

Understanding The Democratic Republic Of The Congo's Agricultural Paradox

Based on the eAtlas Data Platform



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Bringing Light to the Policymaking Process

THE HUGE AGRICULTURAL POTENTIAL OF THE DEMOCRATIC REPUBLIC OF THE CONGO (DRC) IS WELL DOCUMENTED. The country is endowed with well over two million square kilometers (km²) of land, 800 thousand of which is arable, yet only 10 percent is currently under cultivation. DRC also has favorable climatic and ecological conditions, allowing several harvests of numerous crops per year. Nevertheless, few studies have looked at the country's spatial heterogeneity in terms of economic activity, public goods, or the livelihood strategies of smallholder farmers. As a result, policymakers have little evidence to guide their decisions in planning and implementing interventions to improve the nation's food and nutrition security status.

To fill in this knowledge deficit, the Regional Strategic Analysis and Knowledge Support System (ReSAKSS), which is facilitated by the International Food Policy Research Institute (IFPRI), provides knowledge products and analytical tools in support of African countries. Among the tools developed, country eAtlas—which is freely available online (<http://eatlas.resakss.org/>)—is a highly interactive, geographic information systems–based mapping tool designed to provide policymakers and analysts with access to high-quality, highly disaggregated data on agricultural, socioeconomic, and biophysical indicators. More specifically, the eAtlas serves three purposes:

- 1. Data provision and validation.** The eAtlas assembles and validates spatial data on the opportunities and constraints faced by Congolese farmers in order to increase their productivity and improve the country's food and nutrition security status.
- 2. Identification of knowledge gaps.** The eAtlas identifies knowledge gaps in terms of the types of data and studies needed to further strengthen the understanding of the specific pathways through which food and nutrition security can be achieved—including the obstacles blocking those pathways.

- 3. Policy support.** The eAtlas provides support to the policymaking process in order to increase the efficiency of public interventions. Given the process of decentralization occurring in DRC, the eAtlas is designed to address the country's ongoing demand for evidence-based information relevant to local policymakers, while providing a tool to harmonize policy interventions between and across the different administrative levels.

By bringing together and discussing a limited number of key indicators available via the eAtlas, this paper intends to highlight the first of the tool's three stated functions.

DRC's Agricultural Paradox

THE DRC ARGUABLY HAS THE POTENTIAL TO FEED THE ENTIRE AFRICAN CONTINENT (RADIO OKAPI 2016), YET IT IS CURRENTLY UNABLE TO ADEQUATELY FEED ITS OWN POPULATION. To illustrate this paradox, we compare the country's daily potential kilocalorie (Kcal) production per capita (as a proxy for agricultural potential), with the prevalence of under-five-year-old child stunting (Figure 1). The proxy for agricultural potential was determined by assuming that all arable land at the pixel level (each representing approximately 0.5 km² as seen through satellite images) are under cultivation following the country's overall consumption pattern of its three main staple foods—that is, 50 percent cassava, 33 percent maize, and 17 percent rice (Broxton et al. 2014; République Démocratique du Congo, Ministère du Plan 2008). Yield estimates by the country's national agricultural research institute (République Démocratique du Congo, Ministère de l'Agriculture, Pêche et Élevage 2009) were combined with conversion factors and energy content for each of the three crops. The results were then aggregated for each province and converted to daily per capita values (that is, divided by 365 and by the estimated total population). We acknowledge that this proxy measure is not accurate. On the one hand, it does not reflect the international frontier of agricultural research and technology, the multiple yearly harvests feasible for certain crops, or food obtainable from waterbodies and forests; on the other hand, it does not eliminate areas with slopes or altitudes that are not suitable for these food crops, or consider harvest losses or the micronutrient content of diets as opposed to only energy intake. The second variable, child malnutrition, was straightforwardly calculated as stunting in under-five-year-olds, one of the three basic anthropometric indicators.

The contrast between agricultural potential and nutrition status is clearly established across provinces (Figure 1). Note that the agricultural potential map is primarily green, whereas the map of child malnutrition largely indicates orange or red warnings signs. With the exception of Tshuapa, every province has the potential to produce at least 2,500 kcal per capita on

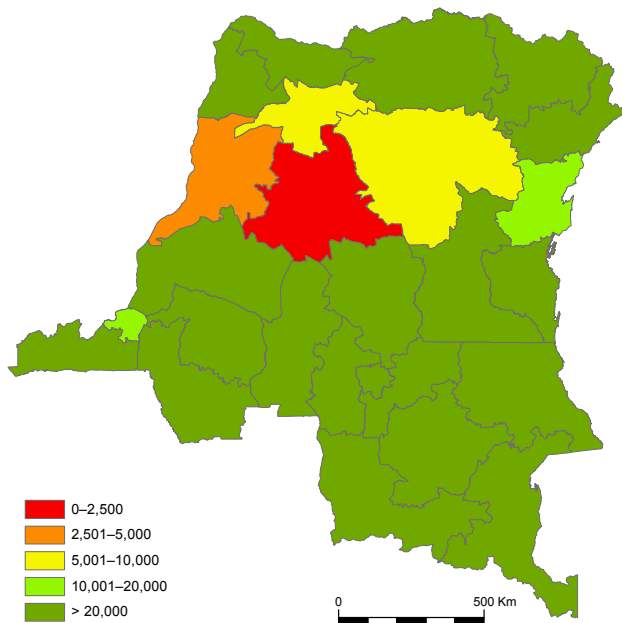
a daily basis, and the vast majority of regions could actually produce more than 20,000 kcal. This huge potential is primarily driven by a combination of extensive areas of savannah (below the latitude stretching from the city of Bandundu to Uvira and in provinces bordering the Central African Republic and South Sudan) and very low overall population densities.

BOX 1 — The limitations of a spatial approach

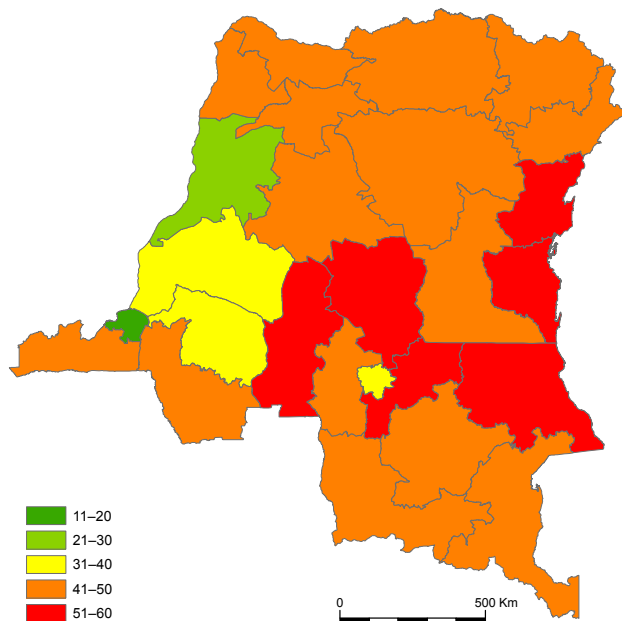
An atlas, understandably, is not intended to act as a substitute for the many and varied ways by which the characteristics of a country and its population can be investigated—not least because it presents information through the singular lens of spatial profiling. Moreover, geographical representations can be misleading because surface areas do not equate with population distribution. This is especially the case when mapping prevalence levels of vast, yet scarcely populated territories compared with tiny, densely populated urban areas. Whereas vast expanses visually dominate maps, they tend to be of little relevance; small urban areas, on the other hand, may be obscured despite their effect on large numbers of people. In a similar vein, maps often only display averages for a given unit of area, such as an administrative unit, thereby ignoring dispersion or inequality. For these reasons, it should not be overlooked that the spatial approach is but one of numerous methods required to construct an appropriated level of specificity with which to inform policy decisions.

FIGURE 1. Proxy for agricultural potential versus child malnutrition

a. Daily potential kilocalorie production per inhabitant (kcal/capita), 2016



b. Prevalence of under-five-year-old child stunting (%), 2013-2014



Sources: Broxton et al. (2014); République Démocratique du Congo, Ministère de l'Agriculture, Pêche et Élevage (2009); République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014a); and CAID (2016).

Note: Stunting is defined as having a height for age ratio lower than minus two standard deviations from the median height for age of the reference population.

Four provinces in the Equatorial forest and, to a much lesser extent, Kinshasa and North Kivu have somewhat less agricultural potential, first because of the unfavorable land cover and second because of higher population density. Chronic malnutrition among under-five-year-old children is, on the other hand, pervasive across the country, with rates averaging more than 30 percent (except in Kinshasa and Equateur). No fewer than 6 of the country's 26 provinces have a prevalence rate of more than 50 percent.

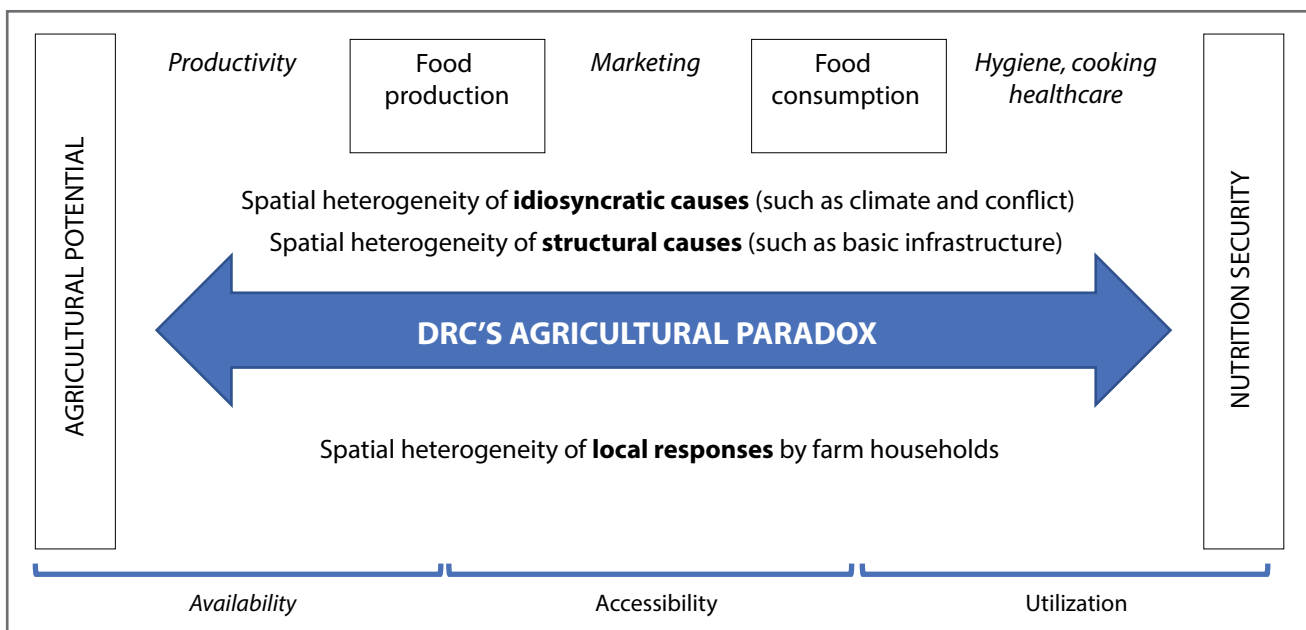
However, the national paradox is not homogeneous across provinces. First, the provinces of Tshuapa, Mongala, and Tshopo each have lower potential and higher rates of child malnutrition. Similarly, Kinshasa has fairly high agricultural potential combined with the lowest rate of child stunting.¹ For these provinces, the contradiction between agricultural potential and child malnutrition is less pronounced, but, for the latter province, this is because of its linkages with international food markets and relatively better overall healthcare, not because of its favorable agricultural potential. Finally, the province of Equateur combines lower agricultural potential with relatively low rates of child malnutrition, which probably relates to the prevalence of both rivers and forests that provide an important food source (Ndoye, Muir, and Tonnoir 2016).

