VOICE FOR CHANGE PARTNERSHIP (V4CP)

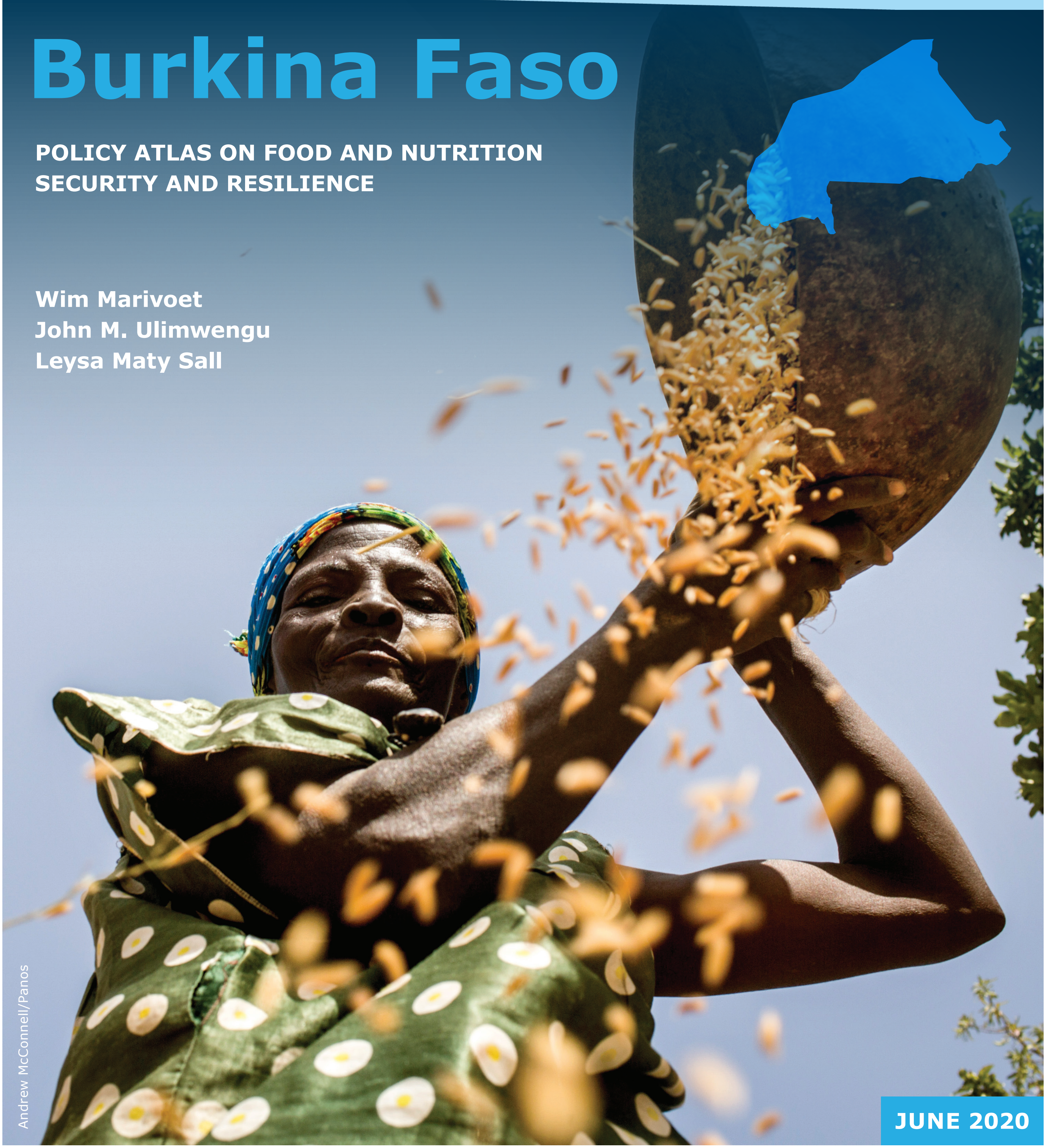
SNV

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI

Burkina Faso

POLICY ATLAS ON FOOD AND NUTRITION SECURITY AND RESILIENCE

Wim Marivoet
John M. Ulimwengu
Leysa Maty Sall



Andrew McConnell/Panos

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VOICE FOR CHANGE PARTNERSHIP (V4CP)

The Voice for Change Partnership (V4CP) is a multisectoral programme funded by the Dutch Ministry of Foreign Affairs (DGIS), operated jointly by the Netherlands Development Organization (SNV) and the International Food Policy Research Institute (IFPRI), and implemented in six countries: Burkina Faso, Ghana, Honduras, Indonesia, Kenya and Rwanda. The V4CP supports advocacy by Civil Society Organizations (CSOs) in order to influence policies and decisions. By enhancing CSO capacities in leadership, knowledge development, advocacy skills, and organizational sustainability, CSOs are empowered to speak with a greater voice. The V4CP trains CSO members to use research evidence, data and case studies to back up their advocacy strategies. The V4CP tackles four issues—food and nutrition security, resilience, renewable energy, and water, sanitation and hygiene (WASH)—while addressing gender imbalance and climate change mitigation. By collaborating with national and international partners, different levels of government, and the private sector, CSOs contribute to improving the "enabling environment". Strengthening the voice of CSOs in policy creation and the implementation of services ensures that the interests of communities represented by CSOs are better served.

ACKNOWLEDGEMENTS

This report is the final outcome of various knowledge products and training material, usually labelled as "printed eAtlas", which have been developed and shared with CSOs under the V4CP programme. The authors are grateful to SNV and CSO members for the fruitful exchange and their constructive comments during several capacity building workshops and learning events. Evidently, all errors remain the authors' sole responsibility.

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FROM RESOURCES TO POLICYMAKING: A GEOGRAPHICALLY DISAGGREGATED JOURNEY

1.1. MAPS AS POWERFUL TOOLS FOR ADVOCACY

A popular saying states that "a picture is worth a thousand words." Maps are pictures of our world and its conditions. They illustrate how conditions in one area relate to neighbouring areas. Maps can display political boundaries, roads, population, health status, climate conditions, natural resources, poverty, education rates, or economic activities such as crop production. They illustrate information about locations, show spatial patterns, and can be used to compare patterns between different physical characteristics or social phenomena.

Because maps help us understand the **spatial relationships** of different phenomena or conditions, they are useful for understanding where to target our attention and to set priorities accordingly. Since maps can interact with various types of data, they help us design more targeted and comprehensive programs by illustrating where needs are most severe, which bottlenecks hinder progress, and how different challenges relate geographically to one another. To inform time-constrained policymakers, maps can be powerful tools to single out a particular issue and what it takes to address it, in a concise and attractive way.

The maps in this policy atlas use data and statistics on agriculture, livestock and nutrition to consider geographically-sensitive strategies to improve **food and nutrition security (FNS).** They offer a one-time snapshot of realities that are constantly evolving and thus subject to change when events occur or more accurate data become available. For the latest maps, please consult the ReSAKSS eAtlas country webpage of Burkina Faso (eatlas.resakss.org/Burkina-faso/fr), which also provides spatial data and maps beyond those covered in this report.

Box 1.1. Limitations of a spatial approach

Geographic representations can be misleading because surface areas do not necessarily equate with population numbers—especially when comparing vast yet scarcely populated areas with small densely urban settlements. Rural areas typically dominate maps, while densely-populate urban centres may appear insignificant despite their significance for large numbers of people. In a similar vein, maps often only display averages for a given administrative unit—such as a province or region—thereby ignoring dispersion or inequality within that unit. For these reasons, the spatial approach is but one of several methods to construct an appropriate level of information to inform policy decisions.

1.2. CIVIL SOCIETY ORGANISATIONS WORKING UNDER V4CP IN BURKINA FASO

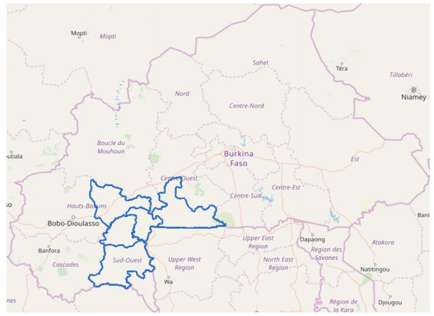
The CSOs working under V4CP in Burkina Faso represent the interests of various groups and communities such as smallholder farmers, food processors, pastoralists, entrepreneurs, development and environmental groups. By fostering collaboration among CSOs and relevant stakeholders, CSOs influence agenda-setting and hold the government and private sector accountable for their promises and actions. The V4CP Programme in Burkina Faso focuses on three thematic areas: food and nutrition security, resilience of pastoral communities, and renewable energy. This policy atlas mainly provides evidence to support the advocacy agenda of CSOs working on the first two thematic areas.

Under food and nutrition security, the CSOs' main advocacy goal is to promote modernization of family farms through improved access to agricultural inputs, modern equipment, and agricultural extension. The following four CSOs operate under this thematic area: Cooperative Agricultural Services Coobsa (COPSA-C), National Union of Rice Producers of Burkina Faso (UNPRB), National Federation of Naam Groupings (FNGN), and Federation of Agricultural Professionals of Burkina Faso (FEPA-B). The main advocacy agenda under the pastoral resilience theme involves improving local contextualisation of livestock policies while addressing the pressures of climate change and population growth. Two CSOs focus on this particular area: Association for the Promotion of Livestock in the Sahel and Savannah (APESS) and Action Platform for Securing Pastoral Households (PASMEP).

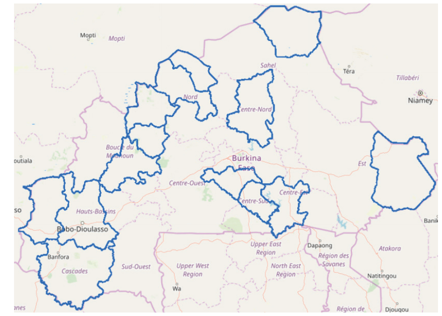
Box 1.2. provides a short description of each CSO with their main geographic target zones.

Box 1.2. Description and target provinces of CSOs under V4CP Programme

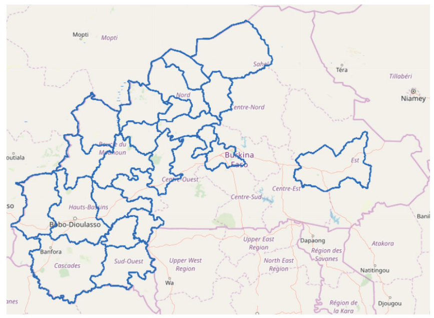
The Coobsa Agricultural Service Cooperative (COPSA-C), which in Dagara language means "to cultivate is better" is a peasant organization that began in March 2009. Its members include three grain storage and marketing cooperatives and five rice producer unions. COPSA-C offers agricultural services to members (approximately 3,500 producers) by enhancing production and increasing incomes in a region with high agricultural potential. It is headquartered in Founzan in the province of Tuy.



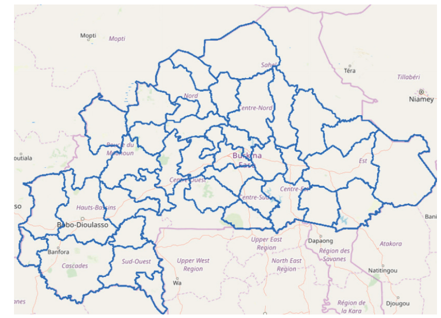
The National Union of Rice Producers of Burkina (UNPRB) is a peasant organization, created in 2005. Its 20 members come from 13 cooperatives and 7 provincial unions totalling 20,000 rice farmers. Its headquarters are located in Ouagadougou. Its vision is to "Become a core rice institution in Burkina Faso, promoting the organization of producers, facilitating the good flow of information and allowing farmers to be professional and live decently."



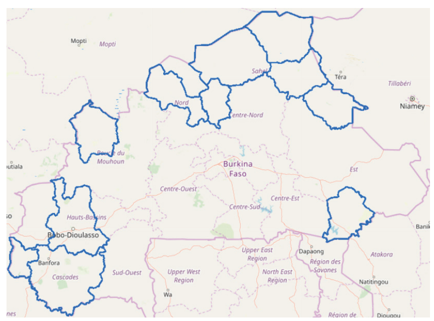
The National Federation of Naam Groups (FNGN) is a non-profit, non-denominational and non-political peasant organization, headquartered in Ouahigouya. The Federation brings together 90 unions spread over 30 provinces. Created under the leadership of Doctor Bernard Lédéa Ouédraogo in 1967, FNGN operates following the philosophy of "development without damage" that empowers actors to be authors of their development projects, driven by their own values and potential.



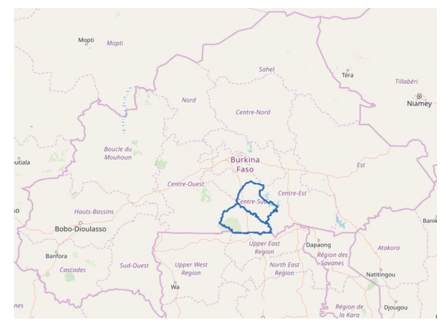
The Federation of Agricultural Professionals of Burkina (FEPA-B) is an umbrella peasant organization, established July 1997. FEPA-B builds capacity and improves the socio-economic power of Burkinabe producers. Its mission is to ensure the representation and defence of its members' interests in order to increase their market competitiveness. FEPA-B covers 37 provinces of Burkina Faso and has more than 240,000 members. Its headquarters are in Ouagadougou.



The Association for the Promotion of Livestock in the Sahel and in the Savannah (APESS) is an international organization of livestock breeders headquartered in Ouagadougou. It began in 1989 in response to repetitive droughts and their effect on livestock environments. Since its creation, APESS has positioned itself as an agent of change at the service of breeders, resolutely oriented towards breeding modernization.



Platform of Actions for the Securing of Pastoral Households (PASMEP) is an association under Burkinabe law, created in 2013. Its mission is to "contribute to the security of agro-pastoral communities by promoting their fundamental rights, the establishment of mechanisms for concerted management of natural resources, and the development of socio-economic activities." PASMEP is an active member of several networks in the fight for access to water, land and peasant seeds.

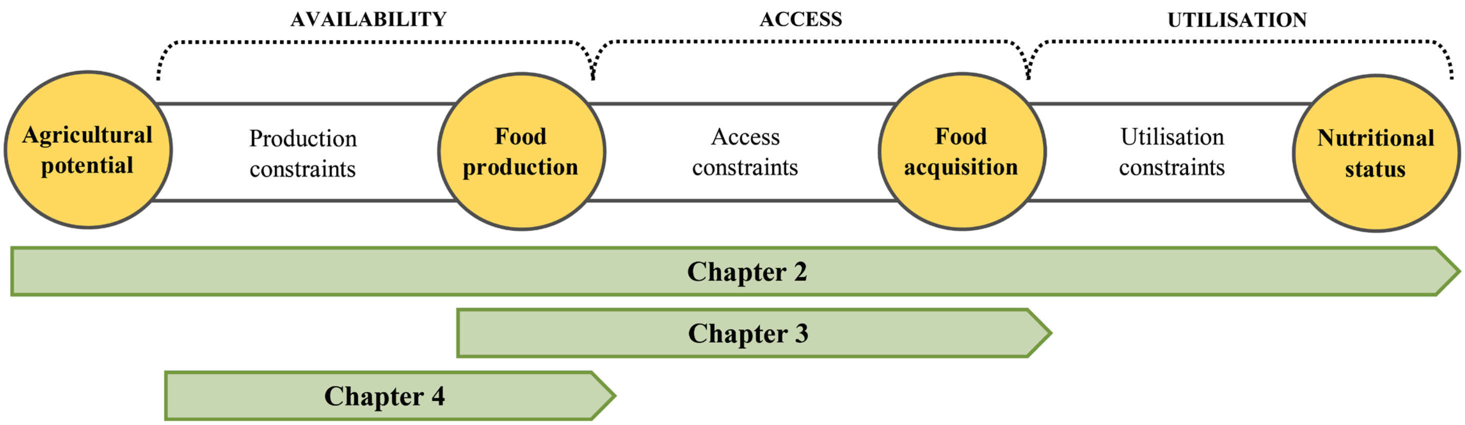


1.3. OBJECTIVE AND OVERVIEW

This policy atlas utilises maps to investigate **how nutrition, agriculture and livestock interventions could most effectively be targeted** in Burkina Faso. Future CSO advocacy strategies could be strengthened and enriched with spatial information that indicates *where* policy efforts would be most effective, addressing bottlenecks faced by the most deprived communities, reducing disparities, or helping zones meet their full potential.

The conceptual framework used in this policy atlas is based on the sequential pillars of food and nutrition security (FNS), typically labelled as **availability, access and utilisation**. For people to "have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996), the **constraints** linked to each pillar should be eliminated or adequately addressed. Figure 1.1. illustrates the sequential or hierarchical nature of these constraints, all having an impact on final nutritional outcomes. To improve nutrition, a population should first be able to produce enough food, which is contingent upon the level of agricultural potential combined with production constraints faced by farmers. Whereas biophysical constraints (such as rainfall, temperature and soil types) determine agricultural potential, *production constraints* refer to all sorts of suboptimal farming inputs and technologies (such as inferior seeds, or lack of agricultural extension). Next, households should be able to acquire diverse food items, which depends on the amount and variety of food produced along with various *access constraints*, such as low-quality transportation infrastructure or economic constraints like limited purchasing power or trade restrictions. Once households acquire food, food must be properly prepared and allocated to each family member, and consumed in hygienic and healthy conditions—which are all various types of *utilisation constraints*.

Figure 1.1. Overall framework and conceptual location of each chapter



Source: Authors.

Each chapter of this policy atlas focuses on a different conceptual part within the overall framework. Chapter 2 evaluates the degree of constraints along the full FNS pathway for each province in Burkina Faso by comparing actual data on local agricultural potential, food production, food acquistion and nutrition status. Chapter 3 explores the regional bottlenecks faced by households in Burkina Faso to acquire enough healthy food. By focusing on nutrients essential for human health, this chapter identifies target regions and foods for improving either agricultural production, market integration, post-harvest handling, or household food budget allocation. Chapter 4 focuses on the livestock sub-sector, prioritising provinces that undersupply various types of livestock infrastructure relative to the local population of livestock. Chapter 5 summarises the overall findings and how they should inform policymaking in Burkina Faso.

At the end of each chapter, we provide a short advocacy note with key messages that indicate how findings could best guide future policies. Throughout the policy atlas, explanatory boxes, key word lists and infographics contexualize each chapter.

