three major programmes in Niger. These are the Iom Miraaa Agadez II programme, aimed at relief coordination, protection and support services; the Satellite Based Water Monitoring and Flow Forecasting programme aimed at delivering agriculture water services; and the ORIO-supported programme around the extension of the existing water supply system in Niamey (WUR, 2018).

Apart from these large, multilateral projects, Dutch actors are involved in a range of other programmes. The Drylands Development Program (DryDev), implemented by ICRAF is funded by the Netherlands. This initiative is a five-year programme aimed at enhancing water management, food security and rural economic development in the drylands of Niger. The Netherlands Space Office (NSO) is executing the Geodata for agriculture and water (G4AW) programme, which improves food security in developing countries by using satellite data. ORIO also supports the project Satellite Based Water Monitoring and Flow Forecasting, supporting the Niger Basin Authority (NBA) with the development, operation and maintenance

of a Meteosat-based water monitoring, flow forecasting and information diffusion system for the nine countries of the Niger River basin (WUR, 2018).

3. Bottlenecks in the Niger food system

There is a range of key bottlenecks facing the Niger food system:

- With 90 per cent of Niger's poor living in rural areas, the economy is largely reliant on the mining and agricultural sectors (WFP, 2018). Frequent droughts in the region reduce crop and livestock yields, contributing to food shortages in the country (USAID, 2018). Productivity is at risks of decreasing further due to more climate events (droughts, floods).
- Security issues plague the borders with Mali and Nigeria, negatively impacting food production in those border regions (FEWS, 2018)
- Deforestation and soil erosion are major obstacles for sustained and integrated socio-economic development for farmers in Niger (WFP, 2018).
- Agricultural encroachment on rangelands is another obstacle for sustained and integrated socio-economic development for several users' groups (f. i. pastoralists).
- As claims on land increasingly compete, land use conflicts rise (local elites acquiring rural land, and tensions with and between smallholders and pastoralists). Land ownership and users' rights are determined by a complex mix of formal regulations and customary practices.
- The fast population growth in Niger translates into a quickly growing food demand and puts more pressure on the scarcely available agricultural and pastoral lands (USAID, 2018).
- Chronic food insecurity and a high prevalence of infectious diseases have resulted in Niger having some of the highest malnutrition and mortality rates in the world (WUR, 2018).

4. The Niger food system – an overview

4.1 Food system activities

Food supply system

The majority of Niger's crop farming is clustered in the south-centre and southwest of the country, in those areas with annual rainfall between 300mm and 600mm. The agricultural economy is dominated by small-scale production orientated at food stocks as well as markets, in general with low productivity (most grains and legumes below 1 tonne per ha).

Pearl millet, sorghum and cassava are Niger's most important rain-fed staple crops. Horticulture is important in Niger in southern agricultural belts, as wells in Sahel-Sahara valleys with low groundwater levels. Cowpeas and onions are grown for commercial export to Nigeria and other coastal countries, as are small quantities of garlic, peppers, potatoes, and wheat. Some agricultural and livestock products reach markets across the Sahara (Libya, Algeria).

Assembly (farmers sell to traders) and wholesale markets (traders sell to traders) are the main marketing channels connecting surplus-producing areas, also in Benin or Nigeria, with deficit areas, among which are the major cities. Food retail sales are heavily weighted towards

the traditional trade (on-farm sales, street vendors, open markets etc.), due to the small number of modern supermarkets in the country.

Livestock production is largely based on extensive (agro-) pastoral production systems, mostly oriented towards meat, local milk and leather products). Niger has a livestock production surplus. Fourteen per cent of Niger's GDP is dependent on livestock production, including the rearing of camels, goats, sheep and cattle. Most slaughterhouses lack the required capacity and/or fail to meet required standards. Still a considerable part is processed in informal circuits by local butchers. Few industrial meat processing plants exist, and most butchers and rotisserie or grill shops use artisanal processing methods. Dried, salted meat is highly appreciated in Niger.

Enabling environment

Large parts of Niger are without connection to electricity. Only 8% of the Nigerien population is electrified. On the other hand, connectivity has increased due to the spread of mobile phones: mobile coverage doubled between 2000 and 2016 (World Bank, 2018). While the use of internet is still low, the share of the population with access to internet has been increasing steadily from 0.8 % in 2000 to 4.3% in 2016 (World Bank, 2018).

Land tenure security and access to water resources are major concerns. Land pressure has led to increased competition and conflict between actors for control and land use, especially in pastoral lands that never received the same protection as agricultural lands. Although the Niger 'Code Rural' framework law is one of the most elaborate in West Africa, the duality of the two existing land tenure regimes – one based on national laws and the other on the customary land practices – continues to lead to confusion on rights and responsibilities, or hampers access to finance.