Since this agricultural paradox holds, to varying degrees, across the majority of the country, a thorough understanding of the dynamics involved requires a high degree of spatial precision. We use a conceptual framework that highlights two broad categories of causal factors (Figure 2). The first set of factors, **idiosyncratic causes**, affects the process of agricultural transformation from potential to outcomes, including variables such as the frequency and severity of climate variability and conflict. The second, **structural causes**, encompasses a vast array of factors that are often the accumulated result of prior public and private interventions (or the lack thereof) in agriculture. Given the diversity of their importance and magnitude across geographical locations, this local set of factors, combined with the country's diverse agroecological conditions, shapes a unique environment for rural farm households. These factors translate into different sets of challenges and constraints to ensuring food availability, access, or utilization.

To overcome these constraints, rural smallholders have devised **local responses**, as indicated by their livelihood strategies and combinations of household capital and assets. Understanding of these local, context-sensitive responses will improve future public action and policies to address the complex causes of DRC's underperforming agricultural production system.

¹ Kinshasa's agricultural potential is mainly driven by two rural communes (Nsele and Maluku), which together comprise around 90 percent of the province's total area.

FIGURE 2. Conceptualization of the agricultural paradox in DRC



Source: Devised by authors based on Pangaribowo, Gerber, and Torero (2013).

BOX 2 — Data sources and reliability issues

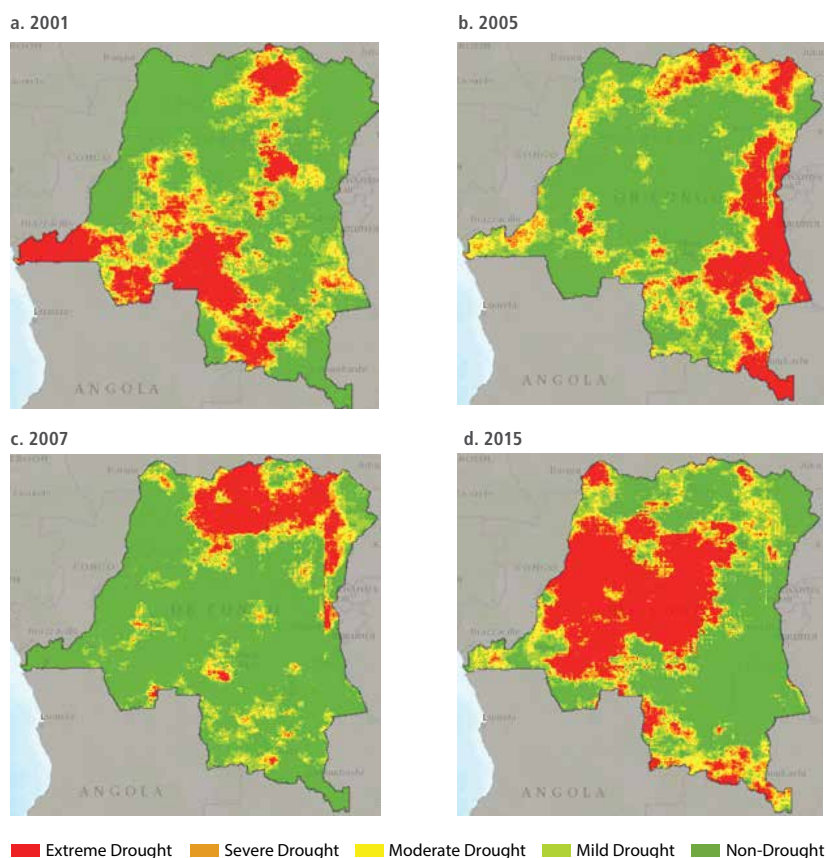
The quality of each map depends, of course, on the underlying data. Unfortunately, the country’s institutional capacity to generate reliable and timely data remains very poor. The maps presented in this paper rely on data either from national household surveys, administrative sources or from satellite images. These data are far from perfect. However, all the data used in this paper have undergone a process of data triangulation and validation (the underlying procedures can be made available on request).

Recently, the government of DRC set up a mobile-based program to collect development related data for each of the country’s 145 territories (République Démocratique du Congo, Primature 2015, www.caid.cd). Not only will these highly refined spatial data be a major source of triangulation, they may also gradually replace household survey data as the primary source for the calculation of national development indicators.

Idiosyncratic Causes of the Agricultural Paradox

A FIRST SET OF FACTORS THAT EXPLAINS WHY DRC'S AGRICULTURAL POTENTIAL IS SO FAR OUT OF ALIGNMENT WITH ITS FOOD SECURITY STATUS RELATES TO THE VOLATILE AND HIGHLY INSECURE ENVIRONMENT IN WHICH FARMERS AND RURAL HOUSEHOLDS OPERATE. Climate and weather variability are the main source of volatility. Changes in the length of the growing season over time or change in precipitation compared with prior years affect agricultural output and hence food and nutrition security—although, compared with other countries, DRC appears to have been spared the worst effects of climate change (Figure 3). In order to identify regions affected by droughts, we compare, using the precipitation condition index, long-term average levels with actual precipitation at the pixel level (approximately 30 km²).

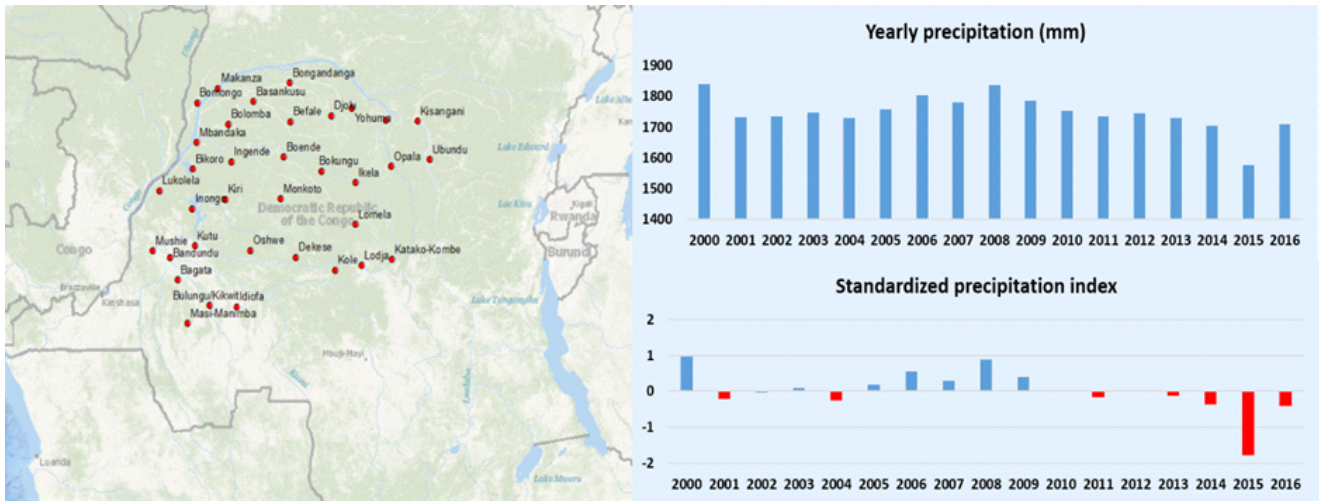
FIGURE 3. Precipitation condition index (PCI)



Source: Funk et al. (2015).

Notes: Mild, moderate, severe, and extreme drought are defined as PCI <40 percent, PCI <30 percent, PCI <20 percent, and PCI <10 percent, respectively.

FIGURE 4. Yearly precipitation and standardized precipitation index, selected localities, 2000–2016



Source: Constructed by authors from the DRC eAtlas, based on Funk et al. (2015).

Note: Yearly precipitation and standardized precipitation index charts refer to the localities shown in the left-hand panel.

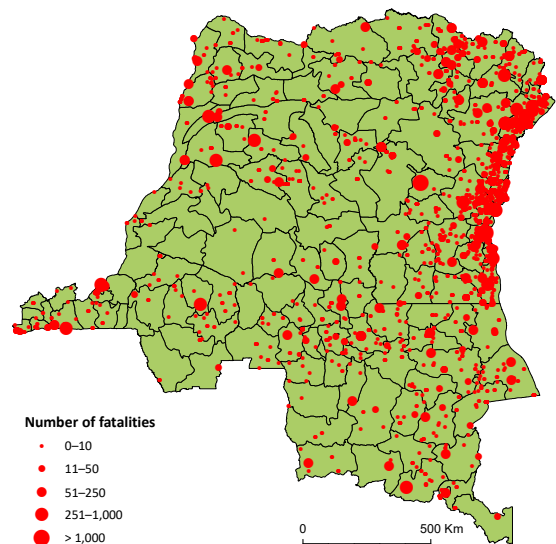
Different regions have experienced drought to different degrees and at different points in time. For example, precipitation levels were markedly lower than usual in the southwestern part of the country in 2001. Similar observations could be made for the east of the country in 2005, the northeast in 2007, and the central-west in 2015. Along the Congo River Basin, 2015 stood apart from the prior 15 years in terms of the incidence and severity of drought (Figure 4).

Apart from nature-induced shocks, Congolese farmers are confronted with several other types of risk and uncertainty. Most salient, perhaps, is the high rate of violence in the country’s recent history, characterized by two wars (1996–1997 and 1998–2003), as well as several military upheavals that pose an ongoing physical threat to the population, while disturbing fundamental economic activity (Figure 5). Undoubtedly, the eastern part of the country has been the most affected by this type of uncertainty.