Chapter 2

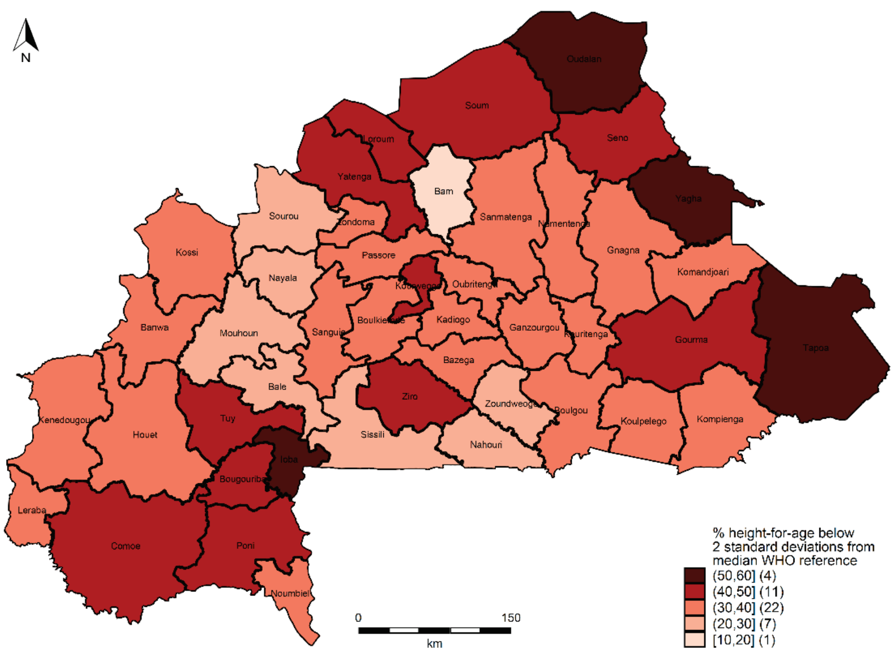
COMPREHENSIVE TYPOLOGY FOR FOOD AND NUTRITION SECURITY INTERVENTIONS

2.1. INTRODUCTION

This chapter presents a comprehensive **typology** to identify possible food and nutrition security (FNS) interventions in rural Burkina Faso. We start by identifying the provinces of Burkina Faso with the poorest nutritional outcomes. In the following sections, we apply the typology to explore interventions that could improve outcomes by comparing four indicators within each province: *agricultural potential, food production, food acquisition and nutrition outcomes*. By comparing these indicators, we identify the provinces that could benefit most from efficiency improvements in *production, access or utilisation*. This chapter ends by offering policy recommendations and illuminates how geographically-specific analysis can guide the design of FNS interventions.

Figure 2.1. presents the **spatial distribution** of chronic malnutrition among children below the age of 5 years in Burkina Faso in 2010.

Figure 2.1. Prevalence of stunting among children under 5 in rural Burkina Faso (2010)



Source: Authors with data from DHS (2010).[1]

Figure 2.1. shows that chronic malnutrition is highest in the most remote corners of the country particularly in the remote north and east, and far southwest where at least 40% of children are stunted. Only in the province of Bam do we observe stunting levels below 20%. In a semicircle from Zoundweogo in the south to Sourou in the north, stunting is between 20-30%. To address differences in nutrition status across the country, it is thus important to design policy interventions that account for **spatial heterogeneity**.

Key Words

Typology a reduction of real-world complexity to types; classification

Spatial Distribution the study of phenomena and their physical locations; the graphic display of that information

Spatial Resolution the number of pixels used to create an image (e.g. of the earth's surface). A higher number (of smaller) pixels shows more resolution and definition; fewer, larger pixels shows less

Remote Sensing scanning the earth from high altitude (i.e. satellite) to gather information

Spatial Heterogeneity the uneven distribution of a trait across regions

Conceptual Framework the way ideas are organized; a structure used to relate different concepts and show their orientation toward a shared goal

Transaction Costs costs associated with the exchange of goods/services across time, place and markets, but distinct from the actual production cost

Indicator a measurable unit that serves as a gauge or symbol to indicate the condition of something

Scatterplot a data visualization that shows the relationship between two variables. It uses dots to represent numeric values (one variable plotted along the x-axis, and the other along the y-axis)

Absolute benchmark is based on an exact target

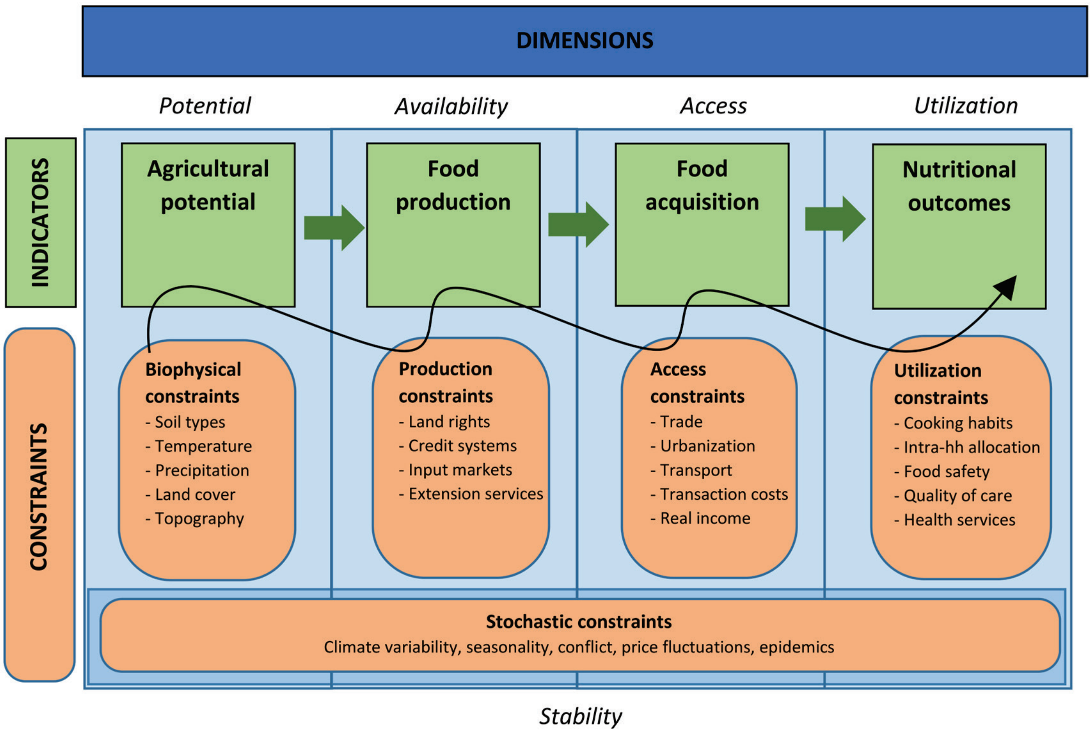
Relative benchmarks compare entities' performance to each other

[1] Although the SMART survey implemented in 2016 (Ministere de la Sante du Burkina Faso, 2016) provides more recent (and consistently lower) stunting rates, its spatial precision is low. However, at the more aggregate level, both data sources align well, similarly ranking different regions by prevalence of chronic malnutrition. This *relative comparison* between geographic areas is the key focus of this chapter.

2.2. CONCEPTUAL FRAMEWORK

To guide policies and programs that address food and nutrition insecurity throughout the country, it is helpful to consider the pathway from agricultural potential to nutrition status. The **conceptual framework** laid out in Figure 2.2. shows four dimensions of FNS. The dimensions flow chronologically with each step facing constraints. For example, with respect to food production, farmers need access to land, knowledge, credit, seeds and fertilizer to be able to tap into the agricultural potential of their land. Further down the chain, even if food is sufficiently produced, families might be constrained due to all sorts of **transaction costs**, such as trade barriers or poor transportation infrastructure that results in higher local prices. Nutrition outcomes could also be affected by utilisation constraints such as lack of food safety or culinary habits, intra-household allocations, or health and sanitation conditions.

Figure 2.2. Conceptual pathway from agricultural potential to nutrition outcomes



Source: Authors adapted from Pangaribowo et al. (2013).

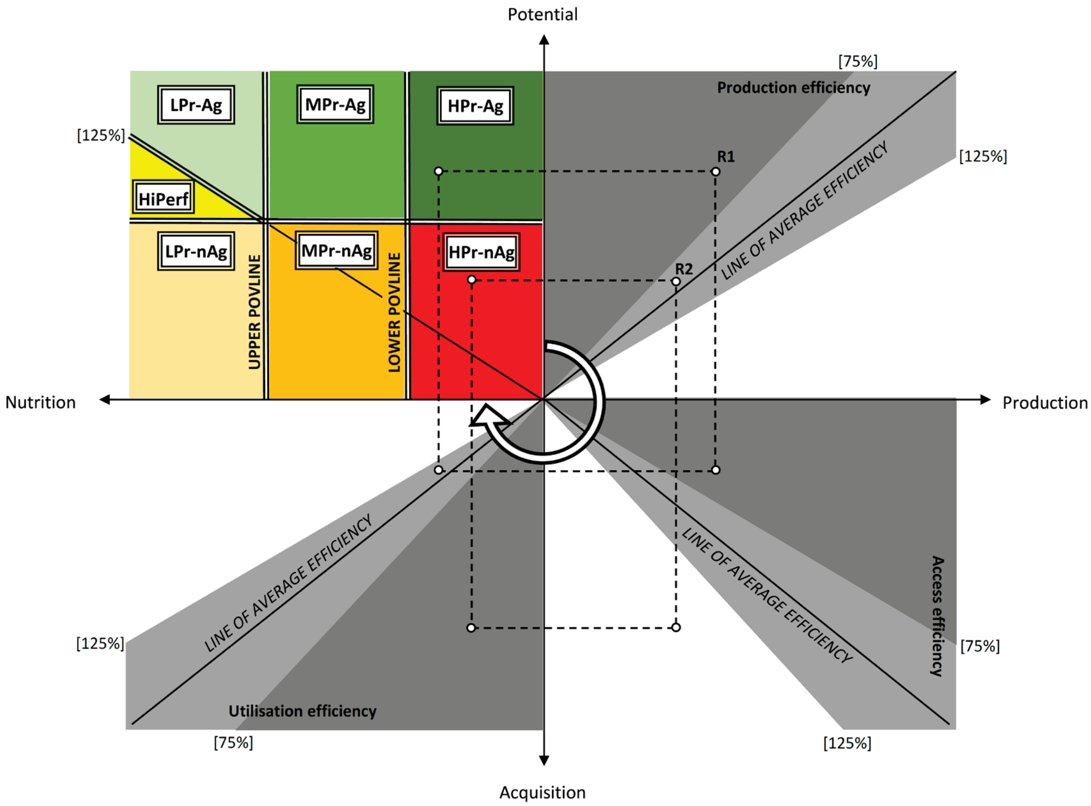
By assigning one **indicator** for each of the four sequential FNS dimensions (see the green boxes in Figure 2.2.), the typology helps point out where and which type of intervention would be most effective at improving the nutrition status of the Burkina population. The typology classifies each province's efficiency at transforming:

(i) agricultural potential into food production (*production efficiency*)
(ii) food production into food acquisition (*access efficiency*)
(iii) food acquisition into nutrition outcomes (*utilisation efficiency*).

To estimate these three efficiency types, we create a diagram that links all the indicators. The diagram (see Figure 2.3.) displays each indicator on a different axis, thus creating a four-dimensional diagram. Starting from the axis measuring agricultural potential (top vertical axis), this diagram should be read clock-wise. The upper-right panel describes the relationship between agricultural potential and food production. In this panel, the diagonal line of average efficiency indicates the level of food production one can *expect* based on each area's agricultural potential. In a similar vein, the diagonal of *access efficiency* (lower-right panel) reflects the *expected* levels of food acquisition based on a province's level of food production. Finally, *utilisation efficiency* (lower-left panel) represents the *expected* levels of nutrition status for every level of food acquisition. These three efficiencies compare provinces in Burkina Faso to each other, which means the *expected levels* are all based on a *relative comparison to the other provinces*.

By drawing a "fork" around the lines of average efficiency, we can define three levels of efficiency: above average, below average and average. When data observations fall *within* the "fork", efficiency is average. For example, for provinces (represented by dots) that fall within the "fork" of production efficiency (upper-right panel), the level of food production is roughly what you would expect based on their agricultural potential (that is under prevailing average production constraints characterizing the country). However, when data observations fall outside this "fork" range, food production performance is either worse or better than what is (on average) observed throughout the country. In this way, we classify provinces that perform better than 125% of the country average as "above average" (represented by the white space in the quadrants in Figure 2.3.). We classify provinces that perform worse than 75% of the country average as "below average" (dark grey space); and "average" provinces fall within the 75-125% "fork" range (light grey space). The same relative benchmarking of "above average", "below average" and "average" applies to *access efficiency* (lower-right panel) and utilisation efficiency (lower-left panel).

Figure 2.3. Combined diagram of FNS dimensions



Notes: LPr, MPr, HPr respectively stand for low-, medium- and high-priority nutrition areas; Ag and nAg refer to higher (Ag) and lower (nAg) agricultural potential; HiPerf stands for high-performance areas. "Povline" refers to poverty line.
Source: Authors.

The upper-left panel in Figure 2.3. shows poverty lines for low-, medium-, and high-priority nutrition areas. In addition, the upper-left panel distinguishes between areas with higher and lower agricultural opportunities.[2] Based on these definitions, there are seven intervention types, which emerge by combining the three priority levels—High Priority area (HPr), Medium Priority area (MPr), and Low Priority area (LPr)—and two levels of agricultural potential—either higher agricultural potential (Ag) or lower potential (nAg).[3] Within the category of "low priority areas with higher agricultural potential (LPr-Ag)," one can further classify areas as "high-performance (HiPerf)" when their overall efficiency level is higher than 125% of the country's average. These areas could serve as examples to others and may not be suitable for an FNS intervention since they already perform well in converting agricultural potential in nutrition outcomes.

Combining all information, the four-dimensional diagram underneath this typology depicts two sorts of benchmarking:

1) The upper-left panel applies an **absolute benchmark** to show the *level of nutrition-poverty urgency*. This panel also identifies whether *a focus on agricultural production* is warranted;

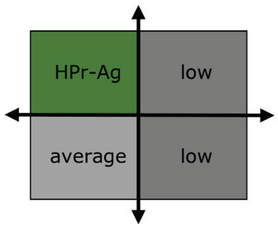
2) The other three panels apply **relative benchmarking** by comparing each province's performance with expected outcomes while roughly detailing where, along the pathway from agricultural potential to nutrition status, the biggest gains can be realised in terms of reducing production, access, or utilisation constraints.

[2] This distinction is based on the level of agricultural potential which corresponds with the intersection of the upper-bound poverty line and the line representing 125% of the average efficiency between potential and nutrition. This means that areas with an agricultural potential below this threshold will not reach a nutritional status above the upper-bound poverty line, unless they perform better than 125% of what is, on average, observed in the country.
[3] These types are much inspired by the work of Torero (2014).

Box 2.1. Typology examples

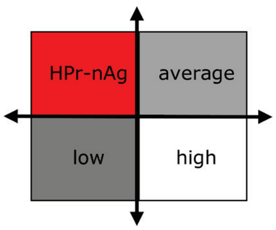
This box discusses the typology profile of two fictitious regions, R1 and R2, capturing data observations for various dimensions in Figure 2.3. Each region is represented by four data points, according to its values for each of the four dimensions. The precise location of data points within each of the panels thus characterises the region. The upper-left panel defines the priority level, with darker colours (green or red) indicating higher urgency, while the other panels provide insight on what type of intervention would be most effective to improve nutrition outcomes.

R1



R1 is a "high-priority region with higher agricultural potential (HPr-Ag)" because the nutrition status of its population is low while agricultural potential is high. To improve nutrition outcomes in this region, most attention should go to removing production and access constraints, as efficiency for both dimensions is lower than what is (on average) observed across the country. Utilisation efficiency is average and therefore is considered a less critical bottleneck.

R2



R2 is a "high-priority region with lower agricultural potential (HPr-nAg)" because both the nutrition status of its population and agricultural potential is low. In contrast to R1, we cannot expect major nutrition improvements to result from removing production constraints because the region's agricultural potential is low and its production efficiency is already average. Neither can we expect major nutrition benefits due to improving access to food because the region's efficiency is already higher than average in the country. To improve nutrition outcomes, R2 should mainly focus on reducing utilisation constraints, as efficiency for this dimension is low.

2.3. DATA ON FOOD AND NUTRITION SECURITY

Based on the conceptual framework above and relying on various data sources, we construct a key variable indicator for each FNS dimension.[4] For quick reference, Table 2.1. summarises the indicators for each dimension and provides some descriptive statistics.

To estimate agricultural potential of each province in Burkina Faso, we consider how many kilocalories could be produced from all available arable land, essentially translating hectares into a kilocalorie equivalent. For agricultural land estimates, we rely on two **remote sensing** satellite data sources. The first source identifies all land used for agriculture in 2015, at 30m pixel **spatial resolution** (Xiong et al., 2017). The second source (Hansen et al., 2013) indicates the amount of forest cleared between 2000 and 2015, assuming that this land was cleared for agriculture (Ouedraogo et al., 2010). We use these satellite data to create a map of (immediately) arable land countrywide. We assign each arable land pixel a cultivated crop (maize, millet, rice, red sorghum and white sorghum) proportional to its share in overall national consumption. We obtained the national "food basket" data from Ministere de l'Agriculture du Burkina Faso (2010). Using optimal yield data (which assumes proper fertilization, good agronomic practices and rainfed conditions) from the Global Yield Gap Atlas for Burkina Faso, each assigned arable pixel of corresponding crop is then converted to estimate crop production and corresponding kilocalories.[5,6] For each province, we sum up the total potential kilocalorie production of all pixels before dividing by the number of people living in that province, which then gives us the potentially-available kilocalories per person.[7]

To derive an indicator for food production, we rely on provincial statistics of *actual* agricultural production in 2015/2016 obtained from the Ministere de l'Agriculture du Burkina Faso (2016). We convert these 2015/2016 production statistics for the most important cereals, tubers and pulses into kilocalories using the same food composition data as above (Stadlmayr et al., 2012). Again, for each province, we then divide the total kilocalorie production by the population of that province resulting in actual available kilocalories per person at the provincial level. Due to data limitations, we exclude agricultural production from animal sources, such as meat, fish, milk and eggs. To represent food acquisition, we use the WFP's Food Consumption Score (FCS) from the Comprehensive Food Security and Vulnerability Analysis (CFSVA) of 2012. Based on recall data of food group consumption in the past 7 days, this composite score takes into account dietary diversity, food frequency, and relative nutritional importance of different food groups (WFP, 2008). For each province, we calculate the percentage of households with an acceptable score (i.e.

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[4] We employ data indicators from different time periods, based on most recent availability; we assume that the geographical structure of older data remains constant over time.
[5] See www.yieldgap.org/burkina-faso.
[6] Based on food composition data compiled by Stadlmayr et al. (2012).
[7] To more easily observe differences across provinces, we apply a 2^{nd}-root transformation on total potential kilocalorie production. To assure consistency, this procedure is later repeated for our measure of actual kilocalorie production.

above 35.5, according to World Food Programme's recommendations). For nutrition, we rely on data from the Demographic and Health Survey (DHS) of 2010. We define our nutrition indicator as the percentage of under-five-years old children who are non-stunted (i.e. have a height-for-age ratio *above* the malnutrition cut-off for the reference population).

