Rwanda

COMPREHENSIVE TYPOLOGY FOR FOOD AND NUTRITION SECURITY INTERVENTIONS

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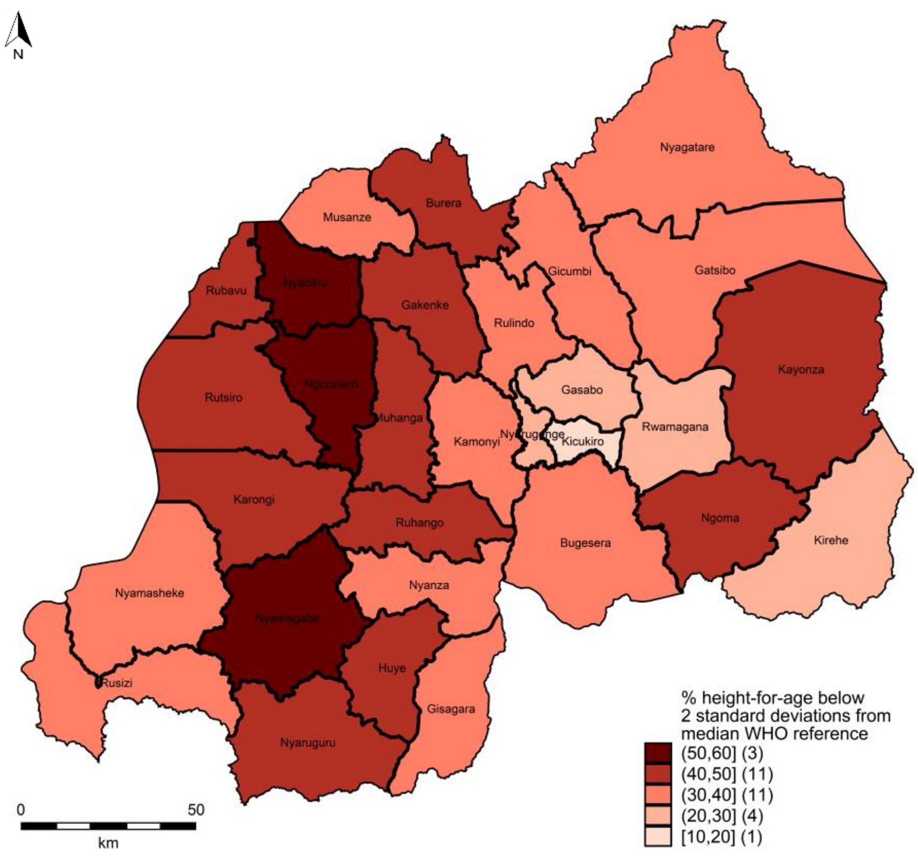
INTRODUCTION

This brief presents a comprehensive typology for food and nutrition security interventions using intervention types and nutrition constraints as a combination of sequential obstacles impeding nutrition security. The typology is applied to Rwanda and aligns well with one of the country's key areas highlighted by the CAADP inaugural Biennial Review. Based on the typical pillars of food security (availability, access, utilisation and stability) and drawing from previous studies (Torero 2014; Yu et al. 2010), this classification is derived from a demarcation of areas within a four-indicator diagram, each of which represents a core dimension of food and nutrition security (FNS). As such, the typology is conceptually sound, operationally flexible and less data intensive. Obviously, given its simplification of the more complex real-world problems into a fixed set of generic issues, the typology provides only the first layer of information to guide the design and implementation of relevant food and nutrition interventions. Though, if more information is available, both content and localisation of these interventions can be further refined.

Figure 1 presents the spatial distribution of chronic malnutrition among children below the age of 5 years in Rwanda in 2014-15.

Figure 1. Prevalence of stunting among under-five-years old children in Rwanda (2014-15)



Source: Authors' with data from DHS (2014-15).