The challenge lies in its implementation (see also Hughes, 2014). New land tenure legislation will be adopted in 2018 in an effort to strike a balance between respect for local practices and ambitions for removing land tenure insecurity as a constraint to development.

Food environment

Most food is traded and purchased at informal markets. The food retail marketing channels are underdeveloped or use food from these markets. Due to lack of enforcement, the country's food system is not impacted by food safety or health standards and regulations. Given the low income levels very few consumers can afford to pay higher prices for better quality.

Consumption of milk, a strong tradition in the agro-pastoral population, is declining because of the reduction in the number of cattle due to drought and to the degradation of the terms of trade of cattle against cereals. The dietary supply, which mostly consists of cereals, is often insufficient to meet the energy requirements of Niger's population. Aggravated by an unequal distribution within the population, undernourishment affects close to a third of the population (WUR, 2018).

Business services

Agricultural extension and support is provided by both the government, through its Nigeriens Nourish Nigeriens (I3N) initiative as well as through a variety of programs offered by multi-lateral donor programs. Among these are the GiZ funded Promotion of Productive Agricul-

ture Programme (PROMAP), the EC-supported National Information Platform for Nutrition (NIPN) and the World Bank's Community Action Program and Climate-smart Agriculture Support Project.

The main constraints on access to credit for agricultural and livestock sector stakeholders are the lack or inadequacy of physical and financial collateral, and the lack of synchronization between loan payment schedules and farmers' income cycles. On the other hand, community-based financial institutions offering grants or microloans are relatively active. The country has numerous local savings- and loans groups, often composed of women. Meanwhile, the enabling environment for doing business in Niger has improved. The time required to start a business has reduced from 35 days in 2000 to 10 days in 2016 (World Bank, 2018).

Consumer characteristics

With large parts of the population remaining under the poverty line, Nigeriens are struggling to provide their families with the right dietary diversity. The prevalence of chronic undernutrition has been increasing in rural areas over the last 15 years, due to poverty, low access to health care, low environmental hygiene and the lack of micronutrients in the food supply. Apart from children, also women of childbearing age are affected by undernutrition. In the urban areas, a different trend is emerging, with overweight and obesity on the rise.

4.2 Food system outcomes

Socio-economic outcomes

Niger ranks 187th out of 188 countries on the UN Human Development Index (WUR, 2018). The country faces a high population growth of 3.8% per year. Niger's population has more than doubled from 8 million inhabitants in 1990 to 21 million in 2016 (World Bank, 2018). Niger's GDP is growing by 4.9%; the agriculture value added is 40% of the GDP. Another important source of income is the extraction of minerals, such as uranium, petrol, gold and coal. It is unclear, however, how some of their revenues are reinvested in Niger's economy. While close to half of Niger's population (44.5%) continues to live under the USD\$1.90 poverty line, there has been a major decrease in poverty over the past decades, with 78% of the population living under the poverty line in 1990. At the same time, life expectancy at birth has improved from 44 years in 1990 to 60 years in 2016. Primary school enrolment has increased from 26.2% in 1990 to 73.7% in 2016 (World Bank, 2018).

Food availability

Niger ranks 106 out of 113 in the Global Food security Index (WUR 2018). In 2017, over 1.5 million people were affected by food insecurity (WFP, 2018). Overall, it is estimated that 20% of the population cannot meet their own food needs. This figure rises to 30 per cent in periods of poor rainfall.

As mentioned above, food production has risen but has stagnated per capita, as population growth is particularly high in Niger. Overall, the Sahel countries, even Niger, often have positive grain stocks/needs balances, however, this says little about local availability and market access. The Sahel area is by definition deficient in grains and has an excess of livestock in years the zone is not affected by a major drought.

Besides availability, the access to food depends on terms of trade and prices: e.g. seasonal and yearly price fluctuations for livestock, feed, as well as grains and legumes (See a. o. Nugteren and Le Côme, 2016). Especially poor people risk food insecurity (FAO, UNICEF, WFP, 2018). The households living in agro-pastoral zones (southern parts of Tahoua, Maradi, Zinder and Diffa regions) have become as vulnerable as the ones in pastoral zones, as the areas are relatively densely populated, which exerts high pressure on natural resources. Local grain balances are precarious because of natural conditions and limited (agric., livestock and off-farm) options for people.³