Table 2.1. Descriptive statistics of key FNS indicators for rural Burkina Faso (2010-2015)

Indicator	Indicator components	Obs.	Mean	Min	Max
Potential	Immediately arable land (km^2)	45	1490.2	13.0	4994.0
	Daily potential kilocalorie production per person	45	12030.8	86.5	33274.4
	2nd-root transformation of daily potential kilocalorie production per person	45	101.2	9.3	182.4
Production	Daily kilocalorie production per person	45	4421.9	1745.8	11198.3
	2nd-root transformation of daily kilocalorie production per person	45	64.5	41.8	105.8
Acquisition	% of households with FCS below 35.5	45	30.8	2.8	90.3
	% of households with FCS above 35.5	45	69.2	9.7	97.2
Nutrition	% of stunted children (<5 years, below -2 standard deviations of the median height-for-age of the reference population)	45	37.4	12.8	51.4
	% of non-stunted children (<5 years, above -2 standard deviations of the median height-for-age of the reference population)	45	62.6	48.6	87.2

Source: Authors with data from Brown de Colstoun et al. (2017); CFSVA (2012); DHS (2010); Hansen et al. (2013); Ministere de l'Agriculture du Burkina Faso (2010, 2016); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

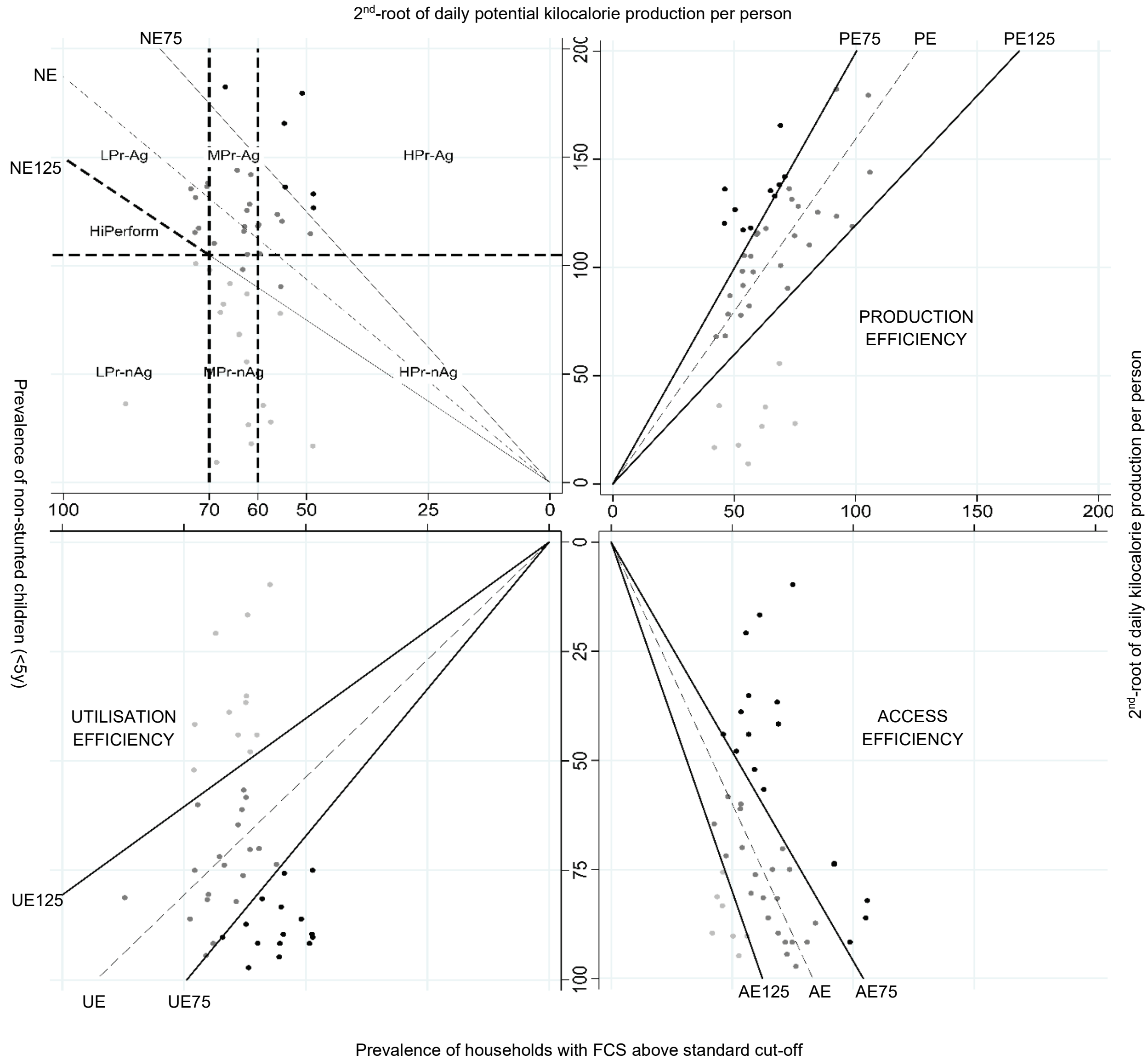
2.4. TYPOLOGY OUTCOMES

Having defined and estimated indicators for each FNS dimension for each of the 45 rural provinces in Burkina Faso, Figure 2.4. presents the four-dimensional diagram loaded with real data. This diagram consists of four **scatterplots** where each dot represents a province and its corresponding pair of values for both constituent indicators. Figure 2.5. adds the spatial dimension by presenting four country maps, each covering a quadrant from Figures 2.3. and 2.4., showing level of production, access or utilisation efficiency and one with colours representing the intervention types. For the three efficiency types (panel b, c and d), the lightest grey colour indicates provinces with "better than average" efficiency while the black colour refers to provinces characterised by "worse than average" efficiency. The latter provinces would be potential candidates for targeted interventions to improve production, access or utilisation efficiency. Panel (a) combines nutrition priority levels of provinces with relative agricultural potential of that province, displaying the seven intervention types.

We observe 15 high-priority provinces, five with lower agricultural potential and ten with stronger agricultural potential. The provinces of Oudalan, Soum, Loroum, Yatenga in the drought-prone north, and the centrally-located province of Kourweogo have less agricultural potential. The high-priority provinces with higher agricultural potential are scattered across the country: Seno, Yagha, Tapoa and Gourma in the east bordering Niger, Ziro in the centre, and a cluster of five other provinces (Tuy, Ioba, Bougouriba, Comoe and Poni) in the southwestern part of country.

Although these provinces all need urgent nutrition interventions (based on child stunting levels), the type of optimal intervention will depend upon their location. The four northern provinces have different combinations of production and access constraints, yet in utilisation perform worse than 75% of the expected average in rural Burkina Faso. Similarly, utilisation constraints are equally challenging in many of the other high-priority provinces, often in combination with severe production inefficiencies in the eastern provinces and in Comoe and with access constraints in Bougouriba and Ziro. Kourweogo in the centre and many of the provinces around Ouagadougou have fairly modest production and utilisation constraints but suffer from severe food access problems. For provinces around Ouagadougou, this might be because, despite good access to production inputs and health infrastructure in the capital city, high demand for food from the region's rising population results in higher food prices and a less-diversified diet. We will return to the topic of poor access to a diversified diet in Chapter 3.

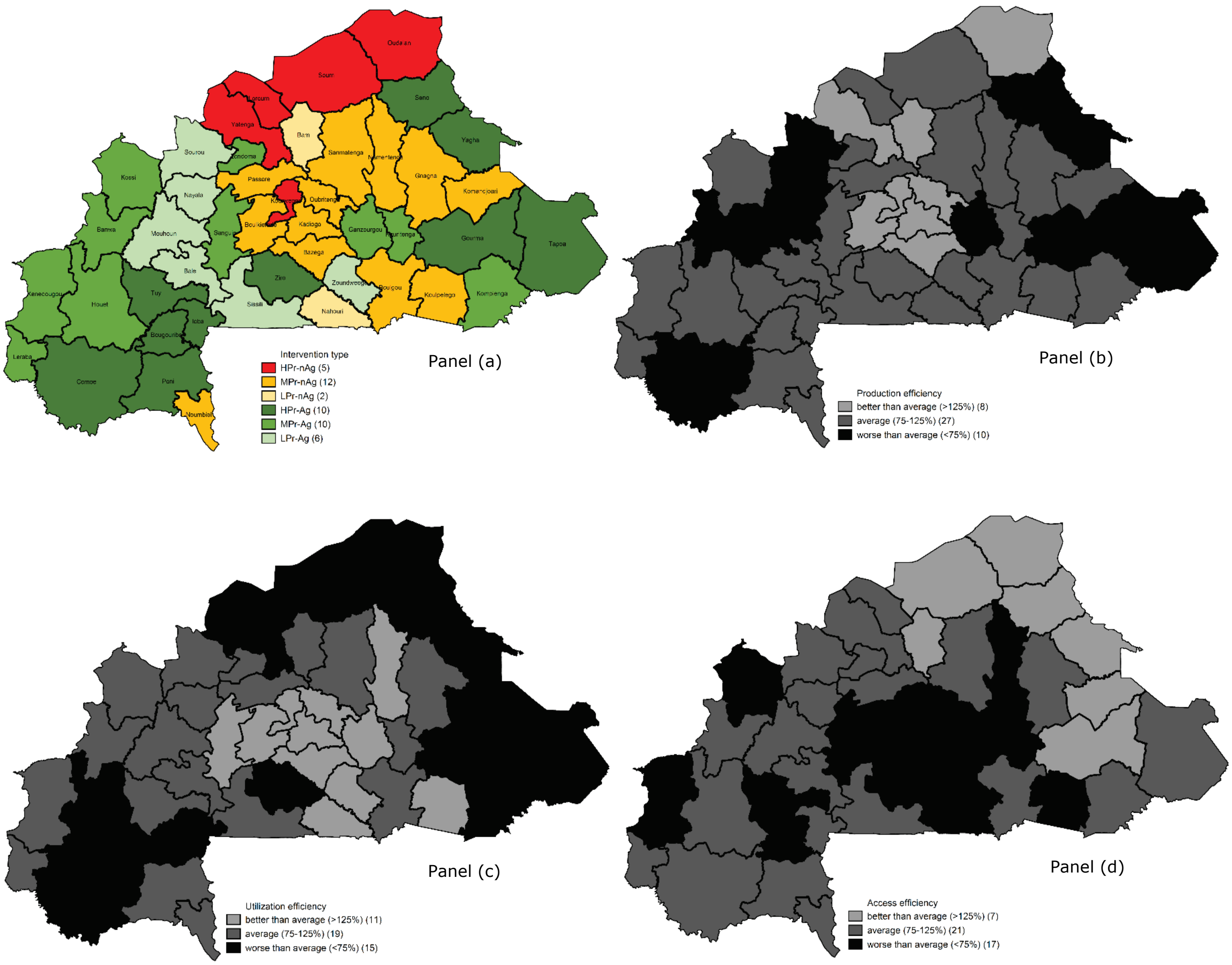
Figure 2.4. Combined scatterplot with provincial data, rural Burkina Faso (2010-2015)



Notes: LPr, MPr, HPr respectively stand for low-, medium- and high-priority provinces for nutrition; Ag and nAg refer to higher and lower agricultural potential; HiPerform stands for high-performance provinces. PE, AE, UE and NE are estimated lines based on population-weighted OLS regressions with intercept through the origin, respectively having a slope of 1.594, 0.884, 0.985 and 0.534. The E75 and E125 lines are derived from the previous lines with slopes being 75% and 125% the size of the estimated slopes.

Source: Authors with data from Brown de Colstoun et al. (2017); CFSVA (2012); DHS (2010); Hansen et al. (2013); Ministere de l'Agriculture du Burkina Faso (2010, 2016); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

Figure 2.5. Provinces by intervention type and efficiency level, rural Burkina Faso (2010-2015)



Notes: LPr, MPr, HPr respectively stand for low-, medium- and high-priority provinces; Ag and nAg refer to higher and lower agricultural potential.
Source: Authors with data from Brown de Colstoun et al. (2017); CFSVA (2012); DHS (2010); Hansen et al. (2013); Ministere de l'Agriculture du Burkina Faso (2010, 2016); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

2.5. LINKING TYPOLOGY TO POLICY

The Second National Rural Sector Program (PNSR2) of Burkina Faso (SP/CPSA, 2017) aims to improve well-being in rural Burkina Faso by targeting six objectives: (1) inefficient production systems and low agricultural growth rates; (2) weak agricultural value chains and markets; (3) fragile food and nutrition security; (4) degradation of natural resources and sustainable management; (5) water resource mobilization and (6) poor human capital and supervision in rural areas. By aligning investments with the challenges and opportunities unique to each province, the country would be better able to attain the six objectives. Strategic FNS interventions could focus on the 15 high-priority provinces and a locally-tailored action plan could be designed for each based on the particular combination of constraints observed, as summarised in Table 2.2.

For example, various sub-programs under axis 1 (food production), 4 (water mobilisation) and 5 (extension) seek to improve agricultural productivity, yet lack a spatial focus. These programs could be more usefully targeted towards the high-priority provinces of Gourma, Seno, Tapoa, Yagha and Comoe. Investments related to market access and value chains proposed under axis 2 could explicitly target the provinces of Kourweogo, Tuy, Bougouriba and Ziro, which suffer most from market inefficiencies. In these provinces, linkages between production, processing and consumers could be improved. To address the utilisation challenges of Gourma, Seno, Tapoa, Yagha, Comoe, Bougouriba, Ziro, Loroum, Yatenga, Oudalan, Soum and Ioba, axis 4 (water and sanitation) of PNSR2 could target these geographic areas where access to improved water and sanitation is lacking.

While Burkina Faso's current agricultural development strategy and investment plans could be improved by spatial targeting, Table 2.2. provides a few incidences where investments align well with the inefficiency profiles of some provinces. Tapoa, for example, which suffers from low production efficiency, could benefit from the fertilizer unit construction under PNSR2. In contrast, Sourou and Houet receive a disproportionately large share of overall investment funding, even though malnutrition is not severe. However, the agricultural development in Samendeni (Houet) and Sourou may be justified if sufficient economic opportunities spill over to surrounding high-priority provinces.

Table 2.2. Efficiency profile of high-priority provinces in rural Burkina Faso (2010-2015) versus PNSR2

Province	Agricultural potential	Efficiency			Second National Rural Sector Program (PNSR2)
		Production	Access	Utilisation	
Gourma, Seno, Tapoa, Yagha, Comoe	higher	**low**	medium/ high	**low**	Capacity building of water management agency of Gourma and Seno Construction of mineral fertilizer unit in Tapoa
Kourweogo, Tuy	lower/ higher	medium/ high	**low**	medium/ high	Not mentioned in PNSR2
Bougouriba, Ziro	higher	medium	**low**	**low**	Construction of barrage in Bougouriba
Loroum, Yatenga, Oudalan, Soum, Ioba	lower/ higher	medium/ high	medium/ high	**low**	Construction of hydro-agricultural and electrical barrage in Ouessa and barrage in Bambakari/Tin-Akoff
Poni	higher	medium	medium	medium	Not mentioned in PNSR2

Notes: The defining set of inefficiencies for each cluster of high-priority provinces is indicated in bold.
Source: Authors with data from Brown de Colstoun et al. (2017); CFSVA (2012); DHS (2010); Hansen et al. (2013); Ministere de l'Agriculture du Burkina Faso (2010, 2016); Pekel et al. (2016); SP/CPSA (2017); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

ADVOCACY NOTE ON CHAPTER 2

The typology results of this chapter may be useful to the advocacy work of CSOs in Burkina Faso in at least two ways. First, they facilitate advocating for more geographically-sensitive FNS policies that heed the differences across provinces. Second, the results help us to question or challenge investments that fail to target the most critical bottlenecks to improving nutrition outcomes.

Two basic questions should be raised when evaluating current or future government FNS policies:

1) What type of bottleneck does this policy address? Is it a production, access or utilisation challenge (constraint)?
2) Which area, region or province of the country does this policy target?

POSSIBLE ACTIONS

- If policies lack geographic targeting, CSOs can reference Table 2.2., which lists high-priority provinces and their most critical bottlenecks.
- If the policy does explicitly mention target areas, then:
    - CSOs could ensure that priorities align with those summarised in Table 2.2.
    - When policies target low- or medium-priority provinces, CSOs could redirect attention toward high-priority areas. Alternatively, CSOs could request guarantees that investments in low-priority provinces will benefit surrounding high-priority provinces.
    - When policies in high-priority provinces do not prioritise the most critical bottlenecks, CSOs could request a reorientation so that interventions first address the most urgent challenges.

Chapter 3

NUTRIENT ADEQUACY MAPS FOR TARGETED POLICY INTERVENTIONS

3.1. INTRODUCTION

This chapter presents a series of **nutrient adequacy** maps to help understand, identify and locate the major challenges behind the country's insufficient or unbalanced food intake. The maps show food production and consumption data converted into corresponding calorie and nutrient amounts, comparing them with the nutrition requirements of each region's population. The adopted method roughly aligns with the food system approach currently advocated by many researchers and development partners (Ericksen, 2008; Gillespie & van den Bold, 2017; Global Panel on Agriculture and Food Systems for Nutrition, 2016; Jones & Ejeta, 2015; Pinstrup-Andersen, 2013; Stephens, Jones, & Parsons, 2018; Tendall et al., 2015). In this chapter we focus on total calories consumed (energy intake) as well as a set of **micronutrients** associated with "hidden hunger" when they are insufficiently consumed. These include calcium, iron, zinc, folate, vitamin B12 and vitamin A. Even without the obvious signs of malnutrition like stunting or "felt" hunger pangs, micronutrient deficiencies affect a person's well-being and development, and can lead to mental and cognitive impairment, poor health, low productivity, even death. By comparing nutrient consumption adequacy with the locally available food items that contain essential micronutrients, we can strategically design FNS policies.

Figure 3.1. presents the overall challenge of Burkina Faso's undernutrition, expressed both in terms of *diet quantity* and *quality*. Whereas diet quantity refers to a sufficient intake of kilocalories, diet quality looks at intake of micronutrients. In this chapter we define nutrition adequacy at the "household level," which means that the required number of kilocalories or micronutrients for each household depends on size and demographic structure of the family. To obtain mean adequacy rates for each region, we first cap energy and nutrient household adequacies at 100% (since 100% means sufficient intake). Diet quantity is straightforward since it depends only on total kilocalories; for diet quality, we apply the same procedure for each micronutrient individually before computing the arithmetic mean at the household level, also known as the mean adequacy ratio (MAR).

Key Words

Nutrient adequacy sufficient intake of essential nutrients based on individual requirements for optimal health

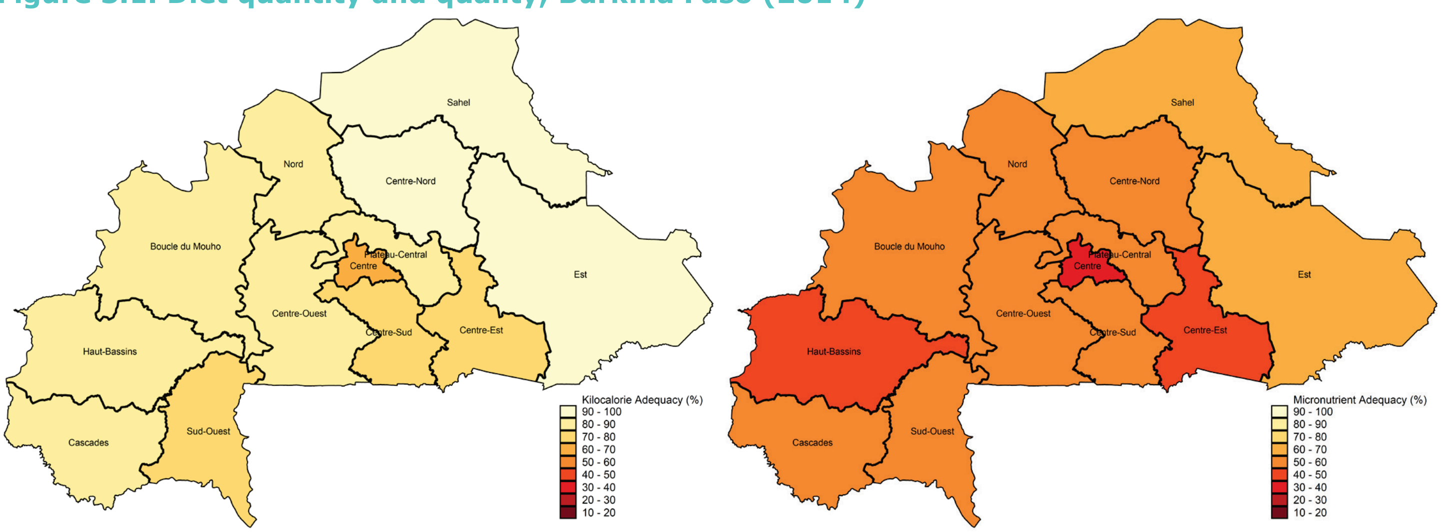
Micronutrients essential elements required in small quantities; vitamins and minerals are two distinct sets of micronutrients

Demand constraint a limitation defined by consumers' ability to afford, or willingness to pay for a certain commodity

Adult-male equivalence a concept to standardise nutrition requirements across population groups

Sampling weights values associated with data observations that ensure that survey statistics are representative of the population

Figure 3.1. Diet quantity and quality, Burkina Faso (2014)



Source: Authors with data from EMC (2014).