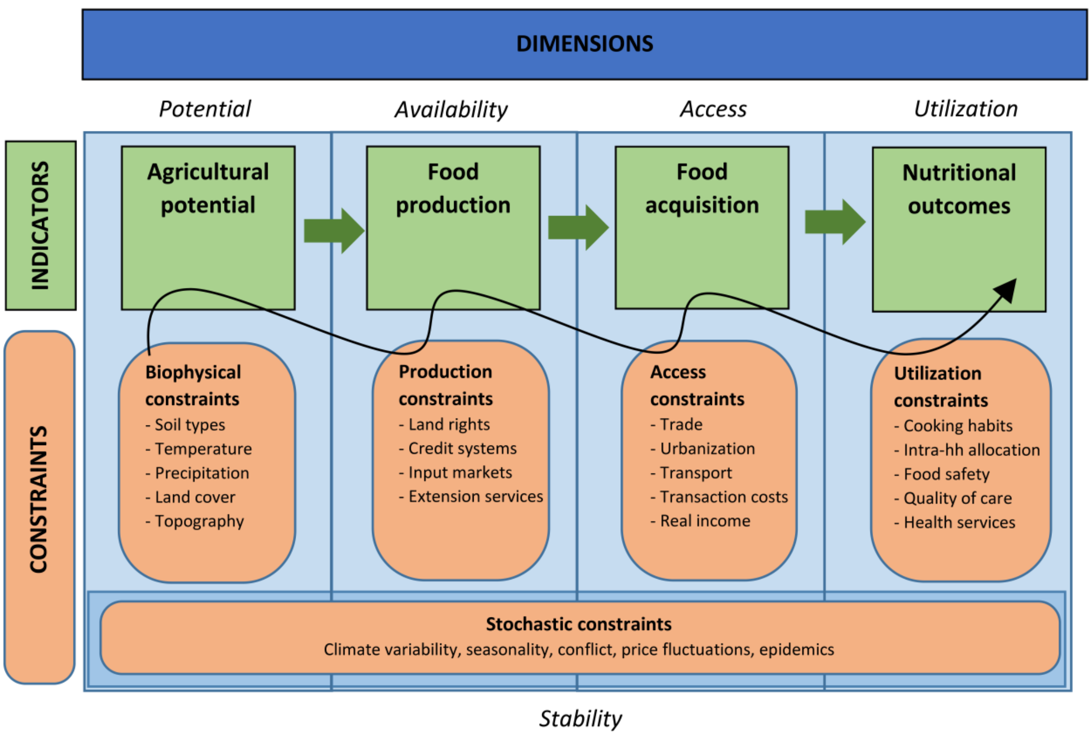
Despite considerable progress over the last ten years, a national average stunting level of 37.9% remains undeniably problematic (DHS 2014-15). Further, as shown in Figure 1, higher stunting levels are mainly observed in the western part of the country and are particularly high in the districts of Nyamagabe, Ngororero and Nyabihu with prevelance levels well above 50%. In the center, around the capital city of Kigali, chronic malnutrition is distinctively lower with less than 30% of the child population being affected. And it is only in the district of Kicukiro that stunting is lower than 20%. It is therefore important that the design of policy interventions accounts for spatial heterogeneity in food and nutrition insecurity across the country.

The latest version of the fourth phase of Rwanda's Strategic Plan for Agricultural Transformation (PSTA4) outlines the priority investments in the agricultural sector for the 2018-2024 period aiming at improving: (i) wealth as measured by agricultural growth and exports; (ii) economic opportunities through job creation and resulting in increased welfare of smallholders; (iii) food security by reducing the prevalence of food insecure households and increasing the amount of calories domestically produced; and (iv) resilience by further extending the use of sustainable land management practices (MINAGRI 2018).

CONCEPTUAL FRAMEWORK

To guide public policies on malnutrition, Pangaribowo et al. (2013) state that it is crucial to go beyond the mere collection and profiling of different food security and nutrition indicators. Each of these indicators certainly point to several important aspects, but knowledge about their interrelation is key to grasp the complete picture and understand the causal chain that determines nutritional status. To do so, we make use of the conceptual framework laid out in Figure 2 which includes all typical dimensions of FNS.

Figure 2. Conceptual pathway from agricultural potential to nutrition



Source: Adapted from Pangaribowo et al. (2013).

