

What drives rural youth welfare? The role of spatial, economic, and household factors

by
Aslihan Arslan
David Tschirley
Eva-Maria Egger

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Abstract

Most of the discourse on rural youth in developing countries lacks robust evidence on where rural youth live and how the challenges and opportunities of their location affect their welfare outcomes. This paper uses the concept of the Rural Opportunity Space from economic geography literature to shed light on these questions. Rural opportunities are expected to be shaped by commercial and agricultural potential of a location. We apply this conceptual framework to global geo-spatial data from 85 low- and middle-income countries on population density, as a proxy for commercial potential, and a measure of greenness, as a proxy for agricultural potential, to locate rural youth within the opportunity space globally. We then combine these data with household-level data from 12 countries in Africa, Latin America and Asia, to assess how the Rural Opportunity Space influences welfare outcomes of young households compared with older households. Our findings show that most rural youth actually live in areas with high potential in terms of commercial and agricultural opportunities. However, their welfare outcomes depend much more strongly on commercial potential than on agricultural potential. Education can have large poverty-reducing effects for younger households, especially in areas where commercialization potential is neither lowest nor highest.

1. Introduction

Youth have become an especially important issue in the international development discourse recently for several reasons. First, and most important, is the particular demographic transition stage most developing countries find themselves in: youth constitute a high proportion of the population – currently about one in five – in low-income countries. This compares with only one in eight in high-income countries. Furthermore, the absolute number of youth in Africa is rising rapidly, even as it has plateaued and begun to fall in the rest of the developing world¹ (UNDESA, 2017). High proportions of youth in the population and, in Africa, rapidly rising numbers of youth pose major challenges for low-income countries needing to invest to improve their citizens' future. Rural youth specifically constitute a high proportion of many developing countries' population (Stecklov and Menashe-Oren, 2019), while rural areas continue to lag behind in economic development (Ghani, 2010).

Second, although the two biggest youth populations are in China, an upper-middle-income country, and India, a lower-middle-income country, the majority of countries with large rural youth populations are low-income countries with high poverty rates and low levels of structural transformation. Most of these countries are in sub-Saharan Africa and Asia, where the high proportions of rural youth, large absolute numbers and widespread poverty make it very challenging for them to invest to improve their citizens' future. Poverty reduction and rural development thus cannot be addressed without rural transformation being inclusive of rural youth (IFAD, 2016).

How to ensure this has been increasingly capturing the attention of development practitioners, policymakers and academics. Most of this discourse, however, lacks robust evidence on where rural youth live and how these spaces affect their welfare outcomes. This paper explores the overlapping national, local and familial settings in which rural youth live. The intersection of these settings – the level of transformation of their national economy, the potential productivity and connectivity of the particular area they live in, and the capacities of their families – determine in great part the opportunities available to rural youth. Conceptualizing rural youth challenges and opportunities in this way allows us to address three questions: (1) Where do rural youth live in the developing world in terms of agricultural and commercial potential? (2) How do these varying agricultural and commercial potentials affect the welfare outcomes of younger households within a country? (3) Does the hypothesized disadvantage of younger households compared with older households vary by transformation level?

This paper provides a conceptual framework to answer these questions using a spatial typology and applies it at global and household levels. To this end, we use spatially explicit population density data from the WorldPop project and the Moderate Resolution Imaging Spectroradiometer Enhanced Vegetation Index (MODIS EVI), to define, respectively, commercialization and agricultural potentials that make up the axes of the rural opportunity space. At the household level, we combine spatial data with 12 nationally representative datasets that span Africa, Latin America and Asia to define welfare indicators, and variables posited to affect them. Our spatial typology builds a "rural opportunity space" (ROS) drawing on the concept of "landscapes of opportunity" by placing rural youth on a rural-urban gradient that represents commercialization potential and a gradient representing agricultural potential (Ripoll et al., 2017; Abay et al., 2019). We posit that, controlling for the level of structural transformation that a country has achieved,

¹ We use "developing world" to refer to low- and middle-income countries, as defined by the World Bank (2018a). We use "developing world" and "low- and middle-income countries" interchangeably to refer to the same set of countries.