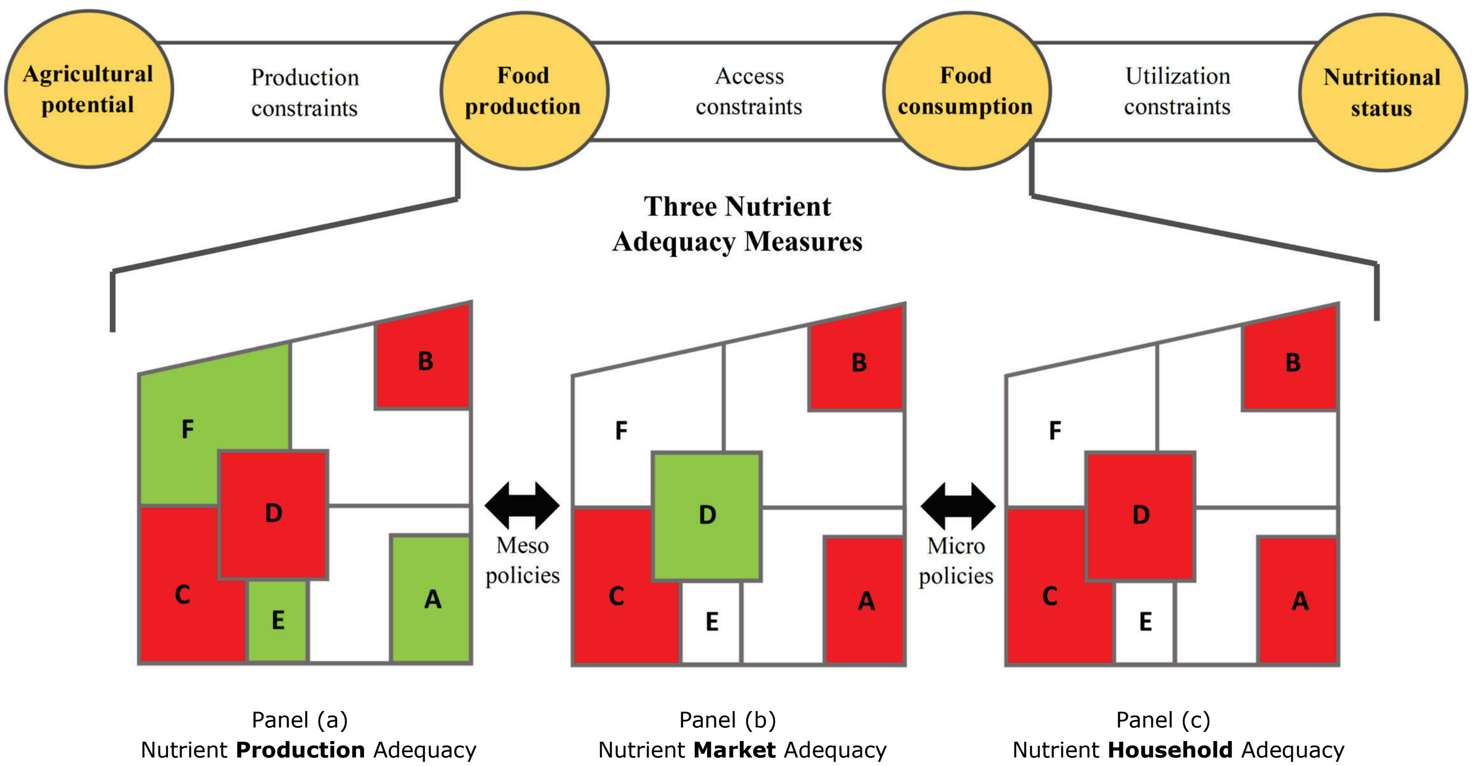
The left-hand side map of Figure 3.1. shows that food energy intake is slightly better in three northeastern regions—Sahel, Centre-Nord and Est—which have adequacy levels above 90%. Towards the west, households living in Centre-Sud, Centre-Est, Sud-Ouest and especially those in the Centre region perform relatively worse. For micronutrient adequacy (right-hand side map of Figure 3.1.) we see a similar disparity between the northeast and the rest of the country, with Centre, Centre-Est and Haut-Bassins most affected by "hidden hunger" malnourishment. With severe deficiencies in both *diet quantity* and *quality,* the capital city of Ouagadougou and its surrounding Centre region has kilocalorie and micronutrient adequacies below 70% and 40% respectively.

3.2. CONCEPTUAL FRAMEWORK

To generate evidence on the causes and related opportunities to address the spatial heterogeneity in food-intake deficiency, we map three distinct nutrient adequacy measures for food energy and micronutrients. The first measure, *nutrient production adequacy*, quantifies the region's agricultural production capacity to meet the minimal energy and nutrient requirements of its population. The second measure, *nutrient market adequacy*, indicates the aggregate accessibility of calories and nutrients, based on the region's population food needs. The third measure, *nutrient household adequacy*, addresses the unequal access among households within each region. By comparing the three nutrient adequacy maps and by connecting them to their corresponding food sources, we can strategically design and evaluate FNS policies.

The green colour in Figure 3.2. indicates nutrient surplus in an area, red indicates a deficit, and white indicates self-sufficiency. Panel (a) in Figure 3.2. shows three areas with insufficient nutrient production (areas B, C and D). Increasing nutrient production in these areas might be an appropriate policy strategy, but it is important to explore additional challenges and opportunities first. For example, look at area D in panels (a) and (b). Even though area D does not produce enough nutrients, its neighbouring areas E and F have production surpluses—the market in area D is *not* nutrient deficient, perhaps thanks to successful market integration with areas E and F. Given its location, area C might seek similar forms of market integration with areas E and F.

Figure 3.2. Three nutrient adequacy measures to identify and locate bottlenecks to food security



Note: White indicates self-sufficiency, green indicates surplus and red indicates deficiency.
Source: Authors.

Now look at area A in panels (a) and (b). Area A *produces* enough nutrients, but markets in area A do not sell enough to keep the local population healthy. We call this "nutrient loss." It occurs when nutrients produced locally are traded or sold outside the area, or when post-harvest losses prevent those nutrient-rich foods from making it to local markets. Fixing the nutrient loss may require revising commercial or trade policies, improving transport infrastructure to better link markets to producers, or by investing in storage and processing capacity.

Finally, let us compare area D in panels (b) and (c). Although enough nutrients make it to the market (panel b), households still lack adequate nutritious food (panel c). Why would this be? Perhaps the nutritious food is simply unaffordable for households; or perhaps people lack nutrition knowledge and therefore ignore important nutrient-rich food. We call these obstacles **demand constraints** since they do not depend on the suppliers, but on the consumers demanding food products. Fixing these challenges might require nutrition-sensitive social protection schemes that help supplement income, or behavioural change campaigns that promote nutrient-rich foods or nutrition education.

3.3. DATA

The data used in this chapter come from various sources but each source allows us to compute estimates of nutrient adequacy for the 13 regions of Burkina Faso. For production adequacy, we combine the official 2014 production statistics of five main cereals (maize, rice, millet, sorghum and fonio), two tubers (sweet potato and yam), four pulses (cowpeas, groundnuts, sesame and voandzou) and various livestock products including different types of meat, milk and eggs (Ministere de l'Agriculture du Burkina Faso, 2015; Ministere des Ressources Animales du Burkina Faso, 2015). In addition, we estimate fruit, vegetable and fish production by actualising the 2008 figures using a constant productivity-to-population ratio. These data cover 16 horticultural products and seven fish species (Ministere de l'Agriculture et de la Securite Alimentaire du Burkina Faso, 2014). Using food composition data compiled for West Africa (Stadlmayr et al., 2012), we convert production quantities into kilocalories and other nutrient equivalents and aggregate by region. We estimate the ratio of production adequacy by dividing the food energy and nutrient production levels by their respective required intakes according to each region's demographic makeup. We use the same approach for market adequacy, based on food consumption data obtained from the Burkina Faso *Enquête Multisectorielle Continue* (EMC) conducted in 2014 (Institut National de la Statistique et de la Démographie du Burkina Faso, 2016). This survey combines different sources of food consumption, such as purchases, home-produced, gifts in-kind and depletion of food stock, recorded during four visits throughout the year. In total, more than 50 food items are covered. Quantities of food purchases are estimated by imputing regional food prices. Using the same food composition data (Stadlmayr et al., 2012), we derive aggregate nutrient consumption by region and divide it by the region's required intake levels. We derive household adequacy from the same household consumption survey, estimated at the household level by considering the family's required intake (capping all values above 100%), then averaging household ratios by region. The required intake levels for each household and region are determined using the common **adult-male equivalence** approach combined with population **sampling weights**. Each of the three measures is a ratio, where 100% reflects adequacy, and values below (above) 100% point to deficiency (surplus). The colour scheme applied throughout this chapter is pale yellow for adequacy, green for surplus and red for deficiency.

3.4. NUTRIENT ADEQUACY

Table 3.1. provides an overview of absolute gaps in nutrient production and consumption, compared to recommended intake levels as well as the three nutrient adequacy measures. Burkina Faso fares decently well in kilocalorie and protein consumption: households on average consume at least 80% of the recommended intake. Unfortunately, micronutrient deficiencies are alarming, especially for vitamin B12 (28%), calcium (33%), vitamin A (35%) and iron (63%). Low production adequacies—only 6% for vitamin B12 and 35% for vitamin A—seem to drive these deficiencies. Burkina Faso appears to import many foods rich in vitamin B12, which somewhat compensates for production shortage, yet the imports may only reach a limited population.

Table 3.1. National food energy and nutrient adequacy levels based on production, consumption and recommended intake, Burkina Faso (2014)

	Production per day, AME	Consumption per day, AME	Recommended intake per day, AME	National Production Adequacy (%)	National Market Adequacy (%)	National Household Adequacy (%)
Kilocalories (kcal)	4690.1	2523.1	2750.0	170.5	91.7	81.4
Protein (g.)	158.9	76.7	50.0	317.7	153.4	95.7
Calcium (mg.)	848.0	329.4	1000.0	84.8	32.9	33.3
Iron (mg.)	39.4	18.2	27.4	144.0	66.4	62.5
Zinc (mg.)	28.7	12.4	14.0	205.3	88.9	77.3
Folate (mcg.)	844.9	378.4	400.0	211.2	94.6	79.1
Vitamin B12 (mcg.)	0.1	0.7	2.4	5.9	28.8	27.9
Vitamin A (mcg.)	209.7	213.9	600.0	34.9	35.6	35.4

Source: Authors with data from EMC (2014); Ministere de l'Agriculture (2015); Ministere de l'Agriculture et de la Securite Alimentaire (2014); Ministere des Ressources Animales (2015).

Burkina Faso also does not produce enough calcium-rich foods, yet the primary concern involves "losses" occurring between production and markets. The country produces 85% of the required calcium intake, yet adequacy at the market level is only 33%—pointing to either food losses or exports of calcium-rich food items. Nutrient losses affect all the other nutrients, though with lesser health consequences thanks to the production surpluses for iron, zinc, folate, as well as kilocalories and protein. For zinc, folate and protein, unequal access to locally-available nutrients exacerbates nutrient deficiencies, as can be inferred from substantial drops between market and household adequacy.

Figure 3.3. displays the same three adequacy measures for each of the six micronutrients covered in this chapter, illustrated geographically by region.

Note in panel (e) that insufficient *vitamin B12* production affects all 13 regions of the country: all have production adequacies well below 30% (left-hand side map). Due to imported food items rich in vitamin B12, the situation is less dramatic at the market level (middle map), especially for the western regions of the country and Centre-Sud. This spatial pattern is similar at the household level (right-hand side map) with Cascades and Sud-Ouest showing nutrient adequacy ratios slightly above 40%, while households in most regions (on average) consume less than 30% of what is recommended. To address the problem of severe vitamin B12 deficiency, Burkina Faso could implement nutrition-sensitive protection schemes such as B12 supplementation through fortified foods, increase production of animal products, or implement trade policies that encourage imports of animal-based food items.

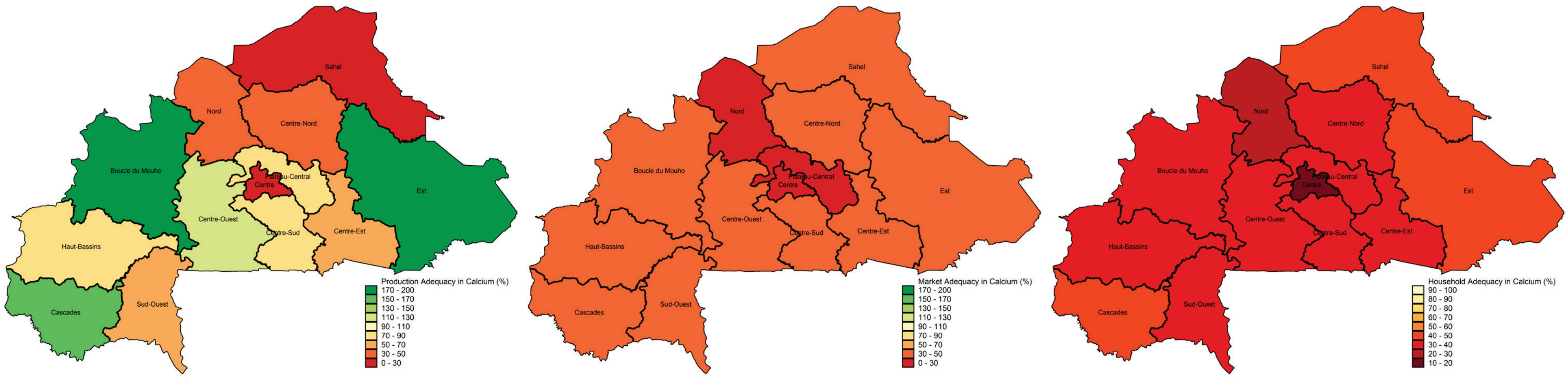
Vitamin A's production deficiencies are more heterogeneous across the country (see panel f). In the southwest we observe the highest production adequacies, with Haut-Bassins the only region producing a surplus. In the northeast, vitamin A adequacies are below 30%. This spatial pattern is not surprising given the ample rainfall in the southwest, where tropical fruits such as mango and papaya (both rich in vitamin A) grow (according to the official statistics, mostly produced in Haut-Bassins). Comparing vitamin A production and market adequacies, we see nutrient losses in the southwest, which could be interpreted as food losses between production sites and markets or as exports to neighbouring regions. Since the vitamin A adequacy in the east (especially the region Est) actually *increases* between the production stage and market stage, it appears to benefit from imported foods rich in vitamin A. Household adequacies are highest in Cascades and Est with ratios above 50%, and lowest in the Nord region. For policy recommendations, production of vitamin-A-rich foods should increase in suitable agricultural areas, losses must decrease, and foods should be distributed to regions with less-favourable agroecological conditions.

Calcium deficiency (see panel a) poses a major threat, with household adequacies nowhere near 50%, and alarmingly low in Nord and Centre (right-hand side map). The household adequacy map mimics the low market adequacy (middle map). Yet four regions (Boucle du Mouhoun, Est, Cascades and Centre-Ouest) produce enough calcium to feed their respective populations. This points to serious levels of nutrient loss, either from food losses or trade. Sesame cultivation for international export markets likely accounts for the loss. Next to cotton, sesame is Burkina Faso's most important export crop (Glin, Mol, & Oosterveer, 2013), and it is extremely rich in calcium (i.e. 983 mg per 100 g edible portion). In all other regions, especially in the north, calcium production falls short of needs (followed by market and household inadequacy). In addition to stimulating production of (other) calcium-rich food items, farmers in Burkina Faso could be encouraged to produce more sesame for their own domestic market.

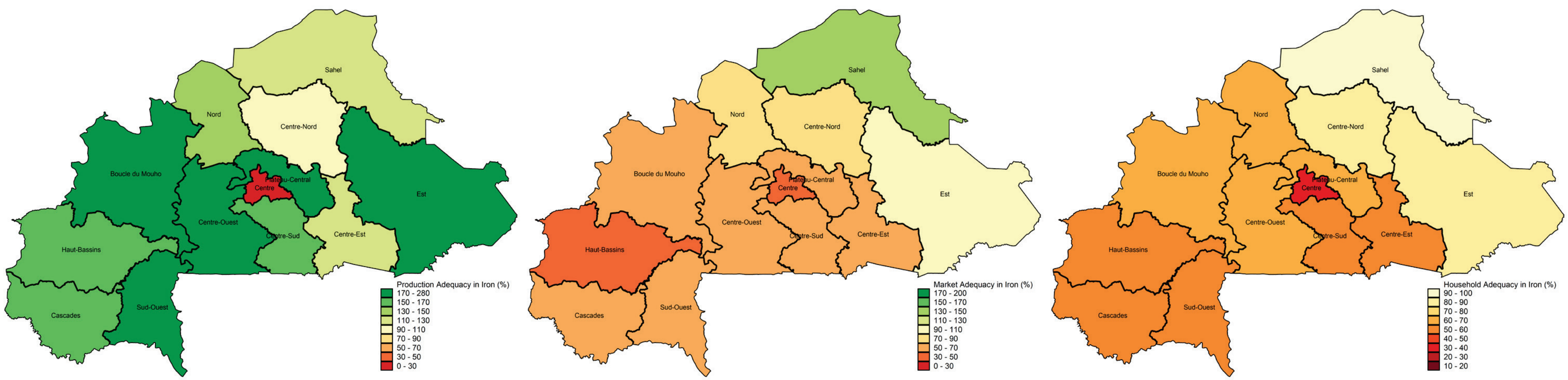
For *iron* (see panel b), *zinc* (see panel c) and *folate* (see panel d), largely the same spatial configuration of bottlenecks applies: we observe substantial nutrient loss combined with demand constraints. Production of all three micronutrients appears sufficient, with adequacies above 100% in all regions (except Centre). However, comparing production and market adequacies, we note huge reductions in nutrient availability across the country (less so in Sahel, Centre-Nord and Est). Similarly, nutrient household adequacies are generally lower compared to their corresponding market adequacies. The decline is less severe for iron, but nonetheless suggest that households face barriers (economic, behavioural, educational) to purchasing iron-, zinc- and folate-rich foods.