Apart from 'stability', which is cross-cutting and points to the absence of shocks, all other dimensions follow a chronological sequence from agricultural potential to final consumption. This chronology is captured by the black wavy line in Figure 2, which also considers the constraining factors affecting the conversion at each step. Regarding food production, farmers should have sustained access to, for example, credit, seeds, fertilizer and knowledge to be able to tap into the agricultural potential of their land. Further, even if food is sufficiently produced, access by families might still be constrained due to all sort of transaction costs, such as trade barriers, poor transport infrastructure and high prices. And finally, even when families have secured access to food, nutrition might still be jeopardised because of various utilisation constraints preventing a correct absorption of nutrients by individuals. These constraints might relate to cooking habits, intra-household allocations, food safety, and health and sanitation conditions.

Making use of one indicator for each of the four sequential FNS dimensions and applying it to the country's 30 districts, the typology helps point out where and which type of intervention would be most effective in improving the nutritional status of the Rwandese population.

DATA ON FOOD AND NUTRITION SECURITY

For each sequential FNS dimension, we construct a summary indicator based on available data at district level. Table 1 summarises the key steps for their construction while providing some basic descriptive statistics for each.

For potential, we rely on two remote sensing data sources at 30m spatial resolution. The first measures current crop land extent in 2015 (Xiong et al. 2017), and the second points to the amount of cleared forests between 2000 and 2015 (Hansen et al. 2013), for which we assume that it has recently been or will soon be used for agriculture (de la Paix et al. 2013). Each of these "arable pixels"[1] are then cultivated with maize, sorghum, rice, cassava, sweet potato, irish potato, taro, plantain, groundnut and soya beans following the national food consumption pattern, as defined by the country's poverty basket (NISR 2015), and by applying potential yield factors as earmarked by the Ministry of Agriculture (FAO 2003). The resulting output is then converted into daily potential kilocalorie production (Stadlmayr et al. 2012), summed up by district and divided by the corresponding population estimate.

Table 1. Descriptive statistics of key FNS indicators for Rwanda (2014-2017)

Dimension	Indicator	Obs.	Mean	Min	Max
Potential	Immediately arable land (km^2)	30	518.5	19.0	1361.7
	Daily potential kilocalorie production per person	30	2502.8	84.5	4565.0
Production	Daily kilocalorie production per person	30	1553.8	145.8	2668.0
Acquisition	% of households with FCS below 35.5	30	28.5	2.1	62.5
	% of households with FCS above 35.5	30	71.5	37.5	97.9
Nutrition	% of stunted children (<5 years, below -2 standard deviations of the median height-for-age of the reference population)	30	38.7	17.0	59.0
	% of non-stunted children (<5 years, above -2 standard deviations of the median height-for-age of the reference population)	30	61.3	41.0	83.0

Source: Authors' with data from Brown de Colstoun et al. (2017); CFSVA (2015); DHS (2014/15); FAO (2003); Hansen et al. (2013); NISR (2015, 2017a, 2017b); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

For production, the district statistics of the agricultural year 2017 (seasons A and B), as estimated by NISR (2017a, 2017b), were converted to kilocalories using Stadlmayr et al. (2012) and similarly expressed per person and day. Due to data limitations, this measure does not cover agricultural production from animal sources, such as meat, fish, milk and eggs. As a measure of food acquisition, we use the WFP's Food Consumption Score (FCS) from the Comprehensive Food Security and Vulnerability Analysis (CFSVA) of 2015, which is a food access indicator based on recall data of food group consumption frequencies in the past 7 days (WFP 2008). For each of the 30 districts, we compute the prevalence of households with an FCS above the standard threshold being typically used to distinguish between acceptable and borderline food consumption (i.e. 35.5). Finally, for nutrition, we rely on anthropometric data from the Demographic and Health Survey (DHS) of 2014/15, and define a measure of the prevalence of under-five-years old children with a height-for-age ratio above the common cut-off for malnutrition derived from the reference population.