BOX 3 — Administrative configuration of DRC

A new provincial structure came into effect in 2015 resulting in 26 provinces instead of the former 11. With a few exceptions, this change reflects the upgrading of former districts to provinces in an attempt to move the center of decision-making closer to the population. Within those 26 provinces, there are 145 territories (plus the urban areas of the major cities). Data collected at the territorial level, obtained by satellite images, or instruments with GPS provide far more spatial precision than national household survey data, which are typically only disaggregated up to the provincial level. However, this is also the level of most political significance with respect to the new institutional setting (compared with territories, pixels or points).

FIGURE 5. Locations of conflict by intensity level, 1997–2015



Source: ACLED (2016).

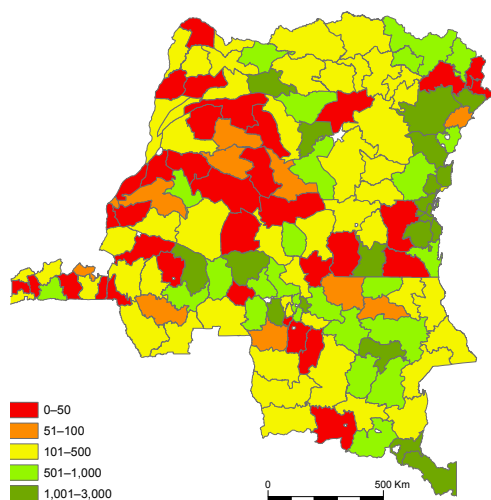
Structural Causes of the Agricultural Paradox

The Rural Economy

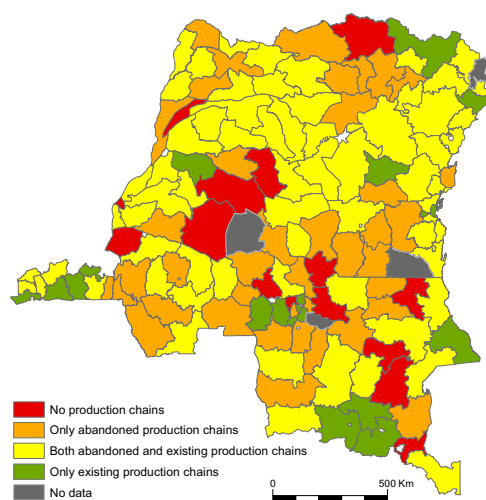
ECONOMIC ACTIVITY, MEASURED BY THE NUMBER OF SMALL AND MEDIUM-SIZED ENTERPRISES (SMES), IS HIGHLY VARIABLE ACROSS DRC, ALTHOUGH SOME ECONOMIC ACTIVITY ASSOCIATED WITH CROSSBOR-DER TRADE APPEARS TO BE CONCENTRATED IN THE EAST (FIGURE 6A). Apart from the east, a corridor of higher economic activity runs from Malemba-Nkulu in Haut-Lomami to Idiofa in the province of Kwilu. On average, the territories in Kasai-Central display higher levels of economic activity. As expected, the least economically active area of the country is found in the dense Equatorial forest at the center of the Congo River Basin, where territories house fewer than 100 SMEs, on average. Notwithstanding the concentration of economic activity in the east, many territories have abandoned some of their production chains over the years or have shifted their livelihood sources toward commerce and trade. With respect to the production system, three-quarters of all territories are characterized by production chains that have been fully or partially abandoned over time. Some clusters of territories managed to keep all their chains active, including some areas in Kongo- and Kasai-Central and also around the mining cities in Haut-Katanga. Overall, however, the picture appears bleak. Reviving these production chains represents a huge opportunity for the country to close in the gap in terms of employment and food security. Only a handful of territories, some of which are located in the Equatorial forest, have never experienced change in production chain.

FIGURE 6. Number of small and medium-sized enterprises and status of production chains

a. Number of small and medium-sized enterprises, 2016

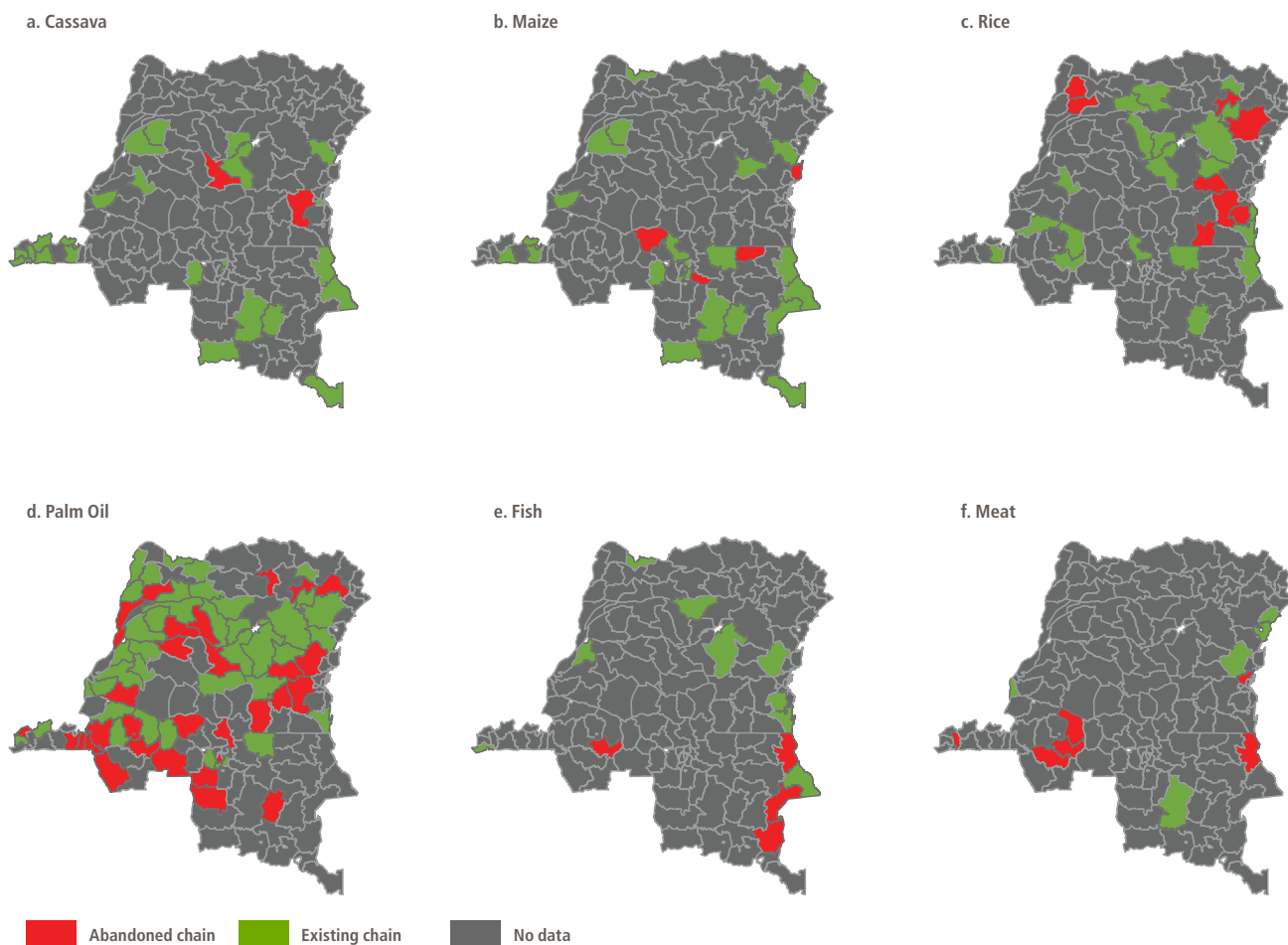


b. Status of production chains, 2016



Source: CAID (2016).

FIGURE 7. Food crop production chains, 2016



Source: CAID (2016).

Note: "No data" indicates either that data were not available or were for less important existing or abandoned chains.

Palm oil was and still is by far the country's most widespread food chain (Figure 7). Indeed, many territories, especially those along the Congo River and in the former province of Bandundu, depend on this particular commodity; however, many territories have stopped producing palm oil. The second most important food chain includes a combination of cassava, maize, and rice, each of which is still being produced beyond subsistence levels in around 20–25 territories across the country. Whereas production sites of cassava and maize somewhat overlap, especially in the former provinces of Katanga, Equateur, and Kongo Central, rice is mainly produced in Kwilu and Tshopo. Of these three staple food crops, cassava has been more resilient to economic shocks, whereas rice production has been abandoned in some territories, especially in South Ubangi, Ituri, Maniema, and South Kivu.

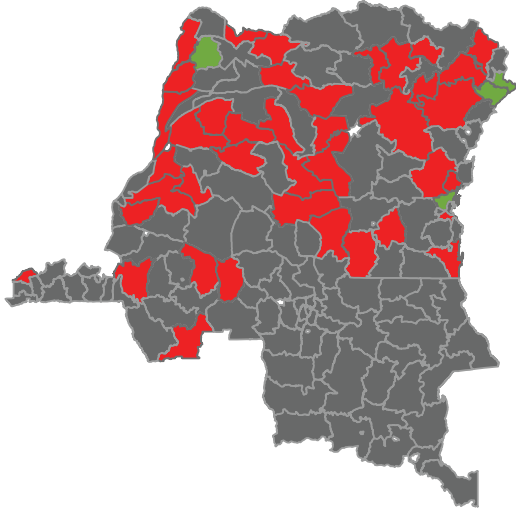
Regarding sources of animal protein, not more than a dozen territories have ever been involved in the production of meat or fish. Lack of fish production is a source of concern given that the country is endowed with water bodies, such as the Tanganyika, Kivu, and Mai-Ndombe Lakes and the Congo River. Animal husbandry mainly occurs in North Kivu, Ituri,

and Haut-Lomami; it has virtually been abandoned in Kwilu, Kwango, and Tanganyika.

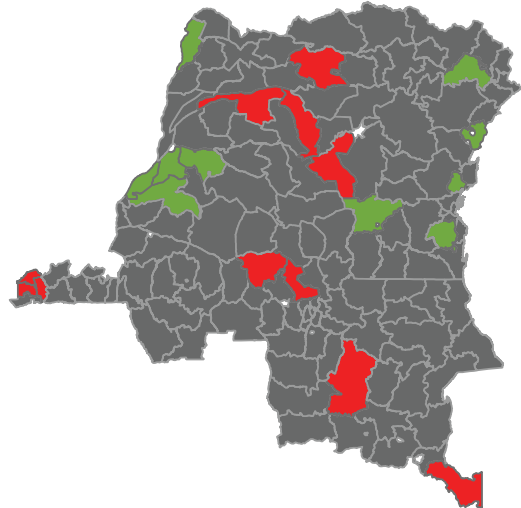
Cash crops have also largely been abandoned (Figure 8). Coffee is the most compelling example. Previously grown in 45 territories, coffee currently provides employment in only 5 territories, mainly in the eastern part of the country. This not only stems from domestic factors, but was also induced by international coffee prices, which have plummeted since the mid-1970s. Similarly, despite being less important overall, the number of territories producing timber and rubber has fallen by more than 50 percent. Given that both have been cultivated in the same areas, it also appears for the remaining production that, to some extent, the survival of one chain occurred at the expense of another. Finally, only one of four territories in the east has managed to maintain tea production.