To end this section, we call attention to the severe food-insecure status of Ouagadougou located in the Centre region. In addition to very low nutrient production adequacies due to limited arable land and high population, the capital city appears poorly connected to its own domestic (or international) food markets. For all nutrients covered in this chapter, Centre always figures among the regions with the lowest nutrient market adequacies, seriously jeopardising households' access to a healthy, diversified diet.

Figure 3.3. Micronutrient production, market and household adequacies at regional level, Burkina Faso (2014)

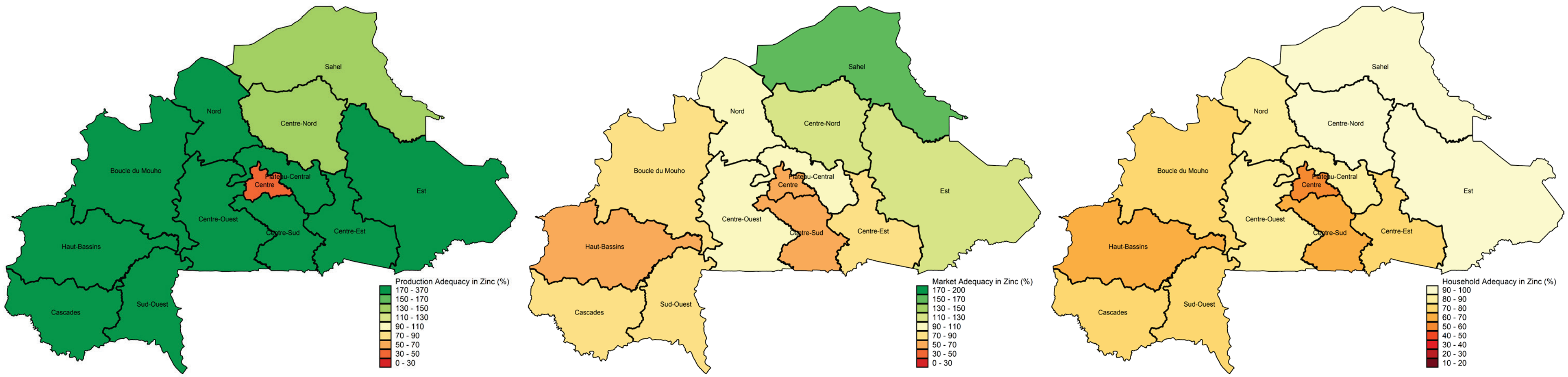


Panel (a): Calcium adequacy

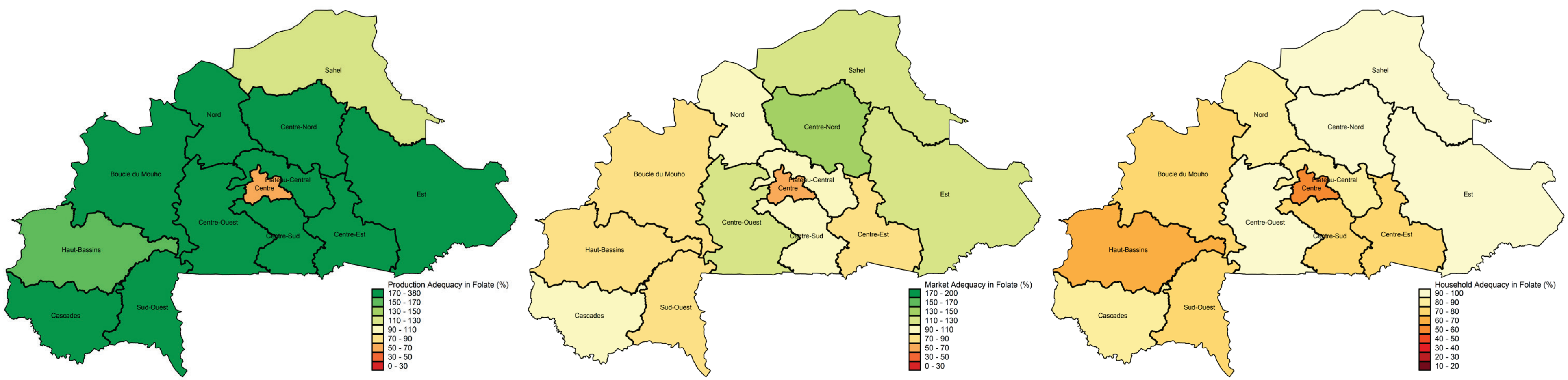


Panel (b): Iron adequacy

Figure 3.3. Continued

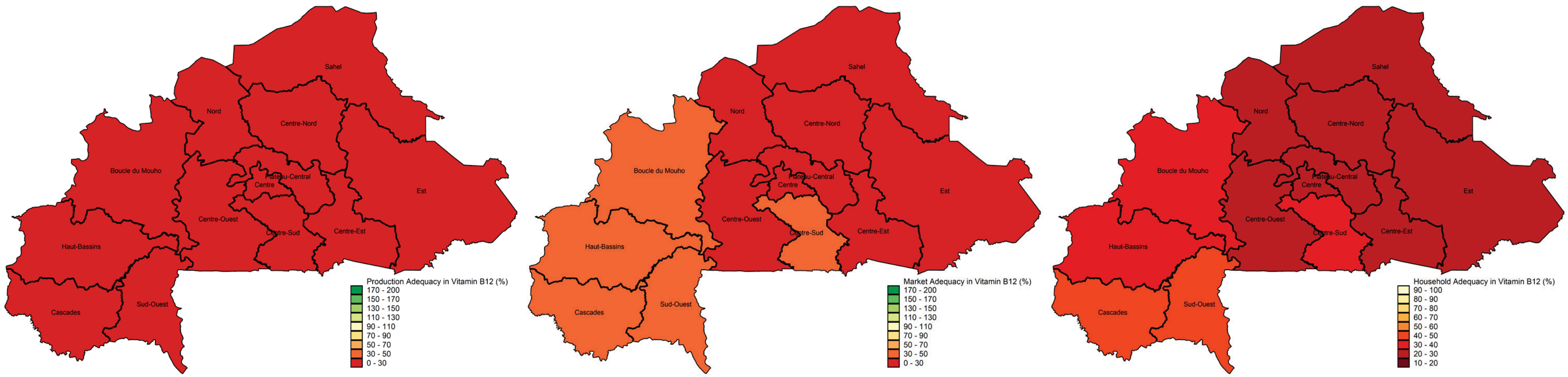


Panel (c): Zinc adequacy

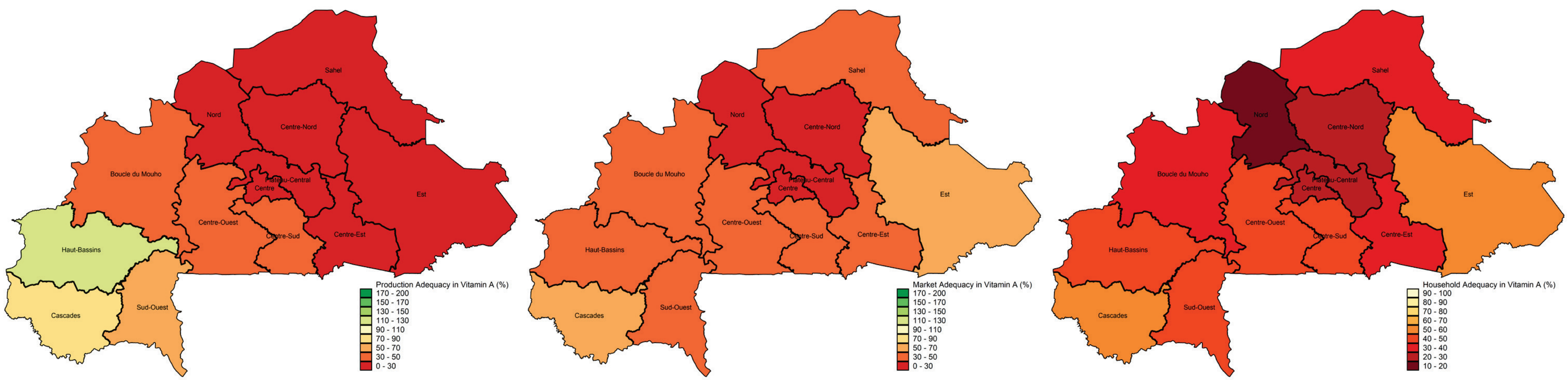


Panel (d): Folate adequacy

Figure 3.3. Continued



Panel (e): Vitamin B12 adequacy



Panel (f): Vitamin A adequacy

Source: Authors with data from EMC (2014); Ministere de l’Agriculture (2015); Ministere de l’Agriculture et de la Securite Alimentaire (2014); Ministere des Ressources Animales (2015).

3.5. FROM NUTRIENT DEFICIENCIES BACK TO FOOD AND TARGETED POLICIES

In this section, we shift focus to the actual food items that supply micronutrients, considering policy recommendations that could help increase production, reduce nutrient loss and improve consumer access to healthy foods. In real life people grow and buy actual foods—not micronutrients. For each nutrient covered in this chapter, Table 3.2. presents the five most important national food items according to two criteria:

1) current share in overall nutrient intake (%) (left-hand side column)
2) cheapest prices per nutrient (expressed in *Francs CFA*) (right-hand side column)

Table 3.2. also identifies the nutritional content per 100 gr edible portion of each food item (Stadlmayr et al., 2012) and its food budget share.

Increasing the production or import of animal food sources could help address vitamin B12 deficiency in Burkina Faso. More availability of animal sourced food will help lower the price and increase household consumption. Currently meat is at least five times more expensive than dried fish, which means increasing livestock production could have a more dynamic impact. Fortifying foods with vitamin B12 could also improve uptake of vitamin B12. In the short run, households could consume B12 supplements, or reallocate a portion of their food budget to spend more on (dried) fish. Similarly, stimulating production of vitamin A-rich foods in areas with favourable biophysical conditions could increase intake. Leafy vegetables (such as sorrel and baobab leaves) are very rich in vitamin A; sweet potato is slightly more cost-effective (but less-consumed throughout the country), with a nutrient price of 0.09 FCFA per mcg vitamin A (compared to 0.11 FCFA per mcg for leafy greens). Since these food items are comparable in price, and both appear in the top-5 lists of Table 3.2., we suggest the greatest nutrition impact will come from increasing production rather than altering food preferences.

Similarly, production of calcium-rich foods should increase the uptake of calcium. As shown in Table 3.2., dried fish might again be a viable candidate, given its relatively low nutrient price and high calcium density (i.e. 904 mg per 100 g edible portion). This strategy could be combined with policies to promote sesame production for domestic consumption. Currently, sesame is virtually absent from the daily food basket because most production is exported to international markets. In addition to increased raw availability on the domestic market, sesame seeds could be processed into products such as sesame bar snacks to more easily meet calcium needs in remote areas.

The five most important food sources (left-hand side column) for iron, zinc and folate—as well as for kilocalories and protein—are remarkably similar to the cost-effective food alternatives (right-hand side column). For all three micronutrients, each top-5 list contains the same cereals and pulses: millet, sorghum, maize and beans. Lacking cost-effective food alternatives to increase nutrient uptake of iron, zinc and folate, this poorly-diversified diet also points to poverty and unaffordability. Increasing the availability of cereals and pulses on the market should make these products more affordable to the Burkinabe population. Since the country appears to be self-sufficient in the production of each of these micronutrients, reducing losses between the production of cereals and pulses and their market distribution could help address iron, zinc and folate deficiency. The export of iron- and zinc-rich sesame offers a partial explanation too. Burkina Faso will need to identify how food loss primarily occurs, especially since Burkina Faso is a net-importer of cereals, which are dry food items (and thus presumably spoil-resistant).

While working to increase agricultural production of some crops and reduce nutrient losses for others, social protection schemes could help to assure essential nutrient intakes for the most undernourished families in Burkina Faso.

Table 3.2. Top-5 food items according to nutrient share and price, Burkina Faso (2014)

	Food item	Nutrient intake share	Price per nutrient (FCFA)	Nutrient content 100gr	Food budget share	Food item	Nutrient intake share	Price per nutrient (FCFA)	Nutrient content 100gr	Food budget share
Calorie	Sorghum	29.0%	0.05	352.5	14.0%	Maize	25.3%	0.04	351.0	10.7%
	Maize	25.3%	0.04	351.0	10.7%	Sorghum	29.0%	0.05	352.5	14.0%
	Millet	15.5%	0.05	382.0	8.2%	Millet	15.5%	0.05	382.0	8.2%
	Rice	10.9%	0.11	349.0	12.6%	Shea butter	1.2%	0.08	900.0	1.0%
	Beans	5.1%	0.08	335.0	4.5%	Beans	5.1%	0.08	335.0	4.5%
Protein	Sorghum	27.9%	1.70	9.6	14.0%	Beans	12.0%	1.27	22.1	4.5%
	Maize	23.1%	1.57	9.1	10.7%	Maize	23.1%	1.57	9.1	10.7%
	Millet	15.9%	1.76	11.1	8.2%	Sorghum	27.9%	1.70	9.6	14.0%
	Beans	12.0%	1.27	22.1	4.5%	Millet	15.9%	1.76	11.1	8.2%
	Rice	7.5%	5.70	6.9	12.6%	Peanut	1.4%	2.20	18.8	0.9%
Calcium	Leafy greens	32.4%	0.09	262.8	3.6%	Leafy greens	32.4%	0.09	262.8	3.6%
	Sorghum	16.4%	0.68	24.0	14.0%	Dried fish	13.5%	0.21	903.9	3.6%
	Dried fish	13.5%	0.21	903.9	3.6%	Sweet potato	0.7%	0.34	35.6	0.3%
	Beans	9.4%	0.38	74.0	4.5%	Beans	9.4%	0.38	74.0	4.5%
	Maize	9.3%	0.92	15.6	10.7%	Peanut	1.2%	0.62	67.0	0.9%
Iron	Millet	28.6%	2.51	7.8	8.2%	Millet	28.6%	2.51	7.8	8.2%
	Sorghum	28.2%	4.32	3.8	14.0%	Sorghum	28.2%	4.32	3.8	14.0%
	Maize	21.5%	4.33	3.3	10.7%	Maize	21.5%	4.33	3.3	10.7%
	Beans	7.9%	4.93	5.7	4.5%	Beans	7.9%	4.93	5.7	4.5%
	Leafy greens	5.4%	5.83	4.0	3.6%	Leafy greens	5.4%	5.83	4.0	3.6%
Zinc	Sorghum	30.6%	7.96	2.1	14.0%	Millet	21.4%	6.70	2.9	8.2%
	Millet	21.4%	6.70	2.9	8.2%	Beans	10.5%	7.47	3.8	4.5%
	Maize	21.1%	8.81	1.6	10.7%	Sorghum	30.6%	7.96	2.1	14.0%
	Beans	10.5%	7.47	3.8	4.5%	Maize	21.1%	8.81	1.6	10.7%
	Rice	6.5%	33.66	1.2	12.6%	Peanut	0.9%	17.24	2.4	0.9%
Folate	Beans	40.4%	0.07	395.0	4.5%	Beans	40.4%	0.07	395.0	4.5%
	Sorghum	16.3%	0.55	29.7	14.0%	Leafy greens	11.6%	0.20	117.5	3.6%
	Maize	12.5%	0.55	26.0	10.7%	Sweet potato	0.8%	0.23	52.0	0.3%
	Leafy greens	11.6%	0.20	117.5	3.6%	Peanut	1.3%	0.45	92.0	0.9%
	Millet	8.2%	0.65	30.3	8.2%	Sorghum	16.3%	0.55	29.7	14.0%
Vitamin B12	Dried fish	60.3%	26.66	7.1	3.6%	Dried fish	60.3%	26.66	7.1	3.6%
	Sheep/goat meat	14.3%	119.99	2.0	3.8%	Sheep/goat meat	14.3%	119.99	2.0	3.8%
	Lait	8.1%	218.83	0.6	3.9%	Fresh fish	8.0%	128.89	1.9	2.3%
	Fresh fish	8.0%	128.89	1.9	2.3%	Smoked fish	2.0%	153.90	1.8	0.7%
	Beef	6.7%	177.99	1.1	2.6%	Beef	6.7%	177.99	1.1	2.6%
Vitamin A	Leafy greens	51.3%	0.11	206.2	3.6%	Sweet potato	5.5%	0.09	135.2	0.3%
	Maize	30.2%	0.57	25.0	10.7%	Leafy greens	51.3%	0.11	206.2	3.6%
	Sweet potato	5.5%	0.09	135.2	0.3%	Fresh tomato	4.5%	0.55	52.0	1.5%
	Fresh tomato	4.5%	0.55	52.0	1.5%	Maize	30.2%	0.57	25.0	10.7%
	Beans	3.8%	1.89	14.9	4.5%	Beans	3.8%	1.89	14.9	4.5%

Note: The grey-shaded columns represent the two ranking variables used to derive top-5 lists of food items for each nutrient.
Source: Authors with data from EMC (2014).

ADVOCACY NOTE ON CHAPTER 3

Let us consider some key advocacy messages from this analysis:

1. Burkina Faso's population suffers from micronutrient deficiency, also known as "hidden hunger," which can cause severe cognitive and physical health, and human development problems.
2. The causes behind Burkina Faso's hidden hunger depend both on geographic location, the type of micronutrient, and corresponding food sources that supply that micronutrient.
3. To address hidden hunger, policy interventions should be geographically-sensitive and tailored to specific foods.
4. The table below summarises the main findings per micronutrient, starting with vitamin B12 which has the lowest national nutrient adequacy. Proposed priority actions are **in bold** and underlined text roughly indicates priority locations.

Nutrient	National Household Adequacy	Targeted policy interventions
Vitamin B12	27.9%	- **Increase availability of animal-based food items** across the entire country - **Fortify foods with vitamin B12**, **provide vitamin B12 supplements**, or implement policy programs to **re-allocate household food budgets** for increased spending on (dried) fish; all applies to the entire country
Calcium	33.3%	- **Promote national sesame production and processing** to supply domestic markets, starting in current sesame producing regions. Sesame is very rich in calcium but mainly exported to foreign countries
Vitamin A	35.4%	- **Increase horticultural production** (rich in vitamin A) in regions with appropriate bio-physical conditions (especially in the southwest of the country) - **Distribute horticultural products** to regions without apt agroecological conditions (especially in the north)
Iron, Zinc, Folate	62.5-79.1%	- **Reduce "nutrient loss"** of cereals and legumes that occurs between production sites and markets - Nutrition bottlenecks for these nutrients have a similar spatial pattern across the country (see maps for reference)
All nutrients	---	- **Implement social protection programs** in the short run to guarantee a minimal intake of key nutrients to the most undernourished households, a large share of which live in Ouagadougou (Centre)

Chapter 4

MAPPING THE RELATIVE ADEQUACY OF LIVESTOCK INFRASTRUCTURE FOR BETTER GUIDANCE OF INVESTMENT POLICIES

4.1. INTRODUCTION

Livestock farming offers a range of benefits to people in developing countries. First of all, it allows people to maintain a more nutritious and diversified diet (especially to avoid vitamin B12 and calcium deficiencies, see Chapter 3). Livestock farming is also an important source of income, through the sale of animal products such as milk, eggs or wool. Last but not least, it provides manure (organic fertilizer), tractor and tilling services, insurance functions and social status. For these reasons, most rural households in Africa try to combine agriculture with the breeding of small or large livestock.