TYPOLOGY

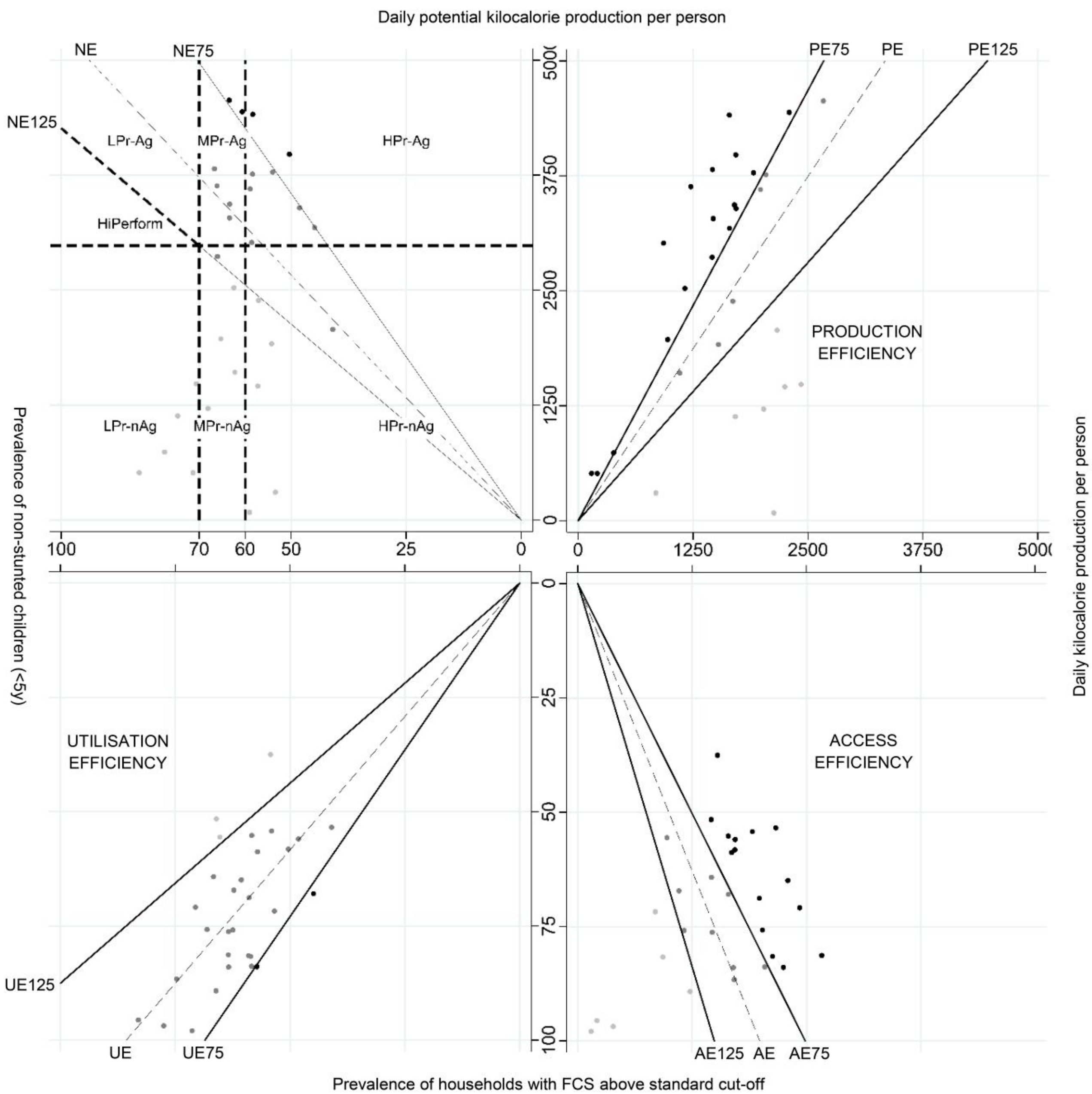
All estimated FNS indicators for each district are combined in one scatterplot (see Figure 3). The North-West (NW) panel of Figure 3 connects both ends of the food system by opposing the measures of agricultural potential and nutrition. Within this panel, we identify three levels of priority based on two cut-offs for nutritional status, set at 60% and 70%. In addition, the level of agricultural potential which corresponds to 125% of the average efficiency observed between potential and nutrition is used in combination with the upper bound nutritional cut-off to differentiate between districts with higher and lower agricultural opportunities. This means that districts with an agricultural potential below this threshold will not reach a nutritional status above 70%, unless they perform better than 125% of what is on average observed in the country. In the latter type of districts, focusing on agriculture alone might therefore be a less optimal strategy. Based on these benchmarks, and largely in line with Torero (2014), seven generic intervention types can be identified by crossing the three priority levels (High Priority (HPr), Medium Priority (MPr) and Low Priority (LPr)) with higher (Ag) or lower (nAg) agricultural potential. Within the category of "low priority with higher agricultural potential (LPr-Ag)", one can further classify districts as "high-performance (HiPerform)", when their overall efficiency level is higher than 125% of the country's average.