FIGURE 8. Cash crop production chains, 2016

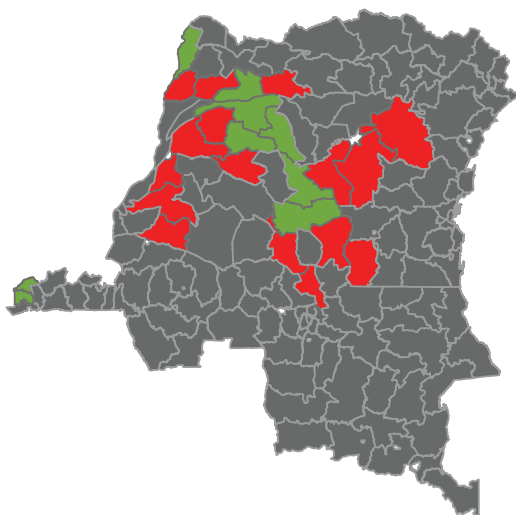
a. Coffee



b. Timber



c. Rubber



d. Tea



Abandoned chain Existing chain No data

Source: CAID (2016).

Note: "No data" indicates either that data were not available or were for less important existing or abandoned chains.

Basic Infrastructure and Public Goods

To successfully revive the agricultural sector, the country's transport infrastructure needs to be improved substantially in order to enable farmers to access input and output markets. In general, road conditions in DRC are very poor (Figure 9). Most territories have less than 1 km of paved roads, and the majority of unpaved roads are of poor quality. There are a few exceptions, however. The 350 km *Route Nationale* (RN1) in Kongo Central provides an economic lifeline, connecting the harbors of Boma and Matadi to the capital city. RN1's extension to Kikwit is also above the country's average standard, creating an accessible economic corridor into the Kwilu province. In the southeast, another road stretches from Haut-Kantanga to the lake-bordering territories in Tanganyika. And finally, many territories around the city of Kindu in Maniema have acceptable portions of both paved and unpaved roads. It is worth noting that despite their slightly better road infrastructure, these regions do not perform better in terms of agricultural production. Hence, while transport infrastructure is a necessary factor for increasing agricultural production, many other conditions must also be met.

Access to electricity is one such condition. Except for some major cities and a handful of territories, many Congolese are still literally in the dark. The situation is slightly better in Kongo Central, where at least 5 percent of households have access to electricity in several territories (Figure 10a). Two territories close to Lubumbashi, one in Maniema and one in North Kivu, have access rates of 16–35 percent. With respect to drinking water, the overall situation is substantially better—although many territories still offer no access to drinking water at all (Figure 10b).

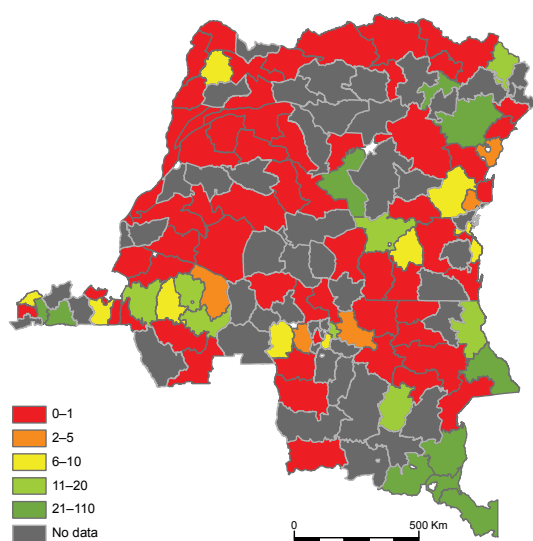
These territories are located mainly in Kwango, Kasai, Sankuru, Lualaba, Haut-Lomami, Bas-Uele, and South Ubangi. Findings also suggest that higher rates of access to drinking water are where access to electricity is better, and in territories close to major cities, such as Kikwit, Bandundu, Gbadolite, Likasi, Goma, and Bukavu.

The banking sector generally remains poorly developed, especially in rural areas (Figure 10c). Most of the territories in the former province of Equateur and in North and South Kivu, for example, completely lack any commercial banking activity. The banking sector's low penetration rate is mainly due to the country's low-activity economy, which provides little incentive for banks to settle in the country's more remote areas. Another reason might be related to the land tenure system in DRC, which prevents even households with secure land titles from using them as collateral for loans (Figure 10d). Indeed, in the vast majority of provinces, fewer than 1 in 5 farm households hold a written land title. Noticeably, ownership of these land titles seems to be lowest in a central band stretching from north to south, where rates are 5 percent or less. Ownership rates are slightly higher in the east and west of country.

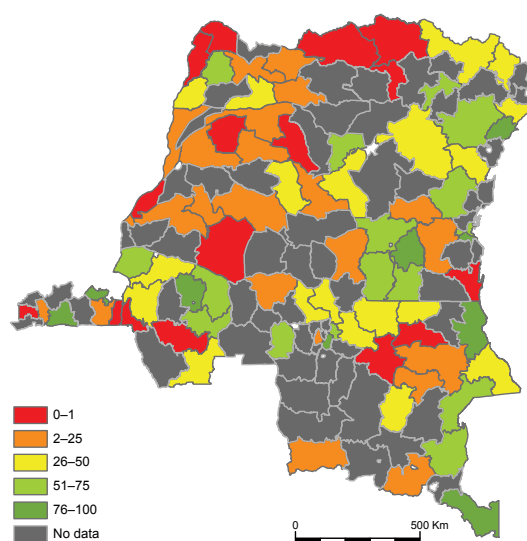
The number of primary schools per 100,000 inhabitants varies across the country, ranging from only 9 to 260 schools (Figure 11a). Territories with the fewest primary schools include Ituri, several areas in Kasai and Kasai-Central, and the country's south-eastern part. Overall, the distribution of secondary schools is the same as that of primary schools, although the midwestern part of the country has slightly more secondary school infrastructure (Figure 11b). The quality of school infrastructure, as indicated by functioning toilets, is significantly different (Figure 11c). In the northwestern part of

FIGURE 9. Road infrastructure

a. Paved roads per 100,000 inhabitants (km), 2016



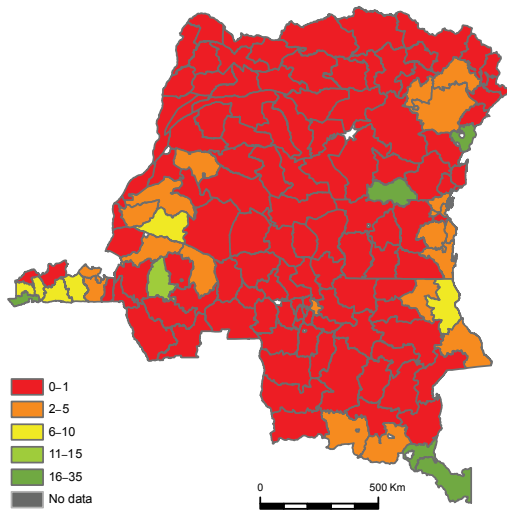
b. Share of unpaved roads of good or medium quality (%), 2016



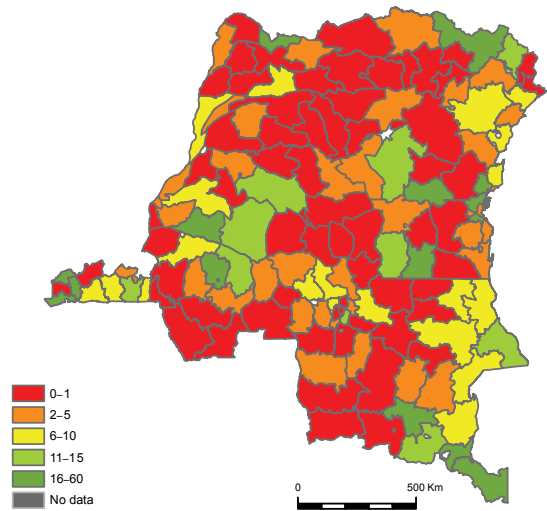
Source: CAID (2016).

FIGURE 10. Basic infrastructure and services

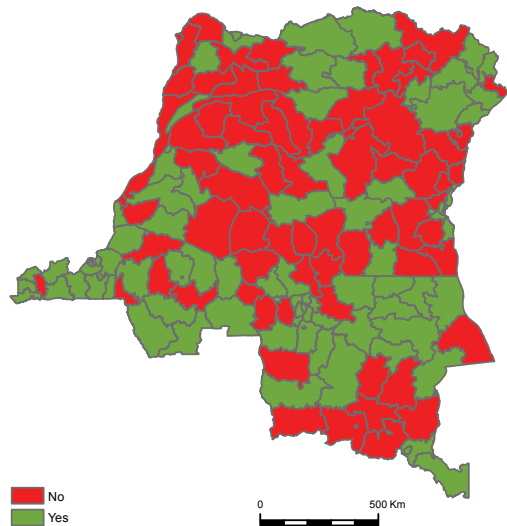
a. Share of households with access to electricity (%), 2016



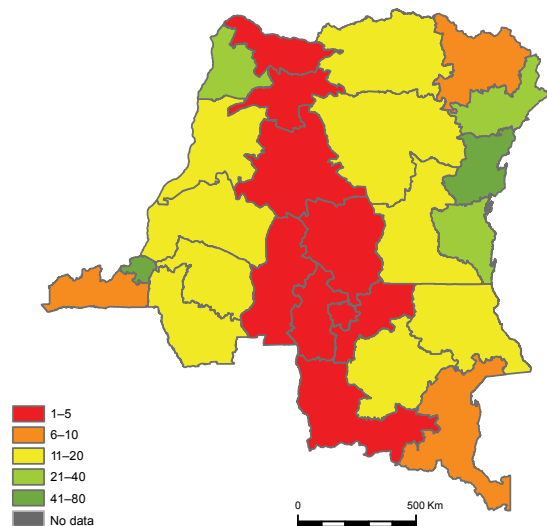
b. Share of households with access to drinking water (%), 2016



c. Availability of banking services, 2014



d. Share of farm households with written land titles (%), 2012-2013

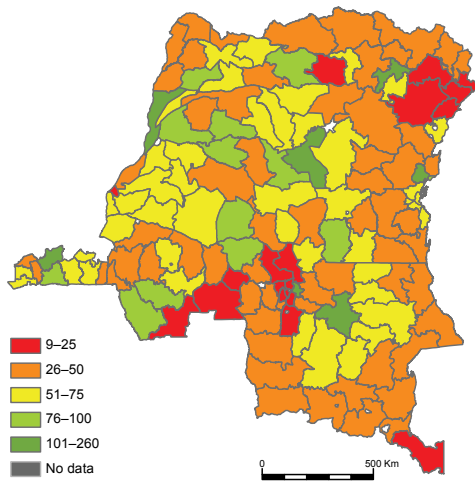


Sources: CAID (2016); République Démocratique du Congo, Ministère des Finances (2014); and République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

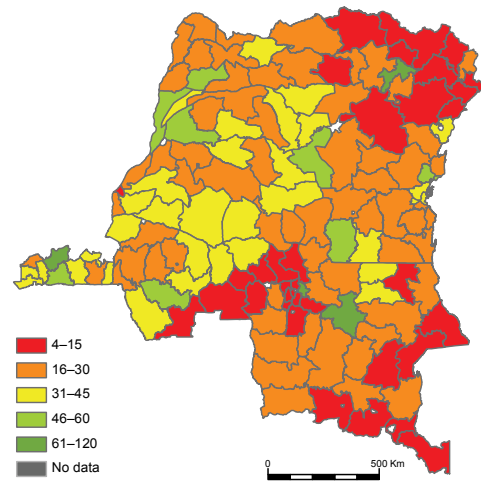
the country, where the number of schools is relatively higher, the number of functioning toilets is lower, with the exception of Kongo Central. Similarly, many schools in Ituri and Haut-Katanga, despite being fewer in number relative to population levels, have larger numbers of functioning toilets.