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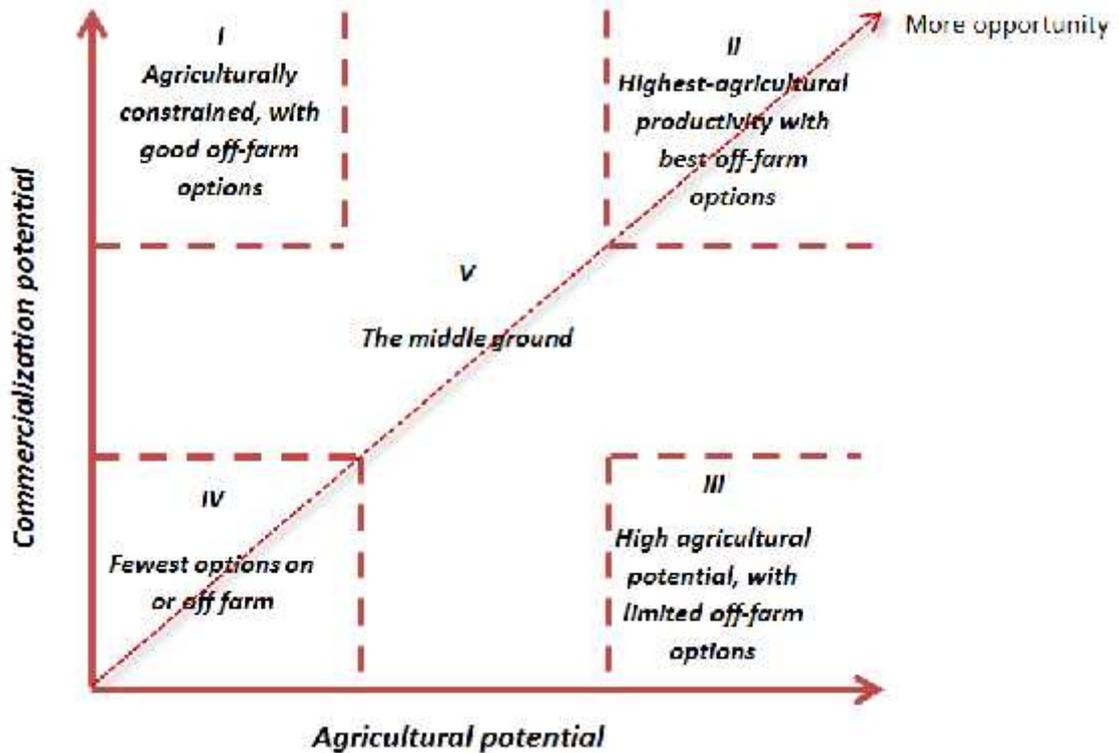
these factors substantially shape the range and attractiveness of opportunities available to rural youth. Whether or not rural youth can capitalize on opportunities presented by their geographical space and their country's economic structure, however, is subject to multiple constraints and closely linked to the characteristics of the households in which they live. Therefore, we differentiate between younger and older households. After careful documentation of rural youth within the spatial typology, we analyse welfare outcomes and how these change by typology to draw policy implications. Using our global definition of the rural-urban gradient instead of inconsistent administrative definitions of urban areas, we find that more than three quarters of the developing world's rural (non-urban) youth live in the areas with most agricultural potential, while only 7 per cent are found in areas with the lowest potential. Our analysis of welfare outcomes reveals that households with mostly young members are more likely to be poor than mostly older households, in all types of countries independent of the level of transformation. In terms of the ROS, commercialization potential relates strongly to poverty reduction whereas agricultural potential per se does not. The young household penalty is worst in the subsample of least transformed countries, and seems smallest in the most transformed countries in our analysis. The schooling bonus in terms of welfare outcomes is highest in less densely populated areas and in the least transformed economies. These findings underline the importance of addressing connectivity challenges to improve the opportunities for the majority of rural youth.

2. Conceptual framework: the rural opportunity space

This paper assesses how the characteristics of the location where rural youth live shape their livelihoods. Yet neither the national structure of an economy nor the household structure in which youth live can be ignored. A more productive economy will increase the payoff to investments specific to rural youth. Sustained growth and structural transformation are typically associated with public commitment to investments in education, health and infrastructure (World Bank, 2018b). As a consequence, in countries that make these investments, more educated and skilled youth have more opportunities and agency to employ their skills productively.

Within a country, rural youth opportunities vary by location. While an economy may be experiencing structural transformation at the national level, not all areas within the country will be transforming equally. In rural areas, opportunities are determined to a large extent by access to markets (for agricultural output, inputs, labour, finance and others) that determines the area's commercialization potential, and by the natural resource base that determines the agricultural potential of the area. Both of these factors have strong spatial dimensions (Wiggins and Proctor, 2001; Ripoll et al., 2017). Together, these two factors form the ROS (figure 1) that affects the opportunities and challenges rural youth face, subject to the characteristics of the broader national economy as well as individual- and household-level constraints. This economic geography framework structures what is possible at the highest level within a given country, independent of local context, specific social norms or any individual preferences (Abay et al., 2019).