In addition to these broad intervention types, the other three panels of the combined scatterplot provide more detail regarding the relative importance of various sets of constraints along the sequential pathway from agricultural potential to nutrition.

[1] Given our aim to construct a conservative and short-term measure for agricultural potential, these pixels represent land which is immediately arable, either because currently or recently used for cultivation, or where trees have been logged to start cultivation (the latter which is the assumed reason for logging).

Reading clock-wise, the North-East (NE), South-East (SE) and South-West (SW) panels respectively focus on production, access and utilisation constraints. For each set of constraints and based on fitted lines through the origin, we define three levels of inefficiency (high-medium-low) depending on whether a district's performance falls below, between or above 75% and 125% of the average estimated efficiency level of the country.

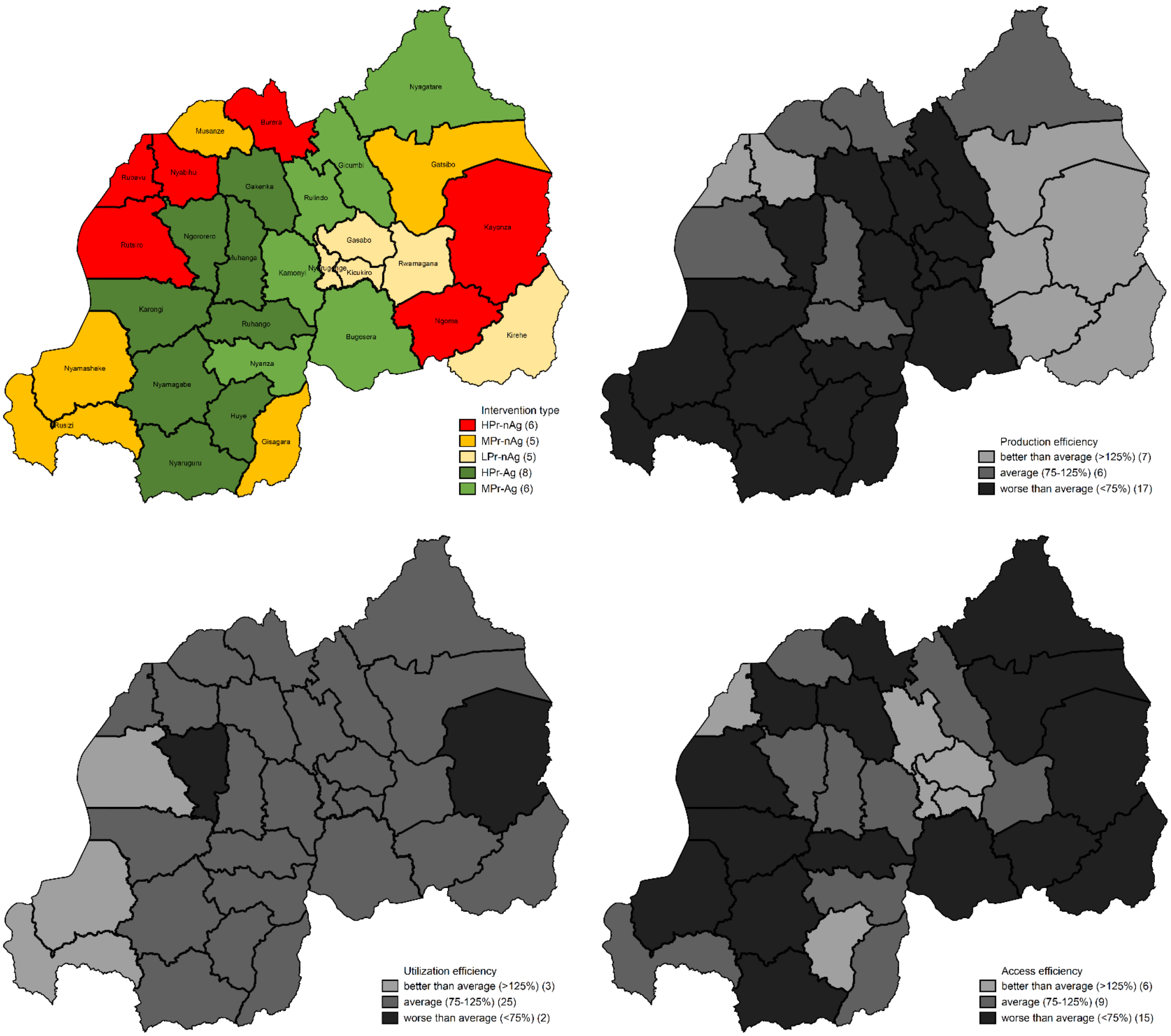
Figure 3. Combined scatterplot with district data, Rwanda (2014-2017)