FIGURE 11. School infrastructure and management

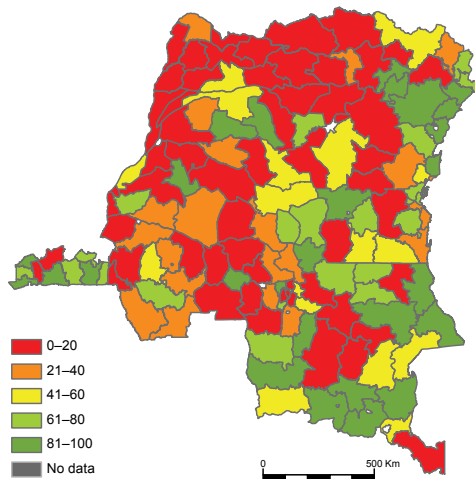
a. Number of primary schools per 100,000 inhabitants, 2015



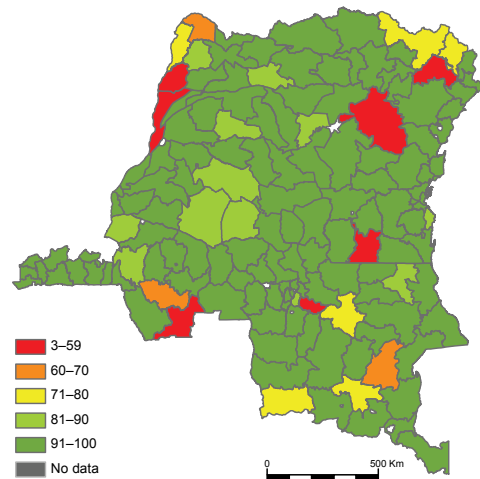
b. Number of secondary schools per 100,000 inhabitants, 2015



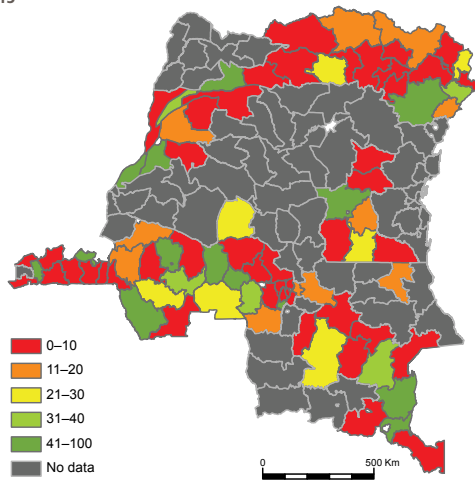
c. Share of schools with functioning toilets (%), 2015



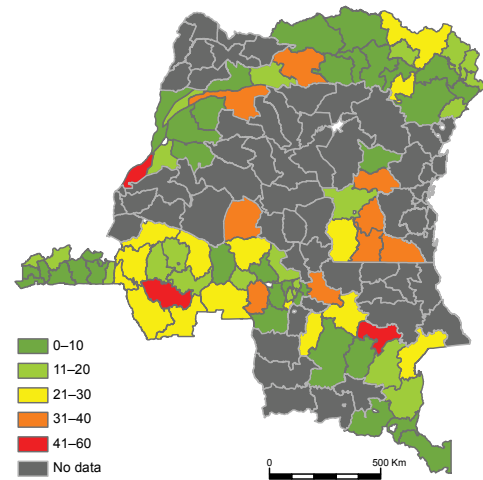
d. Share of schools with a board of directors (%), 2015



e. Share of teachers who received training in the current school year (%), 2015



f. Share of registered teachers who are unpaid (%), 2015



Source: CAID (2015).

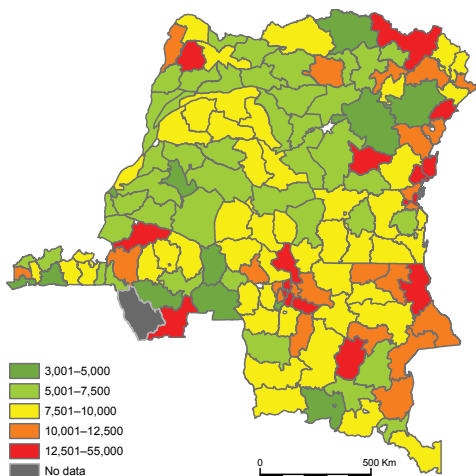
Overall, schools in DRC comply with the requirement of having a board of directors: the share of schools without a board of directors is more than 30 percent in only 10 of 145 territories (Figure 11d). In terms of teacher training and motivation, in many regions there seems to be a contradiction (or, perhaps, a tradeoff): although the share of teachers trained during the 2014/15 schoolyear was fairly low in the provinces of Kongo Central, Equateur, the two Uele's, Haut-Lomami, Kasai-Central, and Kasai-Oriental, the share of registered teachers who receive payment was markedly higher in these provinces (Figures 11e and 11f). For Mongala, Ituri, Kwilu, Kwango, Kasai, Maniema, and Haut-Katanga, no correlation was apparent between teacher training and teacher remuneration.

Another important social indicator is healthcare. Some territories are still poorly endowed with health centers, especially

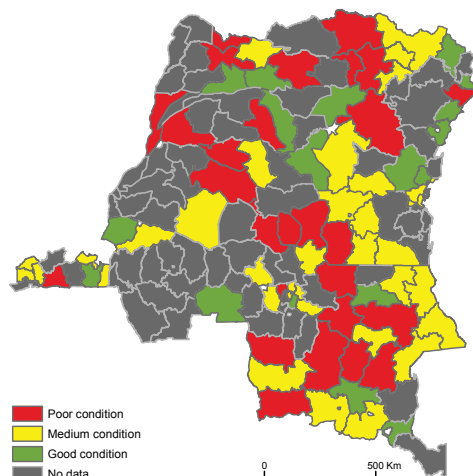
in Tanganyika, Kasai-Oriental, Lomami, Haut-Lomami, North Kivu, and Haut-Uele, where often there is fewer than 1 health center per 7,500 inhabitants (Figure 12a). Additionally, good sanitary conditions in health centers are limited to a small number of territories (Figure 12b). In terms of qualified medical personnel, the situation is mixed: in many territories the majority of births are assisted by qualified midwives, whereas in others, such as the former province of Equateur and in Tanganyika and Kasai, there is a shortage of doctors (Figures 12c and 12d). All in all, the picture seems bleak in Tanganyika, while looking much better in Kongo Central and Mai-Ndombe.

FIGURE 12. Health infrastructure

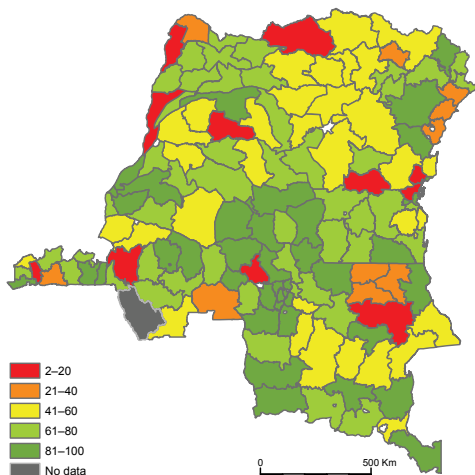
a. Number of inhabitants per health center, 2015



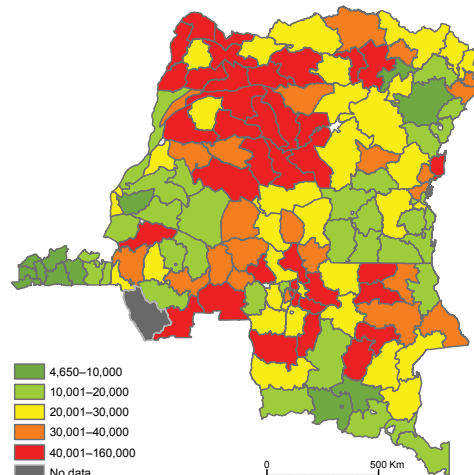
b. Average sanitary conditions in health centers, 2015



c. Share of births assisted by qualified personnel (%), 2015



d. Number of inhabitants per doctor, 2015



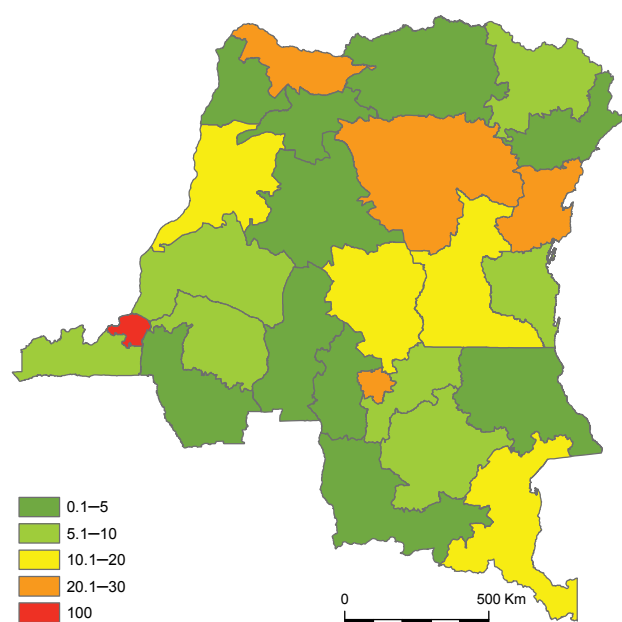
Source: CAID (2015).