Table 4.1. presents indicators for the livestock sector in Burkina Faso, its neighbouring countries and in West Africa as a whole for the year 2016. Burkina Faso's livestock population is among the largest in West Africa with about 10 million cattle, 15 million goats and 10 million sheep. Niger registers similar numbers for these three types of livestock, as does Mali for cattle. Livestock density is higher in Burkina Faso compared to its neighbouring countries (0.70 livestock units per hectare of agricultural land compared to only 0.27 in West Africa as a whole). However, the contribution of livestock to agricultural GDP in Burkina Faso is significantly lower than in Mali and Niger (22% compared to 28% and 27% respectively). The livestock sub-sector in Burkina Faso suffers from low productivity.

Key Words

Tropical Livestock Units (TLU)

A measurement unit used to express aggregated numbers of different types of animals.

Inter- and extrapolation

Technique for inferring a value from adjacent actual observations.

Relative Adequacy Index

An index used to compare the adequacy of one thing (such as livestock infrastructure) with another related thing (such as livestock animals)

Table 4.1. Key indicators on livestock sector, West Africa (2016)

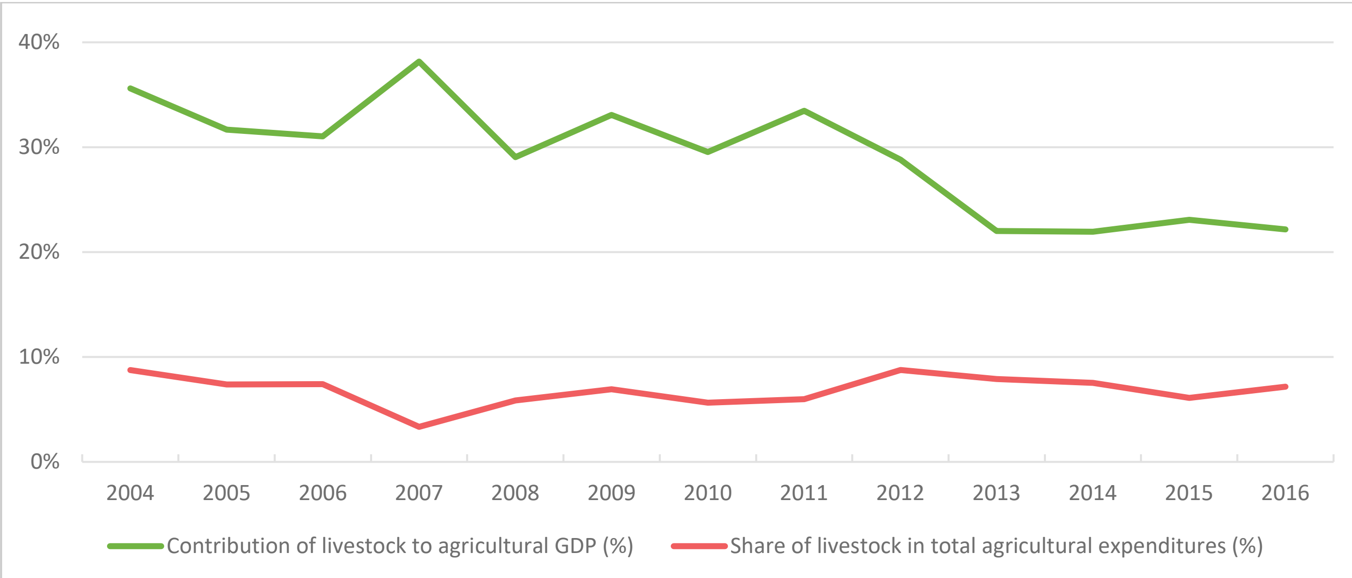
Country	Cattle (unit)	Goat (unit)	Sheep (unit)	Livestock density (TLU per agr. hectare)	Livestock share (% of agr. GDP)
Burkina Faso	**9,457,934**	**14,737,393**	**9,842,712**	**0.70**	**22.2%**
Mali	10,941,300	22,141,497	15,900,300	0.27	28.4%
Niger	12,783,548	16,098,058	11,899,263	0.25	27.1%
Benin	2,339,000	1,836,000	1,836,000	0.49	7.9%
Togo	441,662	3,000,000	2,347,424	0.30	16.1%
Ghana	1,734,000	6,352,000	4,522,000	0.18	6.3%
Côte d'Ivoire	1,674,511	1,441,506	1,815,495	0.09	8.3%
West Africa	74,110,240	158,209,139	111,802,731	0.27	12.6%

Notes: TLU "Tropical Livestock Unit" is equivalent to 250 kg live weight and facilitates aggregation across different types of animals.
Source: Authors based on FAOSTAT (September 10, 2019 Version).

Figure 4.1. shows that the share spent on livestock within total agricultural expenditures is less than 10% over the period 2004-2016. It also shows that the contribution of livestock to agricultural GDP has decreased over the years (from 36% in 2004 to 22% in 2016). However, the GDP contribution remains substantially higher than what the livestock sub-sector proportionally receives in terms of overall agricultural expenditures.

In addition to its important contribution to the country's wealth, increased investment in livestock is essential to address the issue of low productivity and to prepare for the future. While demand for livestock products has begun to stagnate in several industrialised countries (because of environmental, health and animal welfare issues), the livestock revolution has not yet taken place in most sub-Saharan African countries (Gerber et al. 2010:xi). In Burkina Faso, population is expected to explode from 18 million in 2016 to 45 million in 2050, with half of the population living in urban areas. Economists estimate that GDP will triple by 2050, reaching nearly USD 2,000 per capita. These predictions may lead to nearly 300% growth in demand for animal products (FAO, 2019).

Figure 4.1. Livestock economic and budgetary developments in the agricultural sector, Burkina Faso (2004-2016)



Source: Authors based on FAOSTAT (September 10, 2019 Version) and review of public expenses/SPCPSA.

Obviously, such a revolution will not take place without friction and will bring many challenges. First, livestock production systems will have to become more efficient, both economically and environmentally. Second, as livestock product value chains become more complex, they will require greater attention to food safety standards and regulations. Finally, the production and processing of livestock products will likely concentrate around the main consumption centres, at the expense of rural or remote areas. These factors could lead to uneven distribution of the benefits and opportunities offered by growth in the livestock sub-sector among the different strata of Burkinabe society. (FAO, 2019; Gerber et al., 2010).

This chapter aims **to identify and locate the relative adequacy of livestock infrastructure in Burkina Faso** in order to better guide investments. The ultimate objective is to contribute to **better targeted policies by providing options for reducing spatial disparities within the country**. In the first part, we discuss the quality of available data and information, which will be used to better understand the methodology adopted to determine livestock infrastructure adequacies. Next, we compare resulting profiles for six types of livestock infrastructure with corresponding policies across all provinces.

4.2. DATA ON LIVESTOCK AND LIVESTOCK INFRASTRUCTURE

In sub-Saharan Africa and in Burkina Faso in particular, reliable data on livestock numbers remain scarce. Livestock numbers are often obtained through estimation procedures (i.e. **inter- or extrapolation**) as reflected in unchanging growth rates between censuses. For example, we see fixed growth rates of 4.7% for cattle in the 1990-1999 period and 2.0% for the 2003-2011 period. For sheep and goats, the stability in livestock growth is even more striking: roughly 3.0% for the whole period 1990-2011 (Pica-Ciamarra et al. 2016:95). Given the increased insecurity in northern Burkina Faso and its likely impact on animal ownership (Ollo, Ouedraogo, Degueurse, Ouattara, & Hitayezu, 2013), profound deviations between statistics and reality may exist.

In Burkina Faso, the last general census on agriculture dates back to 2006-2010, with livestock data obtained between January 2008 and January 2009 from 7,500 households (Pica-Ciamarra et al., 2016). In 2015, with the political disruption linked to the change in power, a new census initially scheduled for 2017 was postponed.[8] Apart from rather irregular censuses, each year the country conducts a Continuous Agricultural Survey (CAS). Despite the questionable quality of some statistics, the CAS is an important source of information on agriculture and livestock.

Given the purpose of this analysis, we are mainly interested in data on livestock numbers and infrastructure. For total livestock, we rely on estimates produced by the Ministry of Animal Resources and Fisheries (MRAH) for the 45 provinces of the country. These data cover nine types of animals (donkey, cattle, camels, goats, horses, sheep, guinea fowl, pigs and poultry) over the period from 2013 to 2019. Similar to the observations above, these recent figures are again based on extrapolations using reproduction and exploitation rates for each animal type instead of being derived from primary data.

Table 4.2. provides a non-exhaustive overview of different types of infrastructure. Depending on the type and source of the data, the reference year and spatial coverage vary (again, different sources are of questionable quality). For example, the *Direction*

[8] See the World Programme for the Census of Agriculture (www.fao.org/world-census-agriculture/wcarounds/results/en).

Générale des Etudes et des Statistiques Sectorielles (DGESS) of the MRAH provides 2019 information on water points, but only for 10 provinces. The *Direction Générale des Espaces et des Aménagements Pastoraux* (DGEAP) provides wider coverage of pastoral areas, covering 33 provinces, however they are not recent (2009). For veterinary services, vaccination docks and parks, tracks, slaughterhouses, butcher shops, drying sheds, markets and livestock shops, there is also a low spatial coverage. The last row of Table 4.2. is a harmonisation exercise (considered a census) conducted by MRAH that includes 30 types of livestock infrastructure. This census covers all 45 provinces of the country and includes GPS coordinates for the year 2016. However, it does not contain information on pastoral areas and does not provide details on the capacities or functionalities of each infrastructure. Comparing this census to other sources we notice several dissimilarities. Yet considering its complete and precise spatial coverage, and after validation by the country's experts during a workshop held on September 10-12, 2019 in Bobo Dioulasso, our analysis relies mainly on this 2016 census and links it to livestock numbers of 2016.

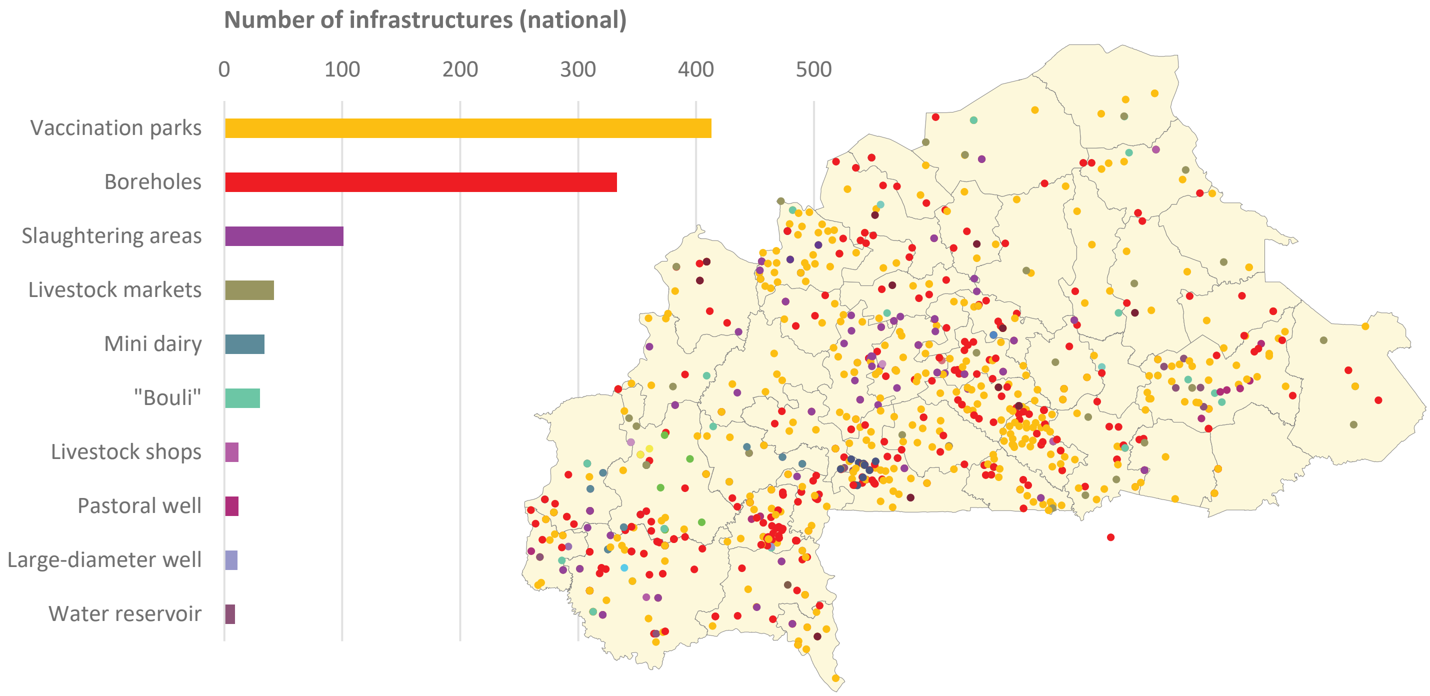
Table 4.2. Overview of existing data on livestock infrastructure, Burkina Faso (2009-19)

Types of infrastructure	Source	Year	Number of provinces
Water points	DGESS/MRAH	2019	10 provinces
Pastoral areas	DGEAP/MRAH	2009*	33 provinces
Veterinary services	CEFCOD	2013	10 provinces
Vaccination docks and parks	DGESS/MRAH	2018	10 provinces
Tracks	DGESS/MRAH	2017	9 provinces
Slaughterhouses, butcher shops, drying sheds, markets and livestock shops	DGESS/MRAH	2018	8 provinces
"Census" on 30 types of livestock infrastructure	MRAH	2016	45 provinces

Note: * Year of last specifications.
Source: Authors based on the different data sources mentioned in the table.

Figure 4.2. shows the spatial distribution of livestock infrastructure according to the MRAH census in 2016. Vaccination parks, numbering more than 400, are the most common and are concentrated in the provinces of Zoundwéogo and Sourou, respectively in the south-central and north-central parts of the country. We identify more than 300 boreholes nationally predominantly in the southwestern part of the country. With the exception of slaughtering areas, all other infrastructures compiled in the 2016 census are significantly fewer and do not exceed 50 units in total.

Figure 4.2. Spatial distribution of livestock infrastructure, Burkina Faso (2016)



Note: A thorough inspection showed that most of the boreholes in Houet Province were misreferenced and erroneously located in Bougouriba Province.
Source: Authors based on MRAH 2016 census.

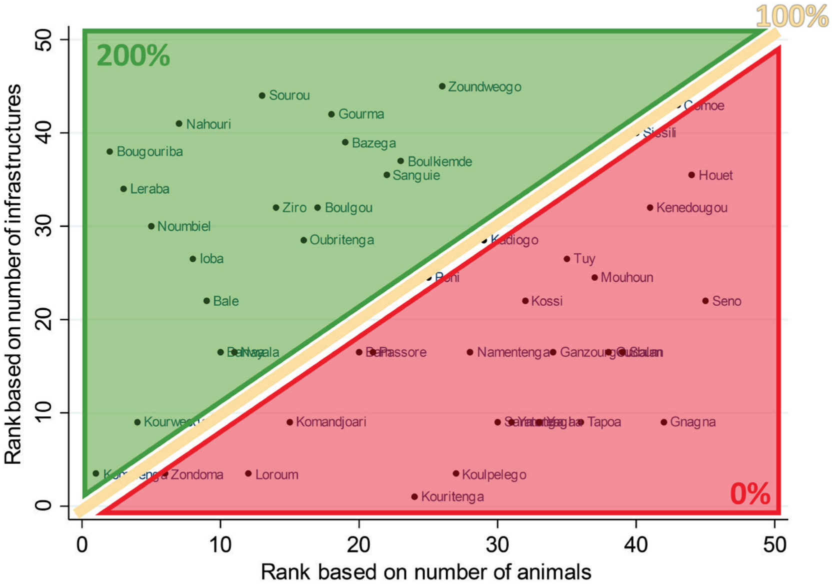
4.3. ADEQUACY IN LIVESTOCK INFRASTRUCTURE

For the purpose of measuring the adequacy of livestock infrastructure, we use a Relative Adequacy Index (RAI) that we apply to all 45 provinces across the country. The relativity for this index is threefold. First, RAI presents infrastructure adequacy relative to livestock population size; the capacity of livestock infrastructure should generally reflect the size of the livestock population. Second, we standardise RAI using the mean relationship between livestock infrastructure and population as observed elsewhere in Burkina Faso. As such, RAI does not guarantee absolute adequacy. To better target and reduce possible geographic disparities, it is however essential to be able to distinguish between different levels of adequacy. Third, in absence of information on the capacity of each infrastructure, we merely assume that total capacity is higher wherever the number of infrastructures is higher, without knowing the exact difference in capacity. For grazing infrastructure, we express capacity in terms of available area, with relative adequacy based on total (functional and potential) area, instead of ranks.

Figure 4.3. provides a conceptual illustration behind RAI. The logic here is that relative adequacy in livestock infrastructure exists if the rankings of provinces' livestock size and infrastructure endowment align. If infrastructure endowment matches the average observed in other provinces with similar numbers of animals, RAI will approach 100%. However, if a province is less endowed in infrastructure with a large livestock population, we characterise it as relatively under-endowed in infrastructure and RAI will approach 0%. A relatively low number of animals and relatively high number of infrastructures indicate relative over-endowment in livestock infrastructure, and RAI will tend towards 200% (or even higher).[9]

[9] Indeed, the relative adequacy index can exceed 200%, which is linked to the choice of having a standardisation based on the average (see related formula). In addition, given that several provinces may occupy the same rank, the 100% line is not necessarily equal to the 45-degree line.

Figure 4.3. Conceptual illustration of the relative adequacy index (RAI)



Source: Authors.

RAI	Interpretation
<100%	Relatively **under**-endowed in infrastructure
≈100%	Infrastructure **in line** with the average observed in similar provinces
>100%	Relatively **over**-endowed in infrastructure

We present the exact formula for RAI below. We use the typical standardisation procedure so that the average difference between both rankings equals 100%. For grazing infrastructure, we replace the differences with ratios, which indicate the number of hectares of grazing land per animal. Apart from this modification, the logic and interpretation remain unchanged.

$$Relative\ Adequacy\ Index\ (RAI) = \frac{diff(rank) - \min\big(diff(rank)\big)}{mean\big(diff(rank)\big) - \min\big(diff(rank)\big)}\ x\ 100(\%)$$

To derive these relative adequacy indexes, we make the following methodological choices. For data compiled in the 2016 Census, we group (by summing the observed numbers) 18 types of infrastructure into five categories according to the need they meet (see Table 4.3.). We distinguish between watering, health, sales, meat production and milk production infrastructure. The other types of infrastructure available in the census are considered less appropriate or less reliable. In order to align with data on livestock numbers, which are only available at provincial level, we sum up the total number of infrastructures (in all five categories) in each of the 45 provinces, ignoring their precise location. For grazing infrastructure, we consider the total area of functional pastoral areas added to the total area of potential pastoral lands. The resulting index shows the relative grazing adequacy including potential grazing areas.