Table 4. Grain* trends 2016-17

Country	Production 2016-17 (T.)	Var. re. 2015-16	Var. re. 5y. average	Availability (kgs/p./y.)**	Var. re. 5y. average	Balance* gross stock-consumpt.
Burkina Faso	4,567,000	9%	3%	234	-9%	738,200
Mali	8,850,000	10%	33%	459	16%	3,852,500
Niger	5,862,000	9%	24%	286	3%	632,600
Senegal	2,125,000	-1%	46%	148	27%	91,900
Mauritania	277,250	-18%	-11%	71	-22%	22,400
Nigeria	27,843,000	14%	17%	152	7%	-313,100

* Millet, sorghum, maize, rice, fonio, wheat; average grain consumption needs estimated at 160 kgs/pers./year.

** FAO norm for grains = 200-250 kgs/pers./year (without other calorie sources).

Source: Réseau de Prévention des Crises Alimentaires, 2017, OECD, Paris, France.

Food access

The majority of Nigeriens depend on rain-fed agriculture for their livelihoods. Frequent droughts and low and variable rainfall reduce their access to food, leading to frequent food shortages in the country. Security issues further endanger food security in some areas. For example 408.000 people are estimated to be food insecure in Diffa, the region home to refugees from Boko Haram. Boko Haram attacked the region first in 2015 and continues posing a threat to the region's inhabitants. It is estimated that 408,000 people are in need of assistance. By 2017, WFP has reached over half of them, a total of 220,000 people (WFP, 2018).

Food utilization

In Niger, 29% of population is undernourished. The prevalence of stunting among children under five is 64.4% (WFP, 2016). Wasting among children under five is 14.8% (FEWS, 2017). Acute malnutrition has been on the rise since 2006 (WFP, 2016). Chronic food insecurity, water scarcity and a high prevalence of infectious diseases have led Niger to record some of the highest malnutrition and mortality rates in the world. (USAID, 2017)

The diet of most Nigeriens is largely based on cereals, mainly millet and sorghum, with some starchy roots (essentially cassava). In rural areas, the diet is complemented with legumes, while in urban areas it is more often complemented with vegetables. Consumption of foods

3 On vulnerability and resilience, see a. o. Gubbels (2011), *Echapper au Cycle de la Faim, Les chemins de la résilience au Sahel*. Groupe de Travail Sahel.

that are rich in micronutrients remains low, namely foods of animal origin and of fruit and vegetables (WUR, 2018).

Environmental outcomes

Niger's high population growth has increased the pressure on land and resources. Soils in many regions have deteriorated, with land degradation estimated to cost 11 per cent of the GDP. Moreover, deforestation has affected biodiversity and increased the risk of desertification. In the past decades Niger's forest area has decreased from 19,500 km² in 1990 to 11,400 km² in 2016, a decrease of 42% within a quarter of a century (World Bank, 2018). Encroachment on pastoral lands has negative effects on livestock production by (agro-) pastoralists.

4.3 Environmental drivers

Climate

The persistent recurrence of droughts and related famines undermines agricultural productivity and food security in Niger (Sendizimir et al, 2011). Niger's low agricultural productivity is anticipated to decrease even further due to climate change, as it affects the length of droughts and the intensity of rains. The impact of climate change is going to be strongly felt in Niger in the coming decades, bringing with it desertification, increased droughts and increased flooding (WUR, 2018).

In all scenarios temperature is on the rise, but different scenarios exist for rainfall: the 200mm-600mm isohyets (1970-2000 compared to 1950-70) have moved southward, although this trend might be blurred due to the fact that the 1950-60s were particularly 'wet' in the Sahel. In the long run the western part of Sahel will become drier, while the central part might remain steady or become more humid. The current trend is higher variability and more unpredictability. Some scenarios predict a major drought before 2040 (See a. o. CILSS, 2016).

Water

The vast majority of Nigeriens depend on rain-fed agriculture for their livelihoods; frequent droughts in the region often reduce crop and livestock yields, leading to food shortages in the country (USAID, 2017). Half of the rural population in Niger doesn't have access to drinking water and 80 per cent of the population doesn't have access to sanitation (WUR, 2018). Meanwhile, there is an increasing pressure on water: annual freshwater withdrawals have increased from 14 per cent of internal resources to 28.1 per cent of internal resources (World Bank, 2018). Recent studies show that migration in Niger is also strongly linked to lack of access to (drinking) water availability (WUR, 2018).

Land, soils, forests, pastures

Niger ranks 180th out of 181 countries in the UNCCD Land Management Index. Population growth, climate change and competing land use all place increasing pressure on land in Niger. Soils in many regions have deteriorated, with land degradation estimated to cost 11 per cent of the GDP. With increasing food demand and the growing use of irrigation, agricultural production areas are expanding, creating tensions between crop-producing smallholders and livestock-rearing pastoralists.