Local Responses by Smallholder Farmers

Livelihood Activities among Farm Households

FARM HOUSEHOLDS PRIMARILY ENGAGE IN ONFARM ACTIVITIES AS A MEANS OF SECURING THEIR LIVELIHOODS. There is a great deal of heterogeneity across territories, however, with around one-quarter of the farming population residing in urban areas within Kasai-Oriental, North Kivu, Tshopo, and North Ubangi² (Figure 13). Given its unique circumstances in terms of access to basic infrastructure, services, and markets, this category of urban farm households needs to be treated separately to avoid overestimation of livelihood conditions rural farmers face. For the same reason, this category is excluded from subsequent maps.

FIGURE 13. Share of farm households in the urban sector (%), 2012-2013



Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

Farm households in DRC engage in a variety of farm and nonfarm activities (Figure 14). Crop production is the main activity across most of the country, especially in Bas-Uele and Mai-Ndombe. Livestock is as important as crop production in the provinces of Kwilu, Lomami, and Haut-Uele, and is even more important in Kasai, Kasai-Central, North Ubangi, and Tshuapa. In terms of mixed activities, Kasai-Central is clearly outperforming all other provinces, with more than one-third of all farm households engaged in both crop and livestock production, followed far behind by the provinces of Maniema, Kwilu, and Kongo Central. It is worth highlighting the reliance on fishing activities as an additional source of livelihood along the major tributaries of the Congo River Basin and especially in the province of Equateur, where more than two-thirds of all farm households have at least one member engaged in fishing (Figure 14a).

Nevertheless, fishing appears to be much less important than expected among farm households in Kwilu and Kongo Central, despite their proximity to important waterways, such as the Kwilu, Kasai and Congo Rivers. Apart from crop production, livestock and fishing, members of farm households often also engage in nonfarm activities (Figure 14b). This kind of diversification is most common in the provinces of Kasai, Kasai-Central, Kasai-Oriental, Tshopo, and Haut-Uele but less common in the former province of Bandundu, in North Kivu, and especially in Haut-Lomami.

² The province of Kinshasa officially has no rural sector, so all farmers located there are considered urban dwellers.

BOX 4 — What defines a farm household?

A farm household is one whose main revenues are generated through farming activities (whether crop or livestock production or fishing). This is the case regardless of which family members are engaged in farming or whether the activities constitute the family's declared principal activity. However, when applying this definition to the available data on farm households in DRC, the sample size shrinks significantly. This is not surprising given households' general reluctance to share information on their income sources and levels, which are complex in the context of seasonal farming. For these reasons, the principal activity of the highest ranked working family member was used to distinguish between farm and nonfarm households. As it happens, this definition has a strong correlation with the formal definition, but it helps secure a much larger sample.

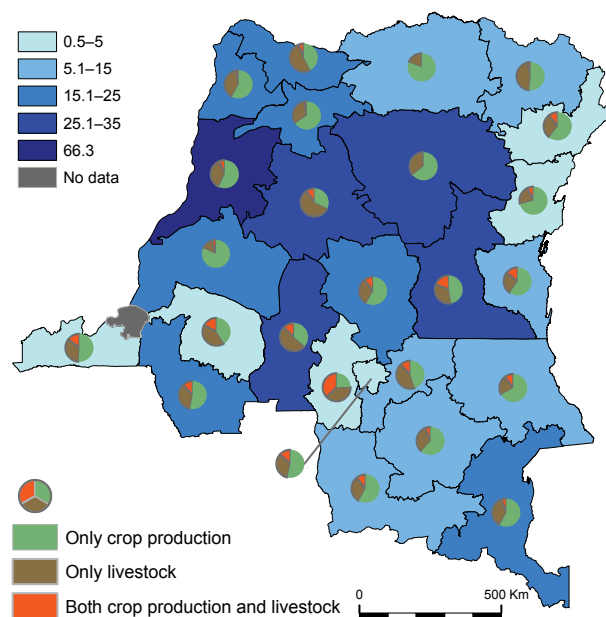
Types of Household Capital

The following maps show the heterogeneity of asset composition, classifying household capital into five categories, each being instrumental in overcoming one or more constraints facing farmers. The first set of critical household assets needed to transform agricultural potential into adequate nutritional intake is human capital (Figure 15). Findings suggest that the educational attainment of most farmers across the country is low and that, on average, it does not exceed primary schooling (Figure 15a). The situation is worse than the national average in many eastern provinces, where most farmers did not attend schooling beyond the third grade. Farmers in Maniema, Kasai, and Lomami, and especially those in Equateur and Mongala, generally have the lowest level of primary education.

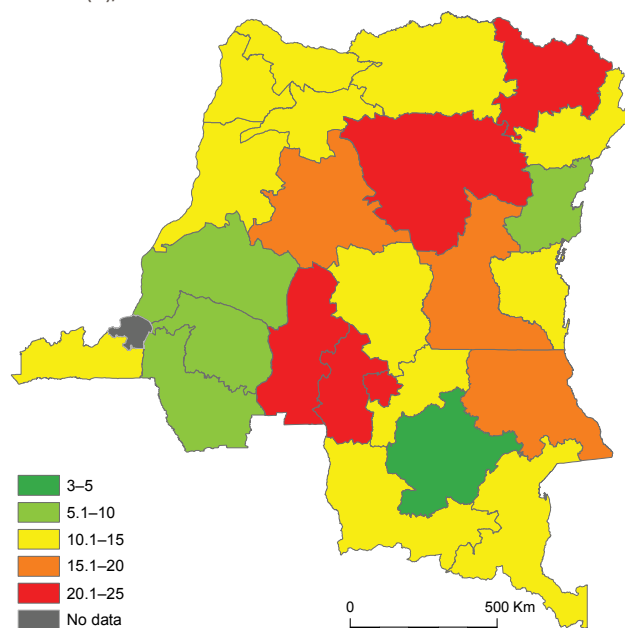
Interestingly, for farmers in Maniema, Equateur, Mongala, North Kivu, and Tanganyika, available information suggests an inverse relationship between general education levels and skilled labor for commercial agriculture (Figure 15b). Overall, except for Haut-Lomami, Kwango, and North Kivu, farmers in the south of the country have higher skills and greater market orientation compared with farmers in the north. Unless access to agricultural extension is seriously improved, this spatial pattern is likely to stay unchanged in the coming years (Figure 15c). Indeed, many regions lack any agricultural extension services to assist farmers in improving their skills and increasing their productivity, especially in the northwestern part of the country, in Sankuru in the center, and in Tanganyika in the east. Only 10–15 percent of farmers in North Kivu and Kongo Central reported having access to some kind of agricultural extension service.

FIGURE 14. Sources of farm and nonfarm income

a. Share of farm households with at least one member engaged in fishing and composition of land use (%), 2012-2013



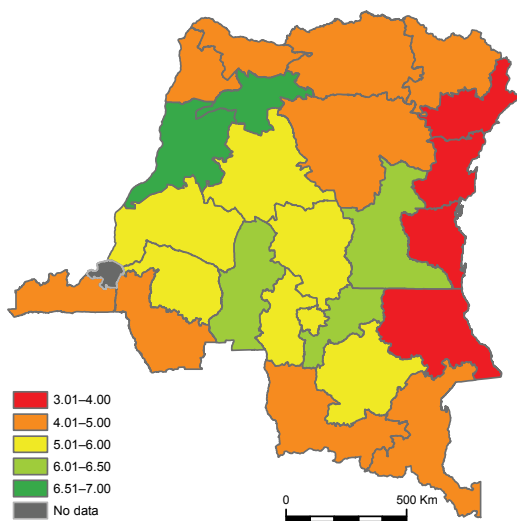
b. Share of working family members partially or fully engaged in nonfarm activities (%), 2012-2013



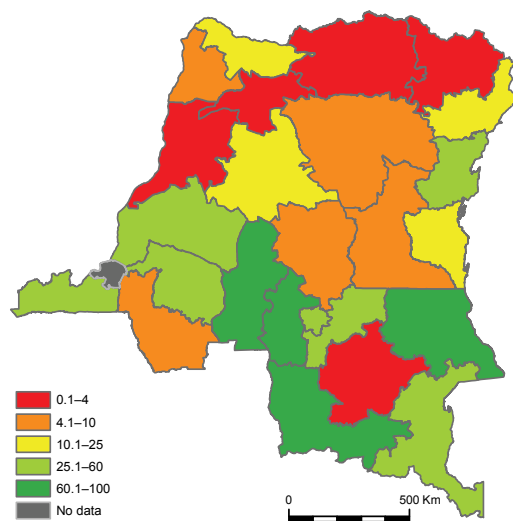
Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

FIGURE 15. Heterogeneity of human capital

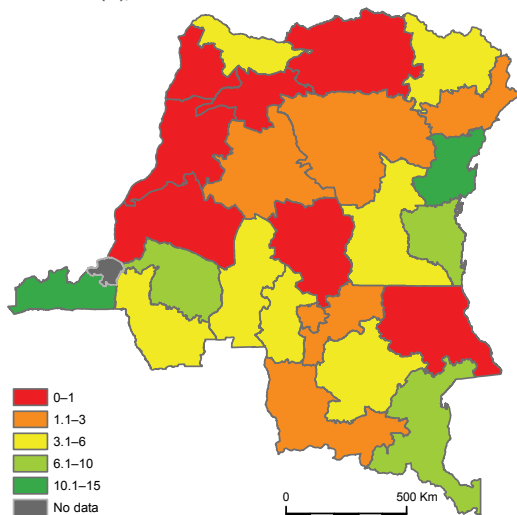
a. Average years of schooling of farmer, 2012-2013



b. Share of skilled labor for commercial agriculture (%), 2012-2013



c. Share of farm households with at least one member benefitting from agricultural extension (%), 2012-2013



Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

Note: In line with the definition of Box 4, the individual characteristics displayed in this figure refer to those of the highest ranked working family member.

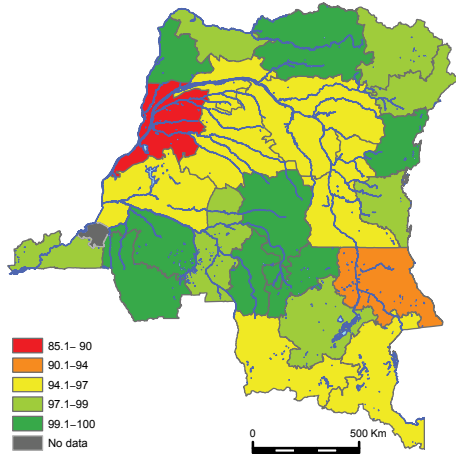
The most crucial production asset of farm households is their access to land (Figure 16a). Almost 98 percent of all farm households own their land, but average farm size is small, and often less than one hectare. Probably because of frequent flooding, the proximity to major rivers is negatively correlated with both land ownership and farm size, especially in the province of Equateur. In contrast, farm households in Haut-Katanga and, to a lesser extent, Ituri and Haut-Uele have larger land holdings, on average (Figure 16b). Despite the wide availability of arable land, the use of improved seeds is generally low (6.6 percent, on average) throughout the country (Figure 16c). Kwilu is the exception in that more than a quarter of all farmers in this province use improved seed³; South Kivu, South Ubangi, and Kongo Central follow far behind.