Table 4.3. Categories of infrastructure, Burkina Faso (2009/2016)

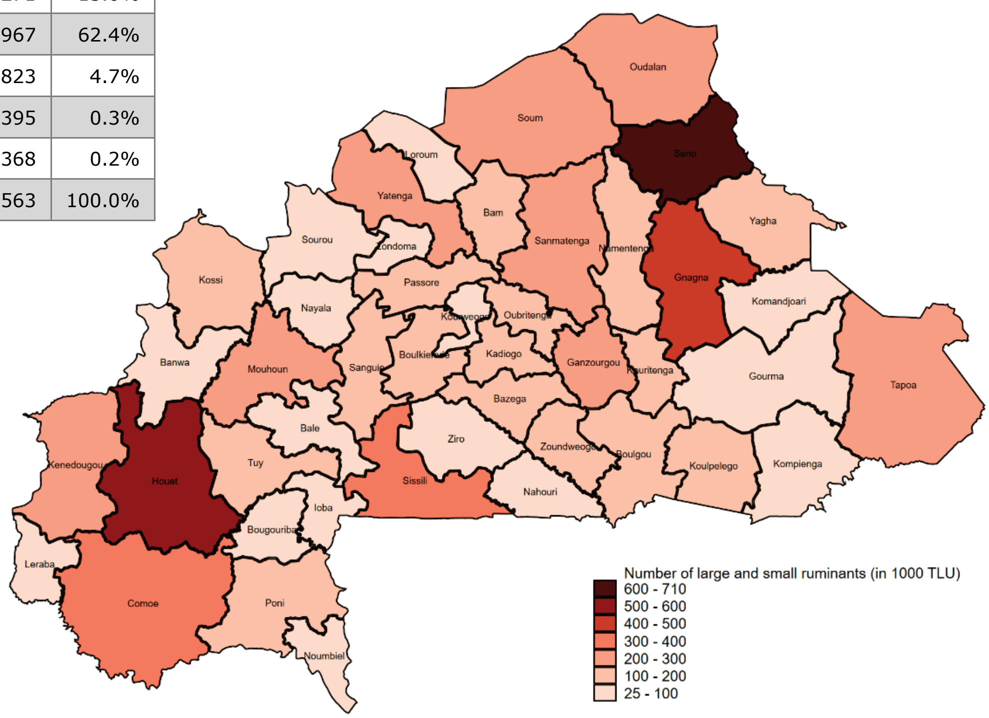
	Categories	Sub-categories	Source
1	Watering infrastructure	Drinking trough, dam, borehole, well, pastoral well, large-diameter well, water reservoir, "bouli"	MRAH census (2016)
2	Health infrastructure	Quarantine park, vaccination park, veterinary station	
3	Sales infrastructure	Livestock market, loading dock	
4	Meat production infrastructure	Slaughterhouse, slaughter area, butcher's shop	
5	Milk production infrastructure	Dairy, Mini Dairy	
6	Grazing infrastructure	Functional pastoral areas, potential pastoral areas	DGEAP/MRAH (2009)

Source: Authors based on data from DGEAP/MRAH (2009) and from MRAH census (2016).

This analysis encompasses all large and small ruminants, such as cattle, donkeys, horses, camels, goats and sheep. Given the year of the livestock infrastructure census, we limit ourselves to 2016, assuming that the span of functional and potential pastoral areas has remained stable since 2009. **Tropical Livestock Units (TLUs)** are used to aggregate numbers across different types of animals; one unit of TLU corresponds to the fodder requirements of an adult dairy cow (FAO, 2011). TLU coefficients for each type of livestock differ from one region to another. For sub-Saharan Africa, goats and sheep represent 10% of TLU, 50% for cattle and horses, 30% for donkeys and 70% for camels (FAO 2011:37). Applying these coefficients to actual numbers (as summarised in the table below), Figure 4.4. shows the spatial distribution of large and small ruminants expressed in TLU in Burkina Faso in 2016. The analysis reveals a significant number of ruminants throughout the country. However, some provinces are particularly concentrated, including Seno and Gnagna in the northeast of the country and Houet, Comoé and Sissili provinces in the southwest. Together, these five provinces account for almost one third of ruminants in TLU equivalent. However, provinces with significantly smaller numbers of ruminants are scattered throughout the country.

Figure 4.4. Spatial distribution of large and small ruminants in TLU, Burkina Faso (2016)

	Unit		TLU	
	Numbers	%	Numbers	%
Goat	14,737,393	41.8%	1,473,739	19.5%
Sheep	9,842,712	27.9%	984,271	13.0%
Cattle	9,457,934	26.8%	4,728,967	62.4%
Donkey	1,182,742	3.4%	354,823	4.7%
Horse	40,790	0.1%	20,395	0.3%
Camel	19,097	0.1%	13,368	0.2%
Total	35,280,668	100.0%	7,575,563	100.0%



Source: Authors based on MRAH (2016) and FAO (2011) data.

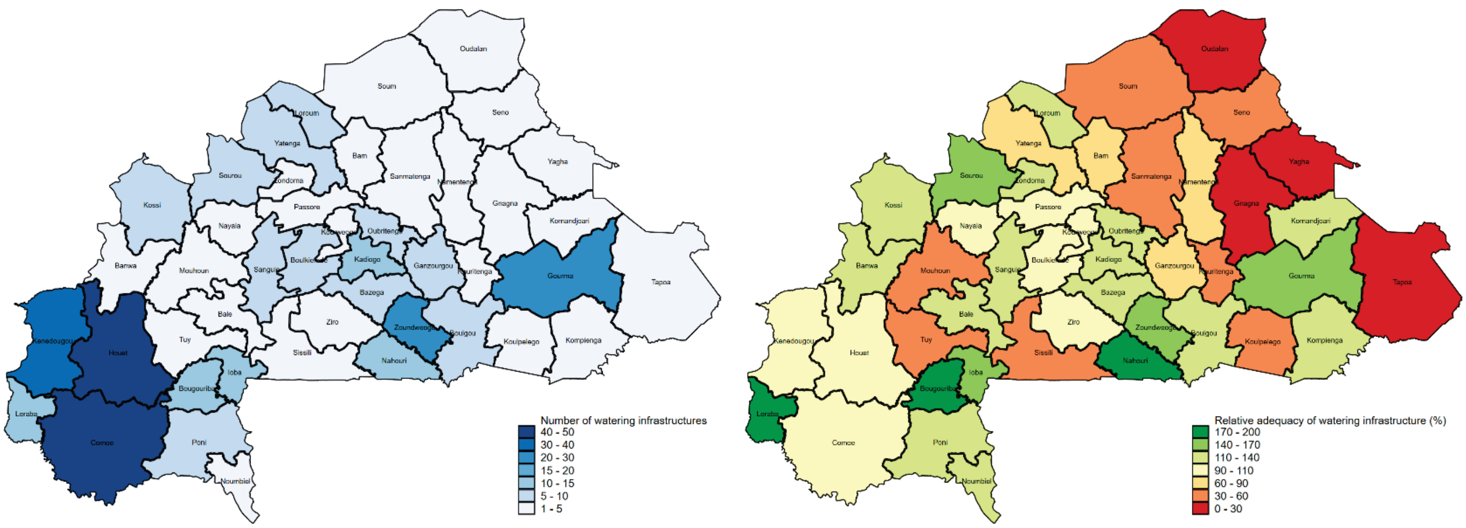
4.4. RESULTS

How does the distribution of ruminants relate to the geographic density of livestock infrastructure in the country? To answer this key question, we present two maps for each category of infrastructure. The first map shows the distribution of infrastructure in absolute numbers and the second shows relative adequacy using RAI. The second map reflects the interaction between the first map and the map that describes the distribution of ruminants in TLU (i.e. Figure 4.4.).

Watering infrastructure

Figure 4.5. shows the spatial distribution of watering infrastructure in absolute numbers and relative adequacy. What immediately stands out is the high concentration of this type of infrastructure in a few provinces in the southwest of the country, namely in Houet, Comoé and Kénédougou. These provinces also host large numbers of ruminants. In this case infrastructure provision is said to be “in line”, with a relative adequacy index of around 100%. However, the northeast around Seno province, which is also characterised by a high prevalence of ruminants, clearly lacks watering infrastructure. This is confirmed by RAI, which stands at less than 60% for most provinces in the northeast. Conversely, three provinces—Léraba, Bougouriba and Nahouri—show a relative oversupply, mainly due to low concentrations of ruminants.

Figure 4.5. Number and relative adequacy of watering infrastructure, Burkina Faso (2016)

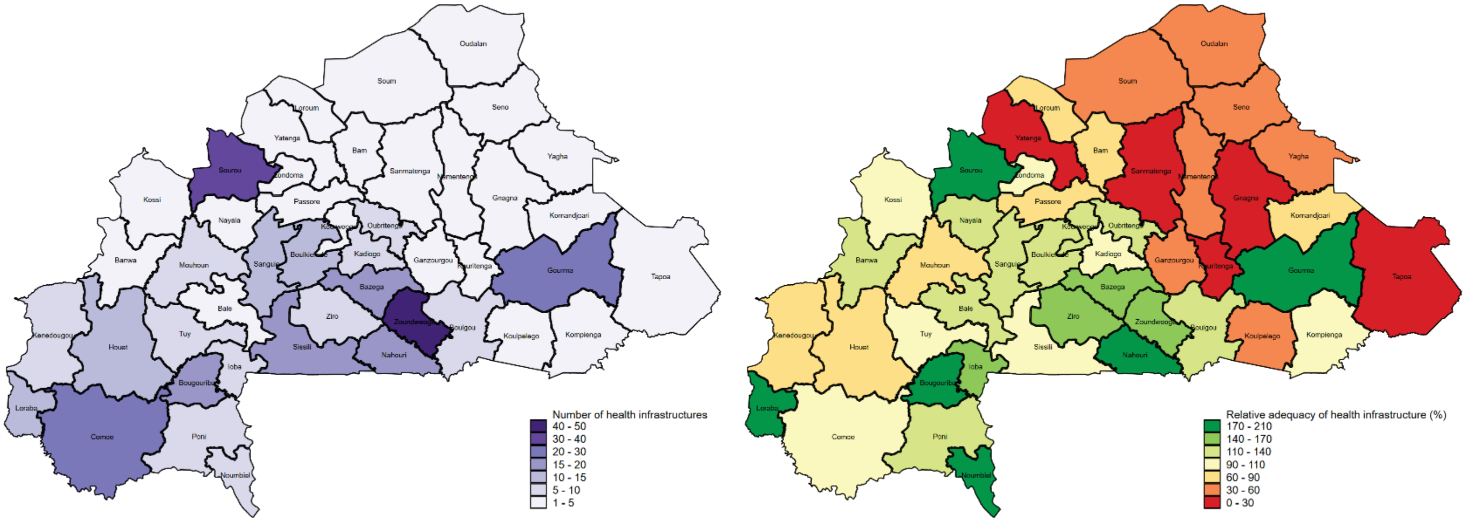


Source: Authors based on MRAH data (2016).

Health infrastructure

Figure 4.6. shows livestock health infrastructure, such as veterinary services. Southwestern Burkina Faso is better endowed than the northeastern part of the country, where RAI sits below 60% in several provinces. In the southwest, infrastructure endowment better aligns with ruminant concentrations in Comoé, Sissili and Tuy, each displaying RAI close to 100%. In the same part of the country, we even see a strong relative over-endowment for the provinces of Léraba, Bougouriba and Noumbiel. More located in the centre, we also observe that the high concentration in health infrastructure in Zoundwéogo, Gourma and Sourou relatively exceeds the lower concentration of ruminants.

Figure 4.6. Number and relative adequacy of health infrastructure, Burkina Faso (2016)

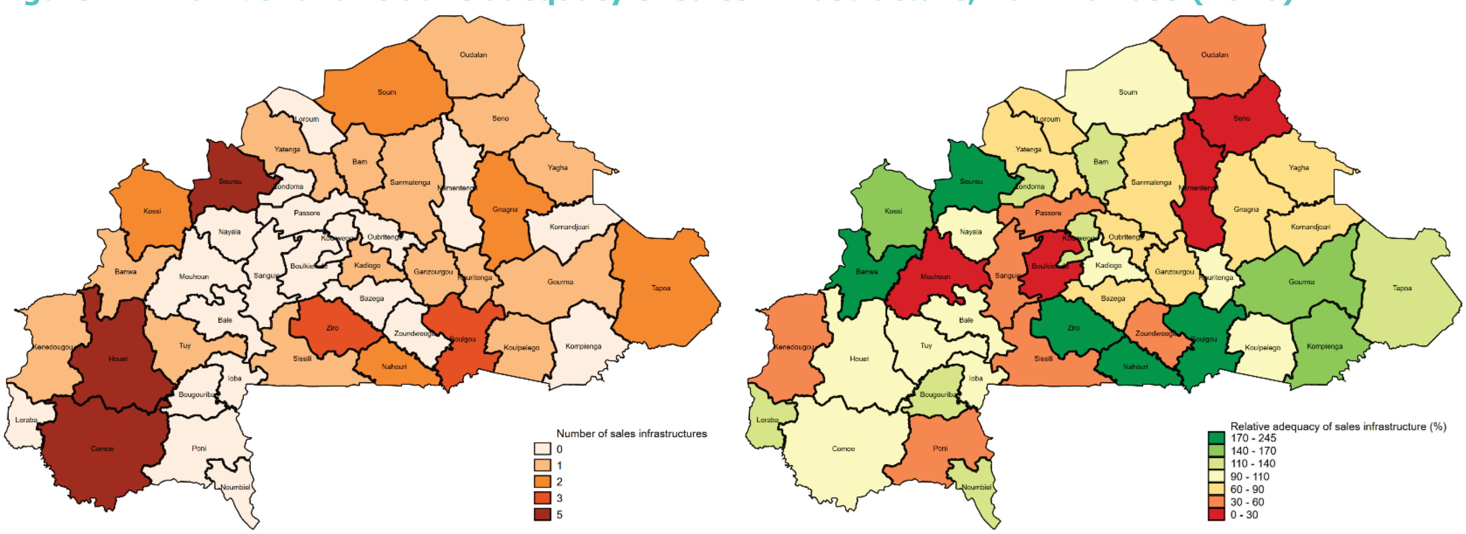


Source: Authors based on MRAH data (2016).

Sales infrastructure

Sales infrastructure shows a less spatially contrasted distribution than watering and health infrastructure (see Figure 4.7.). Several provinces in the northeast, such as Gnagna and Soum, are relatively better endowed with sales infrastructure. In the centre of the country, Mouhoun and Boulkiemdé are relatively under-endowed, with RAI less than 30%. Sales infrastructure matches the high concentration of ruminants in Houet and Comoé, while Seno in the northeast is relatively less endowed, with an index below 30%.

Figure 4.7. Number and relative adequacy of sales infrastucture, Burkina Faso (2016)

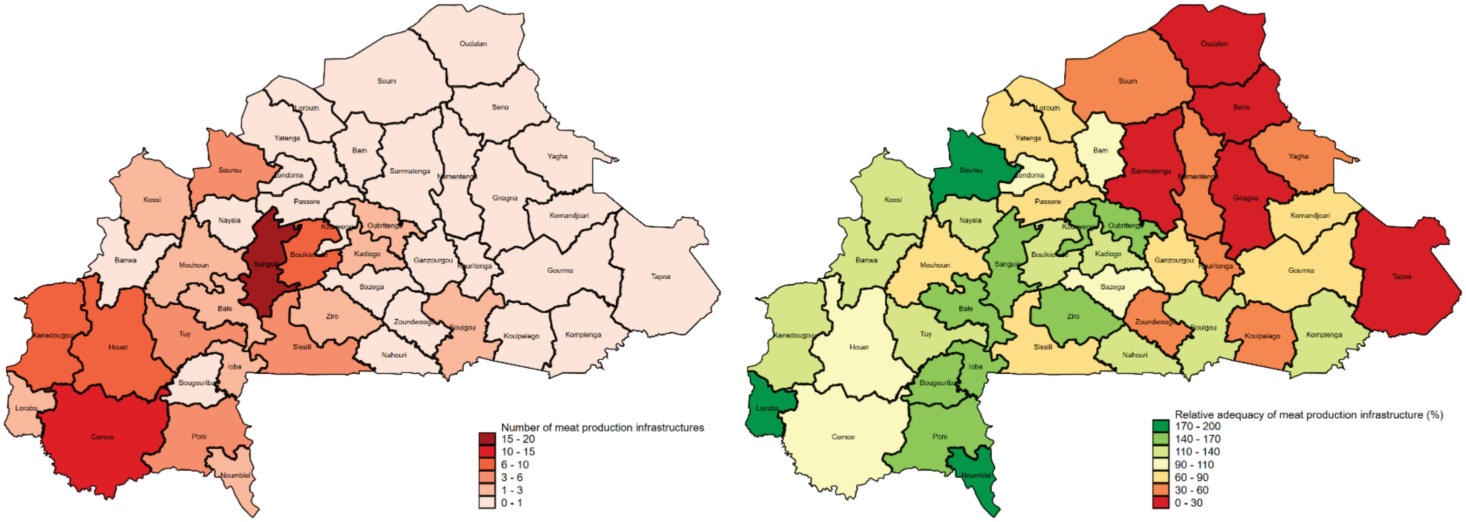


Source: Authors based on MRAH data (2016).

Meat production infrastructure

Figure 4.8. repeats previous patterns between northeastern and southwestern parts of Burkina Faso. Most slaughterhouses, slaughter areas and butcher shops are located in the southwest, with high concentrations in Sanguié and Comoé, while most provinces in the northeast have only one at most. We summarise relative adequacy in the same way, overlaying information on the distribution of ruminants with meat production infrastructure. We can contrast the high concentrations of ruminants in the provinces of Houet and Comoé, which have sufficient infrastructure, with Seno and Gnagna, where a similar high density of ruminants goes unsupported by infrastructure as reflected in RAI below 30%. We also observe relative under-endowment in all the northeast provinces and in Tapoa.

Figure 4.8. Number and relative adequacy of meat production infrastructure, Burkina Faso (2016)

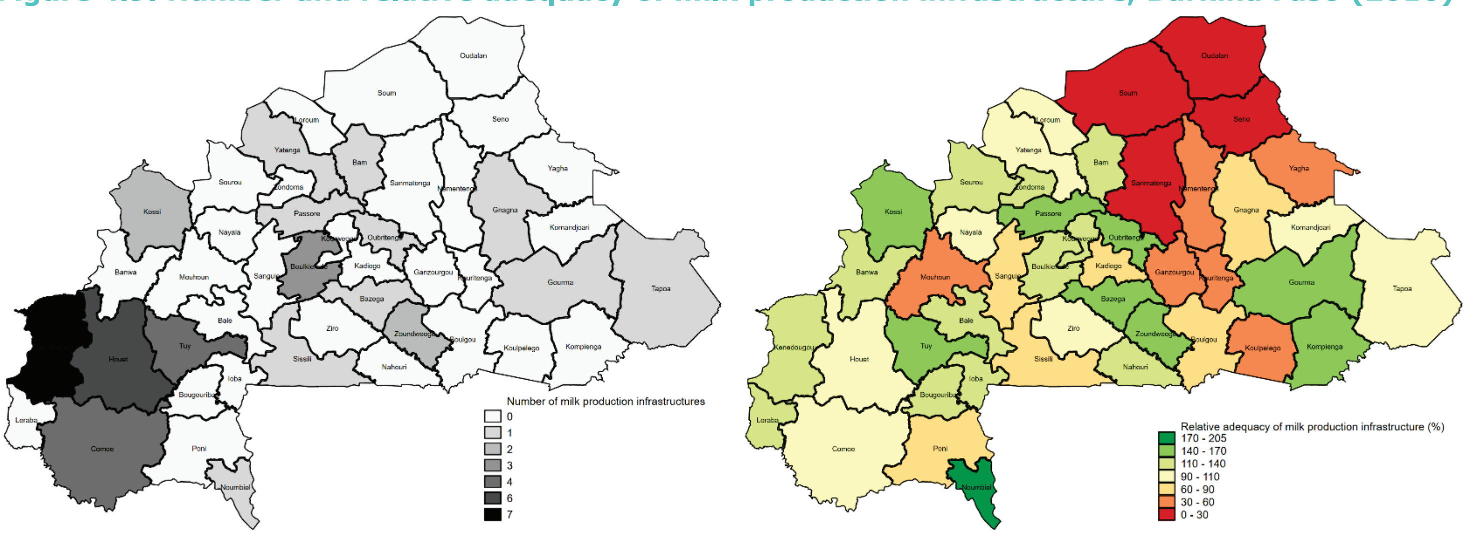


Source: Authors based on MRAH data (2016).