Pastoralism is thus under pressure: exploitation of in principle productive Sahel pastures in the rainy season can only take place through the existence of refuge areas in the dry season (Grain de Sel, 2017). The majority of such areas can be found in river valleys and southern rangelands, typically coveted by farmers as well as by land speculators. Agricultural basins have become 'saturated', especially the old agricultural basins around Dosso, Birni-Konni, Maradi and Zinder. There is high pressure on cultivated lands, which shows two different pictures: on the one hand, there is a general tendency towards land degradation: the felling of trees, decreasing soil fertility, degradation of grass pastures and erosion, reduction of fallows. On the other hand, like in Burkina, we find in some areas genuine efforts towards (farm-) land and water conservation, combined or not with adapted inputs (new seeds, fertilisers) (see a.o. Reij and Winterbottom, 2015).

Biodiversity

Deforestation has affected biodiversity and increased the risk of desertification. In the past decades Niger's forest area has decreased from 19,500 km² in 1990 to 11,400 km² in 2016, a decrease of 42% within a quarter of a century (World Bank, 2018). Regreening efforts in the Maradi and Zinder regions have reversed some of this forest decline, where some 200 million trees have regreened the region, affecting the livelihoods of 4.5 million people (WRI, 2008).

Minerals

The mineral mining industry is an important part of the economy of Niger. Exports of minerals account for 40 per cent of Niger's exports. Mineral commodities produced in Niger included cement, coal, gold, gypsum, limestone, salt, silver, tin, and uranium. In 2006, Niger was the world's fourth-ranked producer of uranium.

4.4 Socio-economic drivers

Demography / Migration

Niger is currently witnessing a high population growth of close to 4% per year. Niger's population has more than doubled since 1990 and is expected to triple by 2050 (WUR, 2018). Niger is an important transit country for migrants travelling from West to North Africa. Increasingly, Nigeriens are also migrating to Europe, despite the high risks. Migration is also associated with significant remittances to families staying behind in Niger: the sum of the remittances increased from 14 million in 2000 to 176 million in 2016.

Markets

Niger shares a common currency, the CFA franc, and a common central bank, the Central Bank of West African States (BCEAO), with seven other members of the West African Monetary Union. In December 2005, it was announced that Niger had received 100% multilateral debt relief from the IMF, which translates into the forgiveness of approximately USD\$86m in debts to the IMF, excluding the remaining assistance under HIPC. Nearly half of the government's budget is derived from foreign donor resources. Future growth may be sustained by the exploitation of oil, gold, coal, and other mineral resources.

Policies

Niger has an active policy environment around food security, water and climate change. Its main policy on food security is the Nigeriens Nourish Nigeriens (13N) initiative for food security and resilience. This constitutes the general framework for food and nutrition security for Niger. The most important strategy within this framework is the National Multi-sectoral Nutritional Security Policy, focused on improving the nutrition situation of the Nigerien population (WUR, 2018). Niger is trying to install early warning systems for disasters and climate events.

Next to food security, the WASH sector is an important development priority of the government of Niger as 40 per cent of its long-term development budget is related to water and sanitation. In 2016, Niger submitted its first Nationally Determined Contributions (NDC) to UNFCCC. The NDC focuses on climate change adaptation, in particular in the fields of agriculture and sustainable land management, but also includes a commitment to reduce greenhouse gas emissions, which is largely conditional upon international support (WUR, 2018).

Governance and tenure security

Poor governance is another bottleneck faced by farmers and livestock keepers, men and women. Land tenure (in-)security exemplifies this. In all areas rising pressure and higher land values undermine customary tenure regimes, with the risk to reduce a wide range of access and property rights to mere (private) ownership and titles. The country has legislation, based on the 'Code Rural', which recognises different rights, common pool resources and livestock mobility, but practices do not often adhere to legislation.

The commons are exposed to land and water acquisitions (see pastoral areas), but land speculation is not sanctioned and secondary rights holders (women and pastoralists) are at high risk of being excluded from key resources. The inability of the central state to manage and protect resources has remained constant in the past decades. Decentralisation has the potential to break the impasse and bring natural resource management back to local level control, however, until now it has not fulfilled its promise, in large part because of lack of transfer of competencies and finances from the central government to local institutions (Hesse et al, 2013; Grain de Sel, 2012). Moreover, Niger still has a strong custom of chiefdoms, which have an ambiguous relation with these new authorities.