Notes: LPr, MPr, HPr respectively stand for low, medium and high priority districts; Ag and nAg refer to high and low agricultural potential; and HiPerform stands for high-performance districts. PE, AE, UE and NE are estimated lines based on population weighted OLS regressions with intercept through the origin, respectively having a slope of 1.497, 19.892, 1.167 and 0.019. The E75 and E125 lines are derived from the previous lines with slopes being 75% and 125% the size of the estimates slopes.
Source: Authors' with data from Brown de Colstoun et al. (2017); CFSVA (2015); DHS (2014/15); FAO (2003); Hansen et al. (2013); NISR (2015, 2017a, 2017b); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

Based on the schematic demarcation of areas along each pair of FNS indicators, Figure 4 then adds the spatial dimension by presenting four country maps with colors representing the intervention type and level of production, access and utilisation inefficiency.

Figure 4. Districts by intervention type and nutrition constraint, Rwanda (2014-2017)



Notes: LPr, MPr, HPr respectively stand for low, medium and high priority districts; and Ag and nAg refer to high and low agricultural potential.
Source: Authors' with data from Brown de Colstoun et al. (2017); CFSVA (2015); DHS (2014/15); FAO (2003); Hansen et al. (2013); NISR (2015, 2017a, 2017b); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

With respect to the various intervention types, we observe 14 high priority districts, of which six with lower and eight with higher agricultural potential. Among those with less agricultural opportunities, we find two districts in the eastern part of the country (Ngoma and Kayonza) and four in the northwestern part (Rutsiro, Nyabihu, Burera, Rubavu), bordering Uganda and the Democratic Republic of the Congo. On the other hand, the high priority districts endowed with higher agricultural potential are all clustered in the western part of the country, stretching from Gakenke in the North to Nyaruguru in the South.

Although these districts all share the same urgency in terms of child stunting levels, the focus of an optimal intervention will highly depend upon its location. Notwithstanding their spatial diversity, we observe that many high priority districts suffer from relatively severe access constraints. Similar pattern is also observed in several other districts in this country known for its hilly topography, while being less problematic in the districts closer to Kigali. For most of the high priority districts endowed with higher agricultural potential, these constraints are further exacerbated by high production inefficiencies, which is the case in Nyamagabe, Karongi, Nyaruguru and Gakenke, and by severe utilisation constraints in Kayonza. In Huye and Ngororero on the other hand, access inefficiencies seem to be less crucial; instead, severe production constraints for both, coupled with low utilisation efficiency for the latter, characterise the constraining environment faced by the population in these districts. Remarkably, inefficiencies in terms of utilisation do not vary much across districts, as only five districts perform substantially better or worse than the country's average.