Similarly, in general the use of irrigation is very limited, but appears to be more common in Kwilu and Equateur, at around 10 percent on average (Figure 16d). Ownership of large farming equipment such as barrows, tractors, plows, carts, and harrows is almost nonexistent. Only 6.1 percent of all farm households own a fishing line, on average, although the incidence increases for households located close to one of the major tributaries of the Congo River Basin, such as in Equateur, where about 30 percent of households own a fishing line (Figure 16e). Finally, pursuing a loan for farm production appears not to be viable for many farm households in DRC because access to farm credit is generally very low across the country (Figure 16f). Average access to credit is only slightly above 3 percent in Haut-Lomami, South Kivu, and Tanganyika.

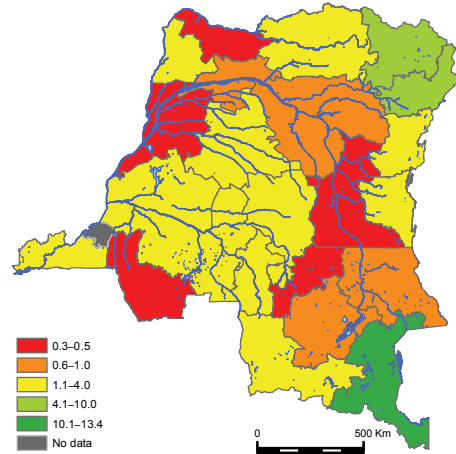
³ This observation relates to the many donor funded projects implemented in Kwilu.

FIGURE 16. Heterogeneity of production capital

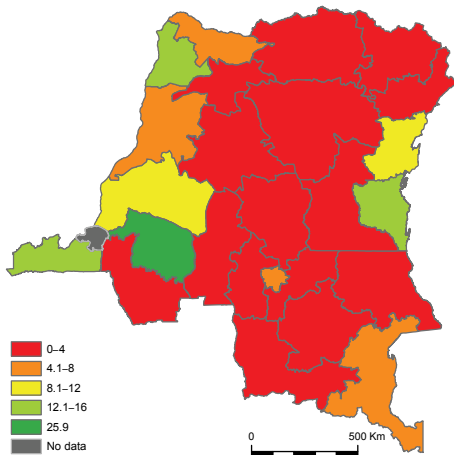
a. Share of farm households that own land (%), 2012-2013



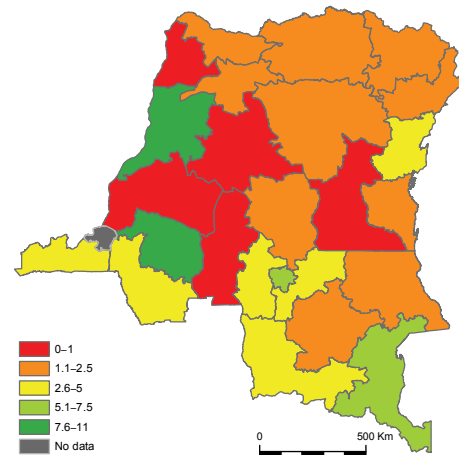
b. Average farm size (ha), 2012-2013



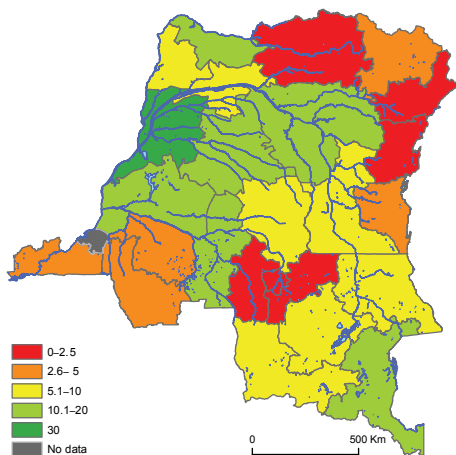
c. Share of farm households that use improved seed (%), 2012-2013



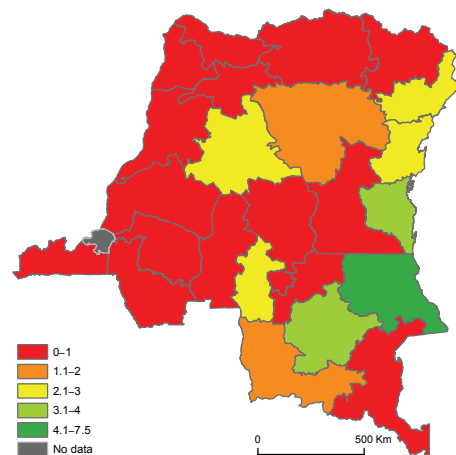
d. Share of farm households that use irrigation (%), 2012-2013



e. Share of farm households that own fishing line (%), 2012-2013



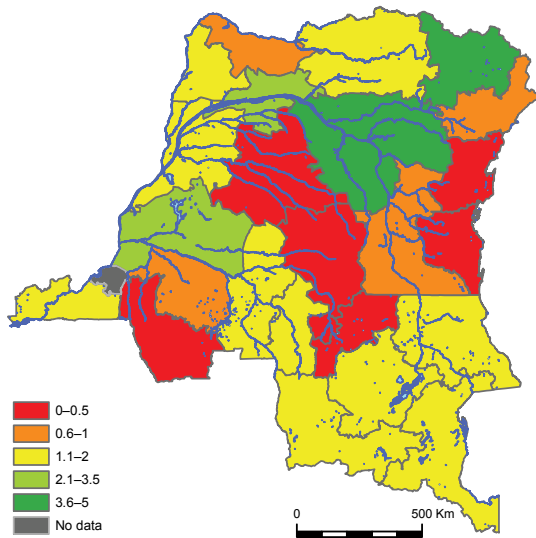
f. Share of farm households with access to credit (%), 2012-2013



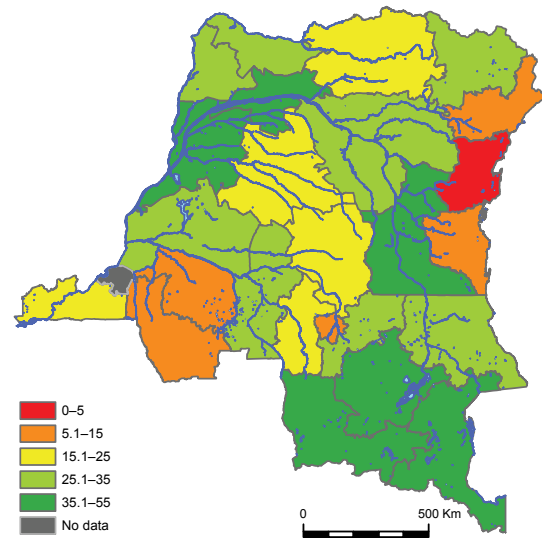
Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

FIGURE 17. Heterogeneity of transport capital

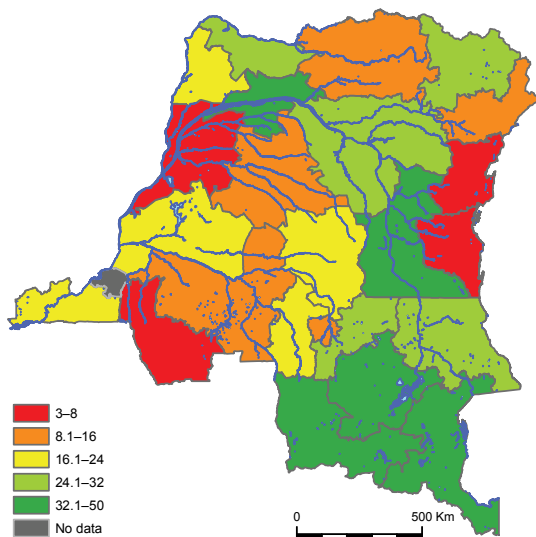
a. Share of farm households with a motorized means of transport (%), 2012-2013



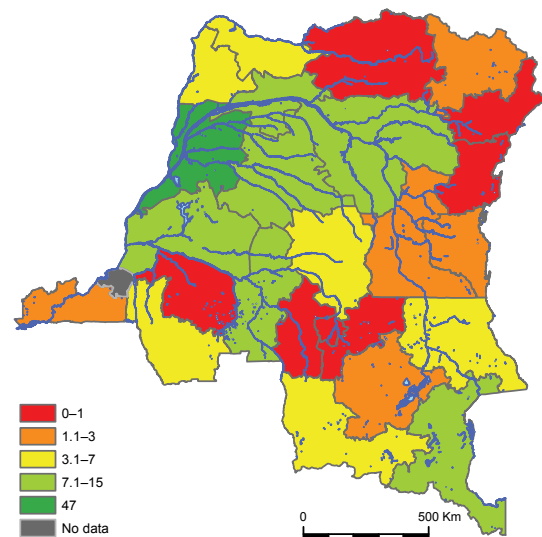
b. Share of farm households with a nonmotorized means of transport (%), 2012-2013



c. Share of farm households that own a bicycle (%), 2012-2013



d. Share of farm households that own a nonmotorized pirogue (%), 2012-2013



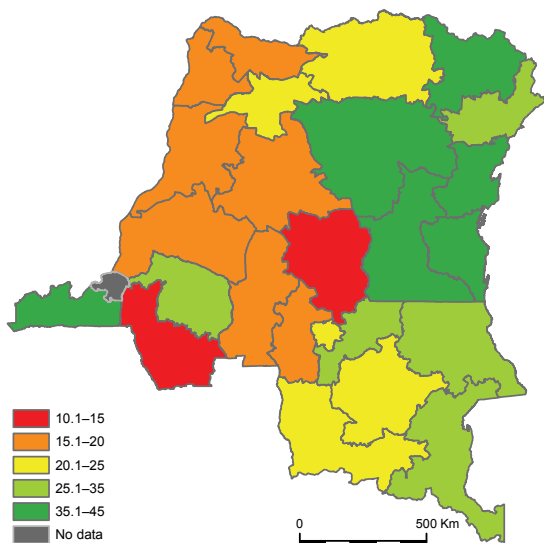
Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

Given the country's geographic size, having a means of transportation is essential to access markets (Figure 17). Whereas ownership of motorized transportation by farm households (cars, pirogues, motorcycles, and so on) is less than 1.2 percent on average, ownership of nonmotorized transportation is far more prevalent, at rates close to 25 percent (Figures 17a and 17b). Ownership of both types of transportation seems to follow the country's topography, with lower rates in the hilly provinces of Ituri, North Kivu, and South Kivu in the east as well as Kwango in the southwest; and the more isolated regions in the country's hinterland—in the case of motorized transport mainly due to lack of fuel. Overall, ownership of nonmotorized transport seems to be higher in regions crossed by the Congo River and mainly in the form of bicycles, upstream, and nonmotorized pirogues, downstream (Figure 17c and 17d).