Increasing displacement and armed conflict

Armed conflict has become a determinant factor in Sahel livelihoods in the past decade: *"The Sahel has experienced an expansion and intensification of armed conflict in certain areas, disrupting basic social services and livelihoods, hindering access and delivery of assistance, negatively impacting trade flows and triggering displacement, as well as economic and pastoral migration there are more than 760 000 internally displaced persons and refugees in Burkina Faso, Chad, Mali, Mauritania and the Niger. In cross-border areas, security measures and new legislations have negatively affected trade and transboundary movement of people and livestock."* (FAO, UNICEF, WFP, 2018).

Science & Technology

Science and technology can play an important role in two challenges Niger is facing: water management and electrification. The African Development Bank is supporting Niger to im-

plement new technologies around irrigation and water management. Meanwhile, the World Bank's Solar Electricity Access Project helps to increase access to electricity through solar energy in rural and peri-urban areas of the Republic of Niger through market development of stand-alone solar systems and service-based solar hybrid mini-grids.

Development organizations

Development assistance has grown from USD\$209m in 2000, to USD\$741m in 2010, to USD\$951m in 2016 (World Bank, 2018). The three most important groups of donors are: EU Institutions (USD\$334) the World Bank Group (USD\$288m) and the World Food Programme (USD\$107m) (IATI,2017). These donors together make up two-thirds of all donor investment.

Apart from these major, multilateral donors, there are different bilateral programmes active in the country. The GiZ funded Promotion of Productive Agriculture Programme (PROMAP) advises the Niger's Ministry of Agriculture on the development and implementation of an appropriate small-scale irrigation policy (GIZ 2018). The ENABEL Livestock support project (PRADEL) strengthens food security, resilience and income of people linked to family farms. (ENABEL 2017) USAID is supporting Niger's agriculture sector with resources focused on improving the agricultural livelihoods of vulnerable populations. USAID activities focus on improving access to credit, diversifying economic opportunities, and improving natural resource and soil management to foster better agricultural and animal production (USAID, 2018).

5. Food systems mechanisms

Existing food security studies on the Niger context have a strong focus on describing the food system, while indicating the most important trends in different parts of the food system. Less attention is paid to the dynamics between different elements of the food system. While some attention is paid to trade-offs and synergies between parts of the system, as will be described below, feedback mechanisms, catalytic effects and key leverage points receive very little attention.

5.1 Trade-offs

Existing studies point to a range of trade-offs in the Niger food system:

- Agricultural production in Niger is organised in two different systems: cereals and other crops are produced in rain-fed agricultural systems by smallholders, while livestock is reared by migrating pastoralists, who move from the North to the South and vice versa.
- With increasing pressure on land, these competing agricultural systems are increasingly a source of conflict. Supporting one of these agricultural systems and helping to expand production has the potential to aggravate the pressure on the other agricultural system and contribute to the risk of conflict.
- With increasing population growth and a changing climate, water is becoming a potential source of conflict in Niger. The expansion of irrigated agriculture for more staple food production (rice) increases the pressure on the scarcely available water resources. At the same time, irrigation does not have enough potential to cover possible food shortages.

Attention for irrigation might go at the expense of investments in dryland agriculture and livestock.

- The food security situation is most acute in those border areas with Mali and Nigeria, which are faced with conflict and insecurity. Repeated outbursts of violence cause development organizations to temporarily withdraw support from some of these regions, putting the most marginalised groups in the country, often refugees, in an even more vulnerable position.
- Grain trade to the big towns and -imports are still in the hands of a small group of traders, some of whom are well connected in political networks. This might hamper the lowering of prices.

5.2 Synergies

Other studies point to possible synergies in the Niger food system:

- Integrated programming could help address different challenges simultaneously. Agricultural and agro-pastoral development projects focussing on livestock-crop association, agro-forestry, gardening and fisheries have the potential to address environmental challenges related to soil degradation and water depletion, while also increasing nutritional diversity and increasing the economic resilience of farmer households.
- Interventions in the field of climate-smart agriculture and agricultural diversification have the opportunity to address two large development issues in Niger at the same time. These projects could reduce the impacts of climate change by making farmers more resilient in their adaptation to climate change, while also improving the diversity of their diets, thereby improving their nutrition and health situation.
- Like elsewhere in the Sahel, there is a widespread, mostly informal food economy wherein trade channels connect remote rural areas to a wide range of small towns, also in border areas with Benin and Nigeria. This trade is responsible for the bulk of food trade in Niger (for grains, livestock, legumes, fruits, vegetables). Modern retail is still modest. The food chains are not merely 'short', since trade can have regional dimensions: livestock markets can go from the deep Sahel to coastal markets; some cereal and livestock markets have already existed for many decades. Women occupy a dominant place as farmers, traders and processors.
- On the other hand, there is little social security. Food quality or hygiene is a crucial question (in both 'formal' and 'informal' circuits). Farmers and traders cope with inefficiencies, while having little working capital. While there is evidence of a substantial volume of grain exchange between Niger and Nigeria f.i., most of the traders indicate transportation, high taxes and low production of grain as the most important risk factors limiting trade (Odozi, 2015). Although the discussion still varies regarding which interventions are needed, there is consensus amongst policy makers to look at the informal economy for improving its role in food supply and its potential as a source of employment.
- Renewable energy programmes have the potential to address both the lack of affordable and healthy energy and the low productivity levels among smallholders. Biogas programmes provide gas for cooking and electricity for lighting, while the bio slurry from the digesters is a safe-to-use fertiliser which can be used on the farm. Solar energy projects can not only provide energy to households, but can also be used to serve agricultural purposes, such as to run water pumps to help irrigate the land.

6. Overview of trends in Niger's agricultural sectors

In Niger, the majority of the population (87%) is economically dependent on agriculture. The livestock sector supports 29 per cent of Niger's population, providing 14 per cent of Niger's GDP. Over half (53%) of the population is involved in crop production, which mainly takes place on stretches of arable land along Niger's southern border with Nigeria. Most of the crop production are staple crops for subsistence (sorghum, millet, cassava), while some vegetables are also marketed in Niger and surrounding countries, such as cowpeas and onions (FAO, 2018).

6.1 Subsistence crops

Pearl millet, sorghum, and cassava are Niger's principal rain-fed subsistence crops. Irrigated rice for internal consumption, while expensive, has, since the devaluation of the CFA franc, sold for below the price of imported rice, encouraging additional production. The main purpose of agriculture policy in Niger is to achieve food self-sufficiency through encouraging irrigation projects, expanding dry-cropping in rural areas, improving soils with chemical fertilisers and manure and by replacing traditional farming techniques with more modern methods.

The majority of crops in Niger are rain dependent (less than 10 per cent of the cropped area is under irrigation) and the recent droughts have severely tested the country, making it a net importer of food on a large scale and very dependent on foreign aid. The government welcomes funding for agribusiness generally and for the development of its agricultural markets in order to achieve growth. The private sector network for improved seeds, fertilisers, and pesticides is poorly developed. Public extension services are weak and poorly funded, and extension services are provided in many regions by internationally funded NGOs (Alhassane, 2016).

6.2 Livestock sector

Livestock rearing is done mainly by Niger's pastoralist populations, which rely upon the rearing of cattle, goats, sheep, and camels. Export of live cattle and meat represents nearly 12 per cent of total exports (90 per cent of which goes to Nigeria and the remaining to Cote d'Ivoire and other coastal countries). Many live animals are exported to Burkina Faso before continuing on to Cote d'Ivoire or other coastal countries, and are marketed as Burkinabe after that, although Niger's reputation for quality meat is well-known throughout the Sahel. (FAO, 2018)

There is a significant potential in the formalization of the butchery industry and for the development of a formal private sector in meat production given the large number of small and informal butchers and the abundant availability of livestock. According to 2013 census statistics, Niger had 10.7 million cattle, 10.7 million sheep, 14.3 million goats, 1.7 million camels, 241,000 horses and 1.7 million donkeys. There is only one modern abattoir in Niger, and it is in Niamey. Consumption of meat in rural areas is very low, as livestock is repeatedly bought and sold, but rarely eaten. Consumption of chicken and meat is higher in urban

areas, primarily in Niamey, and a growing middle class will typically consume more meat (US Department of Commerce, 2017)

6.3 Export vegetable sector

Main crops grown for commercial export are vegetables such as cowpeas, onion and garlic. The Violet de Galmi onion is highly rated and in demand in the sub-region, but suffers losses of more than 30% due to inadequate storage and transport. Other crops such as cotton and groundnuts are also cultivated in some regions, such as Maradi, Zinder and Dosso (Alhasane, 2016).

It should be noted that the agricultural systems in Niger are mixed and that there is practically no region where farms are exclusively specialised in one particular crop. Intercropping (cereals-legumes or cereals-cereals) is widely practiced. In some areas with considerable soil heterogeneity across the field, a farmer may plant different crops (millet, sorghum, maize or legumes) in the same field.