Milk production infrastructure

Figure 4.9. shows the distribution of small and large dairies in absolute numbers and relative adequacy. Again, a similar pattern emerges, with better endowment in the southwest, particularly in the provinces of Kénédougou, Houet, Comoé and Tuy, compared to the rest of the country. The RAI map displays well-matched infrastructure allocation in Houet and Comoé and even surplus in Kénédougou and Tuy, based on relative number of livestock. The index is well below 60% for the majority of provinces in the northeast which have robust ruminant presence.

Figure 4.9. Number and relative adequacy of milk production infrastructure, Burkina Faso (2016)

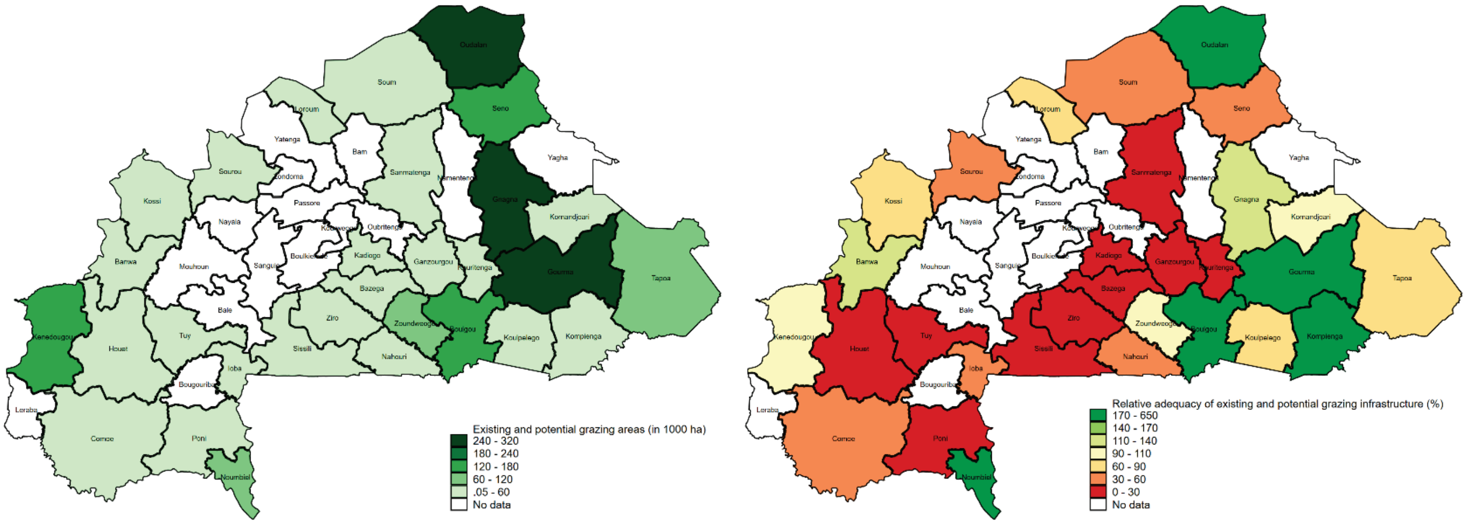


Source: Authors based on MRAH data (2016).

Existing and potential grazing infrastructure

Figure 4.10. shows the distribution of grazing areas in hectares and relative adequacy, including all previously identified potential grazing lands. In contrast to the previous maps, the eastern and northeastern provinces such as Gourma, Oudalan and Gnagna, which record more than 240,000 hectares of pastoral areas, perform better, which is also reflected in their high RAI. The most under-endowed provinces are located in the south and southwest of the country.

Figure 4.10. Number and relative adequacy of existing and potential grazing infrastructure, Burkina Faso (2016)



Source: Authors based on MRAH data (2016).

4.5. TOWARDS A MORE SPATIALLY TARGETED INVESTMENT POLICY

This section uses the relative adequacy results to suggest priority intervention areas for livestock infrastructure. The National Policy for Sustainable Livestock Development (PNDEL) adopted in 2010 serves as a reference framework for the livestock sector in Burkina Faso; its Action Plan and Investment Programme for the Livestock Sub-Sector (PAPISE) describe operations and in turn have informed the livestock-focused programs of the National Rural Sector Programme (PNSR).

PNSR (I and II): Livestock infrastructure programs and assessment

In the first phase of PNSR covering the period 2011-2015, several programs focused on the livestock sector, three of which relate to infrastructure (see Table 4.4.):

- Sub-programme 2 of Axis 1 aimed to **improve productivity and competitiveness of livestock production** through construction or restoration of slaughter areas, livestock markets and slaughterhouses. This sub-programme did not target priority regions.
  However, despite investments, livestock production declined during 2011-2015, with cattle and small ruminant exports decreasing 3% and 4%, respectively (MRAH, 2018).
- Sub-programme 3 of Axis 3 on **securing and managing pastoral resources** (in actions 2 and 3) planned to increase the number of pastoral areas from 25 to 40 in 2015 and to ensure their functionality through suitable and operational infrastructure (vaccination parks, input stores, offices and housing). Action 4 on the promotion of pastoral hydraulics targeted the most deprived areas (one dam, two "boulis", 15 boreholes and 10 pastoral wells per year), rehabilitating existing works and creating a database on pastoral hydraulics.
  The assessment of livestock infrastructure showed that the coverage of livestock water needs in the dry season increased from 50% in 2011 to 61% in 2015, for a target set at 70%. This was made possible by the operation of 529 pastoral boreholes, 136 "boulis", 130 large-diameter wells and 23 pastoral dams. In addition, several efforts have ensured land tenure security and natural resource management. The assessment shows the following achievements: (i) demarcation of 27 grazing areas and the establishment of 1,000 km of cattle tracks; (ii) securing of 200,000 ha of pasture; (iii) restoration of 10,314 ha of degraded land; (iv) improvement of 26 pastoral areas covering 775,000 ha (MRAH, 2018).
- Sub-programme 3 of Axis 1 on **improving animal and veterinary public health** intended to strengthen the legal framework, diagnostic capacity and the inspection system at borders, in slaughterhouses, dairies and places of sales. However, the sub-programme did not provide for the construction of livestock health infrastructure, nor target specific regions.

Overall, PNSR I has had multiple effects on the livestock sector, but paid little attention to optional locations for distributing infrastructure throughout the territory.

Tableau 4.4. Programs on livestock infrastructure and assessment of PNSR I, Burkina Faso

	Categories of infrastructure	PNSR I (2011-2015)
1	Meat sales and production infrastructure	**Axis 1: Sub-programme 2 - Improve the productivity and competitiveness of livestock production** - **Objective**: improve the competitiveness of livestock farming through gradual intensification and better access to markets for livestock farmers. - **Actions:** (i) build infrastructure (one slaughter area per commune, livestock markets, five slaughterhouses, etc.); (ii) rehabilitate existing infrastructure; (iii) equip infrastructure; (iv) set up management and operating bodies; and (v) train actors of these bodies. ➔ **No details on spatial dimension**
2	Watering and grazing infrastructure	**Axis 3: Sub-programme 3 - Secure and manage pastoral resources** - **Objectives:** (i) strengthen the legal and regulatory framework for securing livestock activities; (ii) make pastoral areas secure and functional; (iii) ensure sustainable access to water for animals and livestock production activities; and (iv) implement mechanisms for the prevention and management of livestock crises and food vulnerabilities. ➔ **No details on the choice of priority areas**
3	Health infrastructure	**Axis 1: Sub-program 3 - Improve animal and veterinary public health** - **Objective:** "Effective prevention, control and eradication of priority animal diseases" ➔ **No health infrastructure and no consideration of the spatial dimension**

Source: Authors based on MRAH (2011).

The second phase of PNSR (PNSR II) aligns with national programs such as the Rural Development Strategy (SDR) and the National Economic and Social Development Plan (PNDES), providing additional livestock infrastructure such as health infrastructure with the creation of a Central Purchasing Office for Veterinary Medicines (CAMVET) and vaccine production units. However, the programme is general in scope and does not target specific areas. Productivity and competitiveness goals in PNSR II target refrigerated slaughterhouses in Ouagadougou and Bobo-Dioulasso, which will facilitate meat exports, but require additional measures to meet the required international standards (MRAH, 2010). Phase II's sub-program on securing and managing pastoral resources does not provide any spatial targeting.

Spatially optimal distribution of investments

PNSR II pays little attention to prioritising geographical areas. The maps on relative adequacy of livestock infrastructure and distribution of ruminants in Burkina Faso provide key information to better guide investment policy and reduce spatial disparities. Table 4.5. presents each infrastructure category, noting which provinces are most under-endowed (that is with a relative adequacy index below 30%). The last column summarises corresponding priorities in PNSR II, linking this analysis to government investment priorities for the livestock sector.

Table 4.5. Investment policy guidelines, Burkina Faso

	Categories of infrastructure	Most under-endowed provinces (IAR<=30%)	PNSR II (2016-2020)
1	Grazing infrastructure	Kouritenga, Sanmatenga, Sissili, Ziro, Bazega, Kadiogo, Houet, Tuy, Ganzourgou, Poni	**Axis 3**: Security and sustainable management of pastoral resources sub-programme - Promotion and management of pastoral hydraulics through the creation of water points (boreholes, "boulis", dams and pastoral wells) and a database. - Make pastoral areas functional by equipping them with adapted infrastructure (water points and bodies, input stores, vaccination parks, etc.). ➔ **No details on spatial dimension**
2	Watering infrastructure	Gnagna, Tapoa, Oudalan, Yagha	
3	Health infrastructure	Kouritenga, Sanmatenga, Gnagna, Tapoa, Yatenga	**Axis 1**: Animal and veterinary public health sub-programme - Objective of the program: "Effective prevention, control and eradication of priority animal diseases and **those across borders**" - **Centralized** constructions: (i) Central Purchasing Office for Veterinary Medicines (CAMVET); (ii) vaccine production unit. ➔ **Unclear spatial accuracy**
4	Sales infrastructure	Mouhoun, Namentenga, Boulkiemde, Seno	**Axis 2**: Livestock productivity and competitiveness sub-programme (mainly Action 5) - Development of national strategy for input supplies and livestock equipment - Construction: (i) refrigerated slaughterhouses in **Bobo-Dioulasso (Houet)** and in five other locations; (ii) dairies in each **dairy basin in Bobo-Dioulasso (Houet) and Ouagadougou (Kadiogo)** ➔ **Lower priority targets**
5	Meat production infrastructure	Sanmatenga, Gnagna, Tapoa, Oudalan, Seno	
6	Milk production infrastructure	Sanmatenga, Oudalan, Seno, Soum	

Source: Authors based on MRAH (2016, 2018) and DGEAP/MRAH (2009).

ADVOCACY NOTE ON CHAPTER 4

Key messages from this chapter:

1. The livestock sub-sector has multiple benefits, such as a more nutritious and diversified diet, tilling and insurance services, and manure production.
2. In order to increase productivity and meet the growing demand for food products of animal origin, it is important to invest in the livestock sub-sector.
3. Paying attention to the spatial dimension (the geographic distribution of livestock and livestock infrastructure) will improve targeting of investments and make it possible to better exploit the country's real livestock production potential.
4. Using a relative adequacy index based on livestock numbers and infrastructure, we observe a disparity between north-eastern and southwestern Burkina Faso. The northeast provinces, though densely populated by ruminants, are relatively devoid of watering, health, meat and milk production infrastructure. Relative adequacy maps of grazing and sales infrastructure tell a different story, with more mixed results.
5. The most deficient areas, by infrastructure type, are summarised in the table below.

Types of infrastructure	Most under-endowed provinces
Grazing	Kouritenga, Sanmatenga, Sissili, Ziro, Bazega, Kadiogo, Houet, Tuy, Ganzourgou, Poni
Watering	Gnagna, Tapoa, Oudalan, Yagha
Health	Kouritenga, Sanmatenga, Gnagna, Tapoa, Yatenga
Sales	Mouhoun, Namentenga, Boulkiemde, Seno
Meat production	Sanmatenga, Gnagna, Tapoa, Oudalan, Seno
Milk production	Sanmatenga, Oudalan, Seno, Soum

Chapter 5

BOTTLENECKS AND LOCATION-SPECIFIC ADVOCACY SOLUTIONS

The basic premise of this policy atlas is that **agricultural transformation takes place in a heterogeneous context**. By being geographically sensitive and taking account of biophysical, economic and social variations across the country, policy design and implementation could be more effective. While this viewpoint became part of mainstream development discourse several decades ago, tools that can handle heterogeneity have remained rare. In this policy atlas, we rely on maps to highlight and describe heterogeneity, identify bottlenecks and to suggest location-specific advocacy solutions.

Maps are powerful tools to capture heterogeneity, prioritise and develop an advocacy strategy. By disaggregating data by a country's administration units (i.e. regions, provinces), different data, such as food production, consumption or climate data, can be combined in the same analysis—even though they may be measured in very different ways. Maps allow data and findings to be summarised in a concise visual picture, in contrast to a table that would require many rows (one for each region or province) and be unattractive and unable to display spatial relationships. Finally, maps can tell a convincing story instantly, which is an important feature when dealing with time-constrained policy makers.

Now, what is the story told by this policy atlas?

Hidden hunger is a serious challenge in most regions of the country. Even though households (on average) meet 80% of their recommended energy and protein intake, micronutrient adequacies are substantially lower. Vitamin B12, calcium and vitamin A are most problematic, with national adequacy rates ranging from 27.9% to 35.4%. Intakes of iron, zinc and folate are higher, ranging between 62.5% and 79.1%. Because adequately consuming micronutrients leads to better nutrition outcomes, addressing hidden hunger could be an important advocacy topic for CSOs. Since many donors and development agencies nowadays require interventions to be "nutrition-sensitive," CSOs could help harmonise government efforts along the full food system, from production to final consumption.

As mentioned in the introduction, the CSOs working on FNS under the V4CP programme mostly focus on removing **production constraints** through modernization of family farms. Although agricultural production inefficiencies are ubiquitous across the country, **Comoe, Tapoa, Gourma, Seno and Yagha** suffer from both lower-than-average production efficiencies and the highest child stunting rates, making them high-priority areas. While other provinces may suffer equally from low production efficiency, the effect on final nutrition outcomes is smaller. In a similar vein, there may be other high-priority provinces that could also benefit from increasing production efficiency, but other bottlenecks appear more critical.

According to the nutrient adequacy analysis in Chapter 3, the production of vitamin B12 and vitamin A is very low in Burkina Faso, resulting in low intake rates among the local population. Reducing production constraints of foods rich in both micronutrients could help increase micronutrient intake. For vitamin A, which is found in various horticultural foods, appropriate agroecological conditions are key—such as the more consistent, ample precipitation in the southern provinces. Because vitamin B12 is exclusively found in food of animal origin, increasing production of meat and dairy products is contingent upon available livestock infrastructure. The spatial analysis in Chapter 4 revealed the relative undersupply of various types of livestock infrastructure to handle the substantial concentrations of large and small ruminants in the northeast. Except for Gourma, this observation holds for Seno, Yagha and Tapoa and mainly concerns watering, health and meat-producing infrastructure.

In addition to production inefficiencies impeding FNS, various areas of the country face **access constraints**. These constraints appear most critical in the high-priority provinces of **Kourweogo, Tuy, Bougouriba and Ziro**. The distribution of cereals and legumes—currently the most important sources of iron, zinc and folate—suffers from "nutrient loss", which in turn leads to micronutrient deficiencies among the local population. Except the Centre region, the production of these three minerals exceeds the amount that is available in local markets. Because of agroecological differences between northern and southern provinces in Burkina Faso, production sites of vitamin-A-rich foods and consumption centres would need to be well connected across the country with appropriate transport, storage and processing infrastructure. With respect to calcium, household intake could substantially increase if more of Burkina Faso's sesame production were processed for domestic markets. Currently, most of this calcium-rich seed is exported to foreign countries, making it the second most important export crop of Burkina Faso.

Utilisation constraints appear critical to most of the provinces suffering from high child stunting rates, particularly in **Gourma, Seno, Tapoa, Yagha, Comoe, Bougouriba, Ziro, Loroum, Yatenga, Oudalan, Soum and Ioba**. In these provinces, access to a diverse range of food items is less important than how the foods are utilised at the household level to generate nutrition outcomes. Apart from culinary practices and intra-household allocation, nutritional health outcomes also depend on healthcare, water and sanitation infrastructure and practices.

Not all targeting should be driven by geographic location. Large numbers of deprived and malnourished people may live in administrative areas with average performances that appear less critical due to pronounced internal inequality within those areas. Addressing FNS bottlenecks may take time. In the short run **social protection programs** could guarantee minimal intake of key nutrients for the most undernourished households. These programs could take the form of food or cash transfers, food fortification or nutrient supplementation. The capital city (and its surrounding Centre region) has low food consumption scores and low household adequacy rates for almost all nutrients considered in this analysis. Given its large population, the successful introduction of nutrition-sensitive social protection in Ouagadougou could significantly improve the country's FNS.

Various key **policies and programs on agriculture, nutrition and livestock sector development could be enriched with more spatial detail**. The maps in this policy atlas could thus help CSOs prioritise selection of advocacy topics and corresponding strategies to inform policies on how to best address location-specific bottlenecks across the country.

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About the Authors

Wim Marivoet is Research Fellow, **John M. Ulimwengu** is Senior Research Fellow, and **Leysa Maty Sall** is research analyst in the West and Central Africa Office of the International Food Policy Research Institute (IFPRI). This policy atlas has been prepared in close collaboration with the ReSAKSS eAtlas technical team led by Mohamed Abd Salam El Vilaly and Racine Ly, and with Maurice Taondyande (ReSAKSS-WA). The authors wish to acknowledge the input of many participants who contributed to the discussion at various in-country workshops (2018-2020). They are also grateful to Fernando Sedano, Mariam Katile, Jean Hubert Zongo, Desiré Nanema, Issaka Tingri, Yassia Kindo and Abdelaziz Ouedraogo for their assistance with data analysis and commenting on individual chapters, and to Julie Kurtz, Vanessa Ndong and Fleur Wouterse for copy-editing, translation and final revision.

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A member of the CGIAR Consortium | A world free of hunger and malnutrition
West and Central Africa Office | Lot #2 Titre 3396 - BP 24063, Dakar-Almadies, Senegal
Tel: +221 33 869 98 00 | Fax: +221 33 869 98 41
Email: ifpri-dakar@cgiar.org | wca.ifpri.info

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