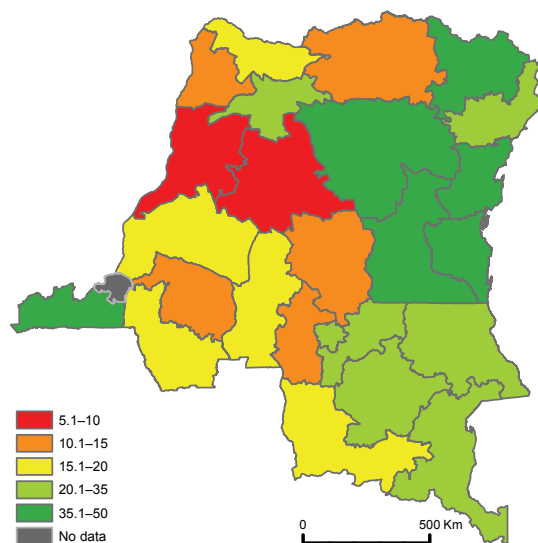
In order to successfully negotiate transactions, farmers need to connect to various input and output markets; hence, any information and communication technologies are vital (Figure 18). Around one-quarter of the country's farmers own a radio (Figure 18a). Apart from Kwilu, and especially in Kongo Central, ownership rates tend to be divided, with more farmers owning a radio in the east than in the west. This spatial divide is confirmed by data on farmers reporting that they follow the news (Figure 18b). Whereas the most informed farmers live in Tshopo, Maniema, Haut-Uele, both North and South Kivu, and Kongo Central, the least informed are found in Equateur and Tshuapa. With respect to mobile phone and internet usage, many farmers have no access to these types of technologies (Figures 18c and 18d). Farmers tend to have somewhat better access to mobile phones in Kongo Central in

FIGURE 18. Heterogeneity of information and communications technology

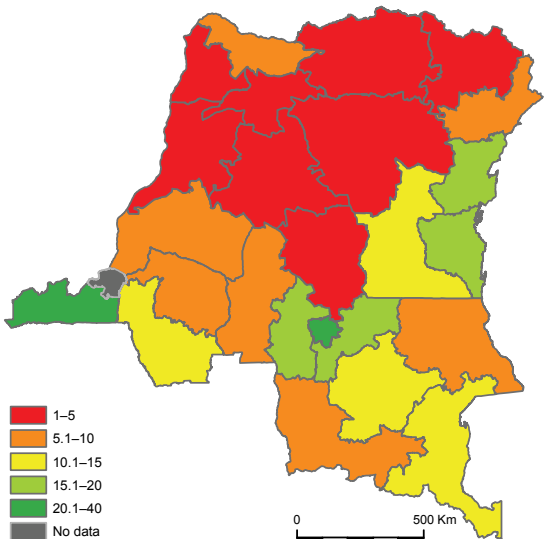
a. Share of farm households that own a radio (%), 2012-2013



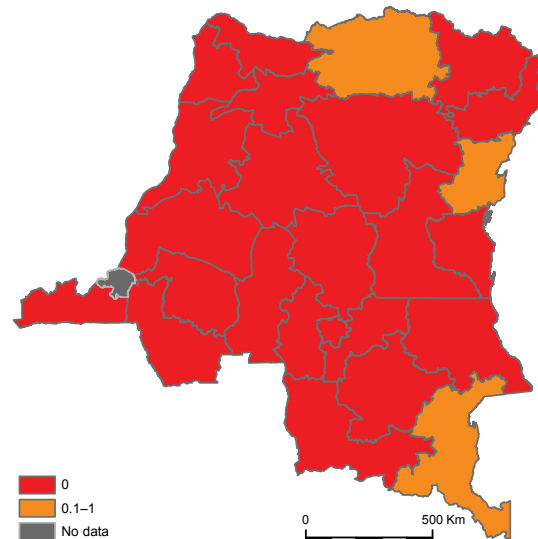
b. Share of farm households that follow the news (%), 2012-2013



c. Share of farm households that use a mobile phone (%), 2012-2013



d. Share of farm households that use the internet (%), 2012-2013



Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

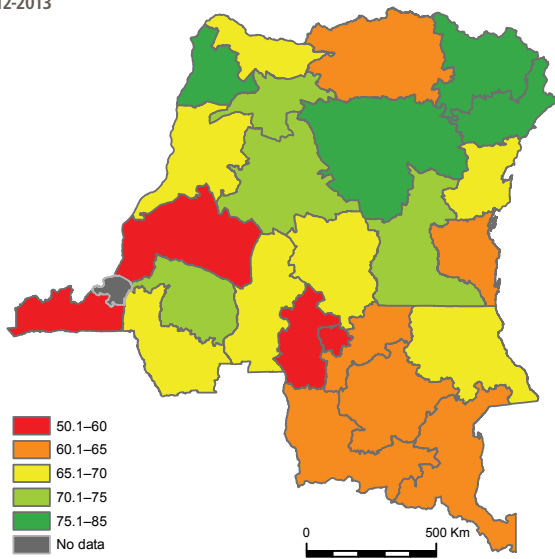
the west, in the Kivu region in the east, and in some provinces in the center of the country. Apart from these areas, farmers in the north and west remain highly isolated.

When dealing with shocks, people typically rely on their social capital to smooth consumption levels and maintain their livelihoods. The extended family remains by far the most important safety net for many farm households in DRC: more than two-thirds of farmers, on average, reported being able to rely on a family member when needed (Figure 19a). Reliance on neighbors or religious organizations is less common, although still substantial at rates close to 50 percent on average (Figures 19b and 19c), followed far behind by a reliance on nongovernment organizations, at 16 percent (Figure 19d). Geographically, households in Mai-Ndombe, Kongo Central,

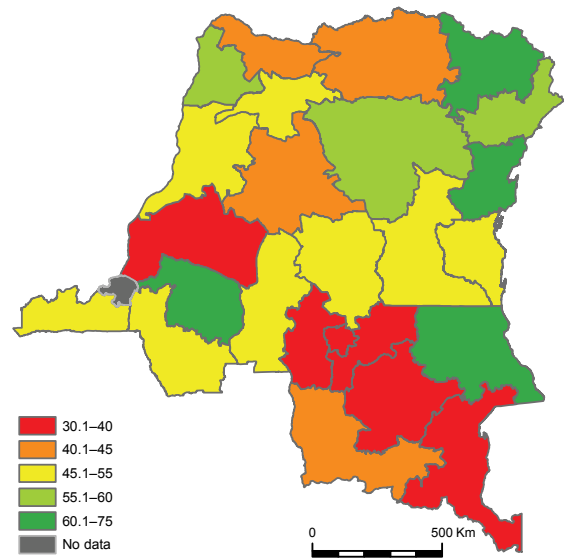
Kasai-Central, and Lomami appear to have markedly lower levels of social capital, whereas social ties among farm households in Sud-Ubangi, Haut-Uele, Kwilu, Tanganyika, and Kasai tend to be stronger.

FIGURE 19. Heterogeneity of social capital

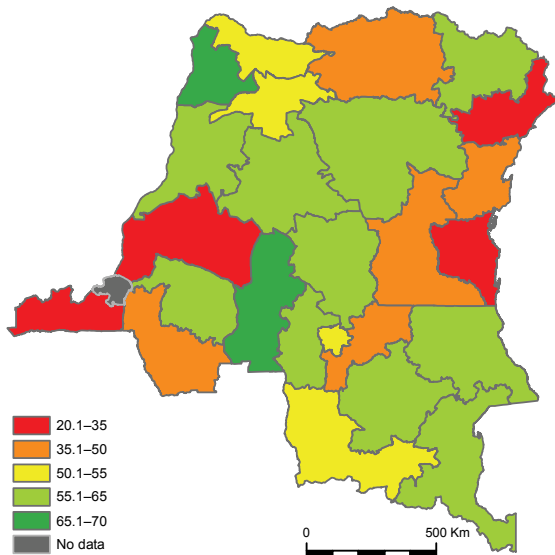
a. Share of farm households that can rely on a family member when needed (%), 2012-2013



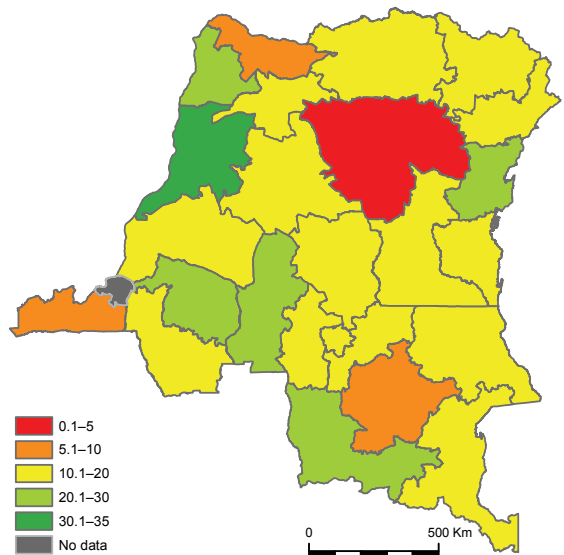
b. Share of farm households that can rely on neighbors when needed (%), 2012-2013



c. Share of farm households that can rely on a religious organization when needed (%), 2012-2013



d. Share of farm households that can rely on a nongovernmental organization when needed (%), 2012-2013



Source: République Démocratique du Congo, Ministère du Plan et Suivi de la Mise en Œuvre de la Révolution de la Modernité (2014b).

Concluding Remarks

We started this analysis with the implicit assumption that a country endowed with abundant agricultural resources should perform well in terms of food and nutrition security. Our findings clearly contradict that assumption in the case of DRC; hence, the paradox. However, if anything, our analysis shows that achieving desired food and nutrition outcomes will require more than one particular set of assets. Indeed, in addition to natural capital (land, water, climate), countries need acceptable levels of human capital (health, education), manufactured capital (transport, energy, ICT), social capital (laws, norms, trust) and knowledge capital (conceptual, factual, practical, know-how). It is fair to say that DRC is structurally short of these critical assets, which explains the country's current inability to tap into its huge agricultural potential. This general explanation however does not hold to a similar extent across the country, as different provinces and territories often face very different portfolios of structural and idiosyncratic constraints. Therefore, there is no agricultural paradox in DRC; observed food and nutrition outcomes can be explained with a spatially diverse set of causes.

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