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APPENDIX 3

Food system dynamics in the Sahel

In a fragile, risk-prone, yet dynamic region like the Sahel and Sudan zones in West Africa, resilience is key. This means agro-ecological, economic and political resilience at all levels (regional, national, local and household). Diversification and multifunctional use of resources support resilience thus needs to be enabled by institutional strengthening and economic development. Traditionally, local communities and traditional institutions have been well equipped to optimise resilience within this region. Interventions should thus seek to strengthen these diverse and complex livelihood strategies rather than impose external development models that may have worked elsewhere but are likely to fail in this region. There is also a plea amongst practitioners to look for grassroots technical and social innovations by working with local groups representing youth and women, and local CBOs and NGOs. It is deemed important to strengthen and empower the civil society movement, rather than the established power structures that are in place. Local contextualised interventions are recommended, rather than top-down programmes through international NGOs and/or national governments – although they have a modest role to play as well.

Below important mechanisms are summed up and described based on the insights of key informants:

Agro-ecological systems (land & water)

Low biophysical carrying capacity due to

- Low soil fertility; with local techniques (e.g. zaï, agroforestry, micro dosage), farmers concentrate nutrients in their fields. This enables localised increase in productivity, but also depletion of land at landscape level through the concentration of nutrients. Soil erosion (through wind and water) remains a physical characteristic of the region.
- Negative water balance due to low rainfall and high evaporation. Climate change results in more erratic rainfall, resulting in more localised droughts and floods and rainfall outside the cropping season. This affects the planting (unreliable start of the season), as well as the harvesting (e.g. rainfall during drying period before harvest, deteriorating grain quality). It also affects the availability of grass for livestock, and as a result the seasonal patterns of the transhumance, where pastoralists move to southern regions before the end of the cropping season (instead of after the harvest, as used to be the case).
- The region knows only one rainy season – food production is only once a year, during the rainy season. Mobile pastoral systems are the most efficient food production systems in the Sahel, where livestock is fattened on nutritious grass in the North (Sahel zone) during the rainy season, and maintained on less nu-

System archetypes

*Limits to success
Fixes that fail*

Limits to success

Tragedy of the commons

trititious biomass in the South (Sudanian Savannah zone) during the dry season.

- A growing population results in the expansion of agricultural land into marginal areas and the fragmentation of land use. Total livestock numbers are also increasing, while transhumance corridors become fragmented. The increasing pressure on land is exceeding the carrying capacity, resulting in land degradation and deforestation.

Solutions

- Sustainable agro-ecological intensification: smart, diverse cropping systems that combine crops, trees and quality inputs (appropriate crop varieties, quality seed, organic and inorganic fertilisers) for maximum synergy in terms of nutrient and water use.
- Water harvesting at field- and landscape level to increase soil moisture retention.
- Flood farming of high-value crops in bas-fonds areas.
- Enable pastoralism transhumance routes in regional landscape planning agreements.
- There are local efforts to promote regreening, farmer-managed natural regeneration and agro-ecological intensification. However, attention needs to be given to multiple property rights and stakeholder involvement to avoid conflict over resource use.

Unequal access to natural resources

- Limited access / user rights of marginal groups (women, pastoralists, youth) to land and natural resources; decision-making on use and management mainly done by men (for household plots and communal land).
- Gender: women are more concerned with (and have more knowledge of) multifunctional diverse farming systems than men. But women have little decision power on land use and allocation of resources.
- Customary tenure regimes of natural resources are being undermined by increasing pressure on land, (armed) conflicts, land speculation and weakened institutions for supervision and enforcement of agreements on the governance of natural resources. Property rights (defining access, governance and use) to common natural resources are replaced by private ownership, thus excluding marginal groups from these common resources and eroding the multifunctionality of land in the Sudanian zone of the Sahel region.
- There has been a repressive control of use and management of trees by the forestry department for a few decades. This negatively affects the trust of rural population in the state, as well as the

Success to the successful

Tragedy of the commons

Escalation

integration of trees into the agro-pastoral system.

- A bias of policies and interventions towards agriculture has marginalised pastoralists.
- Agricultural land is generally owned by men, who decide on which crops to grow and the allocation of resources. Men are responsible for staple crops, while women grow vegetables and condiments in kitchen gardens. In particular in Niger, women have little say in household decision making. Though they show an interest in diversified cropping systems and nutritious food, they receive little formal support in their agricultural activities.