POLICY RECOMMENDATIONS

Starting from the generic framework often used to study FNS, this brief applied a comprehensive typology to classify districts according to their intervention types and magnitudes of nutrition constraints. Despite its broad perspective, the typology is useful in identifying various clusters of Rwanda districts that suffer mostly from production, access and utilisation inefficiencies. Within the current policy framework of highly decentralised development strategies, this relative benchmarking exercise is not only useful to directly inform future district policies but also to assure coherence and capture synergy at the more national level. Based on the above classification, the current country's fourth PSTA (MINAGRI 2018) could be substantially improved with geographical targeting of key investments. For example, various sub-components under priority area 1 (innovation and extension) and 2 (productivity and resilience) which aim to improve agricultural productivity, have little or no spatial focus and should be more explicitly geared towards the high priority districts of Huye, Nyamagabe, Gakenke, Karongi, Nyaruguru and Ngororero. Likewise, investment plans proposed under priority area 1 (innovation and extension) and 3 (inclusive markets and value addition), which aim to improve linkages between production and processing while increasing knowledge and technology, do not explicity target the districts of Nyamagabe, Gakenke, Karongi, Nyaruguru, Ngoma, Rutsiro, Nyabihu, Burera, Ruhango and Kayonza, which mostly suffer from market inefficiencies. And finally, to address the utilisation constraints characterising the districts of Kayonza and Ngororero, the latest version of PSTA is not only spatially underspecified, its investment focus does not really cover the utilisation dimension of FNS, despite the holistic approach taken and the willingness to work across sectors. Table 2 presents areas where the PSTA aligns reasonably well with the inefficiency profile observed for each cluster of high priority districts. Yet, this alignment mainly concerns investments in cash crop productivity as well as extension of irrigation schemes, the latter being spatially determined by the presence of waterbodies.

Table 2. Efficiency profile of high priority districts in Rwanda (2014-2017) versus PSTA

District	Agricultural potential	Efficiency			Strategic Plan for Agricultural Transformation (PSTA) (cf. Annex 7: Government Plan Targets)
		Production	Access	Utilisation	
Huye	higher	**low**	high	medium	Increased area and productivity of coffee production in Huye
Nyamagabe, Gakenke, Karongi, Nyaruguru	higher	**low**	**low**	medium	Increased area and productivity of coffee production in Nyamagabe and Gakenke; increased area of irrigated land in Nyamagabe and Nyaruguru; increased area of tea production in Karongi and Nyaruguru
Ngoma, Rutsiro, Nyabihu, Burera, Ruhango	lower/higher	medium/ high	**low**	medium/ high	Increased area of irrigated land in Ngoma and Ruhango
Kayonza	lower	high	**low**	**low**	Increased area of irrigated land in Kayonza
Ngororero	higher	**low**	medium	**low**	Not mentioned in NAIP
Rubavu, Muhanga	lower/higher	medium/ high	medium/ high	medium	Increased area of irrigated land in Muhanga

Notes: The defining set of inefficiencies for each cluster of high priority districts is indicated in bold.
Source: Authors' with data from Brown de Colstoun et al. (2017); CFSVA (2015); DHS (2014/15); FAO (2003); Hansen et al. (2013); MINAGRI (2018); NISR (2015, 2017a, 2017b); Pekel et al. (2016); Stadlmayr et al. (2012); UNEP-WCMC (2018); Xiong et al. (2017).

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Wim Marivoet is Research Fellow and **John Ulimwengu** is Senior Research Fellow in the West and Central Africa Office of the International Food Policy Research Institute (IFPRI). The brief has been prepared in close collaboration with the ReSAKSS eAtlas technical team led by Mohamed Abd Salam El Vilaly and Paul Guthiga (ReSAKSS-ECA). More technical and conceptual detail with respect to the typology itself can be found in the following IFPRI Discussion Paper (link). The authors wish to acknowledge the input of many participants who contributed to the discussion during a workshop hosted by SNV (The Netherlands) on April 4-6, 2018 in Kigali (Rwanda), and thank Fernando Sedano and Claude Bizimana for their assistance with data analysis and comments on earlier versions.

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