Solutions

- Agree upon and enforce property rights that take into account multiple uses and user groups. (Re)install mediation mechanisms to resolve conflicts.
- Include marginal groups (women, youth, pastoralists) into decision making on the governance and use of natural resources, therebyby empowering civil society groups.
- Promote regional landscape planning that integrates interests and uses of all social groups, including pastoralists, women and youth.
- Work with state services (in particular forestry department) to implement current ECOWAS agreements and change from control to mediation.

Agri-sector / economic systems

Restrained development of trade and markets (value chains)

- Agricultural productivity remains low; local techniques have been able to intensify production to feed a growing population, but the agricultural production remains at subsistence level. There is little surplus for international trade or processing and value addition.
- Mechanisation, supply of quality inputs, finance and other agricultural services remain limited. Access to appropriate and high-quality inputs and resources is very limited. This limits the productivity increase in agriculture. Productivity increase is not only about maximum calories per hectare, but also about crop diversification, labour productivity and water efficiency.
- There is limited investment in the development of the agricultural sector (including service delivery), by private sector (high risks), public sector (weak institutional capacities and limited budget) and international donors (disinvestment). There is not sufficient economic capacity or capital within the current rural economy to trigger / catalyse agricultural economic development in the region.

Success to the successful

Growth and underinvestment

Limits to success

Limits to success

Growth and underinvestment

- The region does not have a comparative advantage in agricultural production at the world market due to high transaction costs: landlocked countries, low productivity, and high risks.
- Extension and advisory services have been decimated and young farmers have less agricultural knowledge than the previous generation. Agricultural education is lacking or inappropriate (not taking into account the complex agro-ecological conditions).
- There is a limited capacity (infrastructure, facilities and utilities) for storage, processing and transport of agricultural commodities, resulting in food losses and limited value addition.

Solutions

- Focus interventions on short local value chains, rural-urban chains and regional trade; explore possibilities of niche markets (e.g. cotton, cashew, sesame, karité) – but be aware of other donor interventions.
- Invest in contextualised agricultural education, integrating local knowledge on agro-ecology and external knowledge on sustainable intensification. High-external-input farming systems is only applicable in few areas. In most cases, farming systems agro-ecological intensification is required to improve soil fertility and optimise local resources (nutrients, water, ecological processes) for diversified food production.

Socio-political systems

Increasing conflict and instability in the region

- The pressure on common resources (grazing land, water) results in conflicts between pastoralists (predominantly Peuhl) and local communities.
- Media and politicians are increasingly stigmatising the pastoralists, deepening the distrust between different social groups.
- Private investors (the political elite) have invested in livestock, which are herded by the pastoralists. These livestock owners provide finance to the pastoralists to arm themselves. In addition, radicalisation among the pastoralists (and foreign finance) exacerbates the situation. Multiple groups are arming themselves, and local armed conflicts are escalating.
- The conflicts between the pastoralists and local communities is increasingly becoming a religious conflict (Islam vs Christianity) where both sides are being radicalised and (financially) supported by foreign groups from the Middle East and USA respectively.
- The escalating armed conflict results in unknown numbers of refugees within the Sahel region. They are added to the regional migration flows to neighbouring countries and urban areas.

Success to the successful

Growth and underinvestment

Growth and underinvestment

Escalation

Tragedy of the commons

Escalation

Escalation

Escalation

- *Solutions*
(though this is not the main focus of the Sahel policy, it is the context and policy interventions should therefore be aware of the following):
 - Strengthen civil society and CBOs
 - Include human rights
 - Governance of common natural resources that allows multi-functional use (focus on access and user rights, not ownership).

Skewed power relations

- Because of the high (economic, political) risks involved, there are few private investors in the agri-sector. Traders of long, cross-border supply chains (predominantly staple crops) monopolise the regional trade. New private sector players that start agribusiness ventures can thus achieve a monopoly position within the agri-sector.
- Women have little decision power on land use and allocation of resources, both at household and at community level. Youth have limited access to land.
- Elite (traditional leaders, political leaders, rich) remain powerful in terms of capital and access to resources; they gain access to land (through speculation), acquire livestock as capital, and control cereal value chains.

Observations related to youth

- More youth than land available: agricultural sector cannot provide sufficient employment for youth
- Youth desire regular income – not possible in current agricultural system. They desire entrepreneurial activities for regular cash flow
- Youth are mobile, better educated and have access to information (internet)
- Young men want to pursue European-style commercial agriculture (mechanization, monoculture); young women have knowledge of multifunctional diverse farming systems
- Encourage youth employment within service delivery ('loonaarbeiders', post-harvest processing, transport, information ICT, trade)
- Not to forget women; a focus on (male) youth can exclude women from current income activities (vegetables & condiments, cottage industry, informal trade).

Success to the successful

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