Figure 1. Rural opportunity space



Source: Authors' conceptualization

Commercialization potential increases with connectivity to cities, their markets and potential for private-sector investment, all of which are crucial for extending opportunities to rural youth. Promisingly, secondary cities closer to rural areas are growing faster than more distant capital cities (Roberts and Hohmann, 2014). This expansion of secondary cities and towns has generated more poverty reduction than has the growth of large metropolitan areas, among other reasons by providing more accessible migration targets for rural residents (Tanzania, for example; Christiaensen et al., 2013) and by displaying more inclusive growth patterns (India; Gibson et al., 2017). Yet physical and virtual connections of these urban centres with rural areas are often poor. Many needed connections depend on public goods, such as improved roads and communications infrastructure, but also on private investment. Increasingly, the private sector is providing mobile technology, post-harvest facilities and processing, and agricultural inputs in rural areas. Public goods such as improved roads and well-designed legal and regulatory systems are necessary for private investments to take place on a broad scale, however. The vast majority of rural youth in developing countries live as dependants within larger families (Doss et al., 2019). Thus, in addition to the ROS in which youth reside, the characteristics of the household in which youth live also influence the set of opportunities and challenges that youth face. As youth transition from adolescence to adulthood, they begin to form their own households or stay longer with their parents. The two trajectories are associated with different challenges and opportunities. We therefore distinguish households by their demographic composition and define mostly younger and mostly older households. Mostly younger households include those with many dependent youth as well as newly formed young households, which usually lack experience and assets that take time to accumulate. Youth in mostly older households are expected to benefit from assets and experiences of their parents leading to better welfare outcomes (holding all else

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constant). In the next section, we present the details of spatial data used to operationalize the ROS and nationally representative survey data to analyse how the ROS affects welfare of rural households and their youth.

3. Data and methods

3.1 Data and variables for global analysis of the rural opportunity space

To create a typology of the ROS, we use commercialization potential and agricultural production potential as two axes of the opportunity space. Commercialization potential is proxied by population density data from the WorldPop project, and agricultural potential is proxied by the Enhanced Vegetation Index (EVI), which stems from satellite observations.

Commercialization potential

Administrative definitions of "rural" and "urban" suffer from two analytical problems. First, they differ across countries, which reduces the usefulness of cross-country comparisons. Second, the definitions are based on a simple dichotomy that may be increasingly at odds with how people actually live. Urban and rural qualities have become increasingly blurred by rapid urbanization, increased rural population densities and economic transformation in rural areas that has driven an increase in "urban" characteristics such as reliance on markets. The increasing prevalence and growth of small and secondary towns plays an important role in connecting the two geographical dimensions and catalysing commercialization opportunities (Lerner and Eakin, 2010). Moreover, the transformation of agri-food systems (AFS) has increased the economic linkages between rural areas and cities (Dolislager et al., 2019), increasing the need for a more fluid spatial definition. One approach to reconciling this is through the increasing application of the concept of "peri-urban areas" (Simon et al., 2006; Simon, 2008). These areas can be seen as rural locations that have "become more urban in character" (Webster, 2002, page 5); and as sites where households pursue a wider range of income-generating activities while still residing in what appear to be areas of rural character (Lerner and Eakin, 2010).

Commercialization potential can be measured by road density, average time to nearest market or population density, each with its own challenges (Abay et al., 2019). Instead of applying administrative rural and urban definitions, we therefore use high-resolution population densities from the WorldPop project to create a rural-urban gradient (see Jones et al., 2016, for a recent application). Spatially explicit global population density data are used to proxy commercialization potential, with the idea that it correlates with agricultural commercialization, off-farm diversification and market density (Bilsborrow, 1987; Wood, 1974). This approach ensures comparability across regions and countries and creates a more precise spatial picture, which allows a better understanding of economic and social characteristics of individuals and households over space. The WorldPop project provides 250 m × 250 m resolution population density maps for each country in the world. The production of the WorldPop datasets principally follows the methodologies outlined by Tatem et al. (2007), Gaughan et al. (2013), Alegana et al. (2015) and Stevens et al. (2015). WorldPop also includes age- and gender-differentiated spatially explicit information on population distributions (at 1 km resolution), which we use to locate rural youth around the developing world. We include 85 low- and middle-income countries² from the global database, for which we have complete data. To define a globally comparable scale of the rural-urban gradient, all grids were ordered from least to most dense,

² As defined by the World Bank (2018a).

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and population was successively summed to create four quartiles of equal population, ranging from least to most densely settled areas. The least dense quartile represents rural hinterland areas, while the most dense quartile represents the urban areas. In between are semirural (second quartile) and peri-urban (third quartile) areas.³ Table 1 displays how our categorization into four groups compares with the administrative rates of urbanization by region. In all regions, official urbanization rates from administrative sources are higher than those in our population-density-based definition. The difference is, however, starkest in Latin America and the Caribbean (LAC) and in countries in the Near East, North Africa, Europe and Central Asia (NEN). In sub-Saharan Africa (SSA) and Asia and the Pacific (APR), although the difference is smaller, the administrative urbanization rate is very similar to the urban and peri-urban areas of the rural-urban gradient combined.

Table 1. Comparing the population shares within the categories of the population density based rural-urban gradient to urbanization rates from administrative sources by region

Regions	Population density based rural-urban gradient				Administrative urbanization rate
	Rural	Semirural	Peri-urban	Urban	
LAC	41.84	16.03	20.33	21.80	67.30
SSA	46.75	13.58	14.43	25.24	38.03
APR	33.31	23.24	23.82	19.63	38.04
NEN	43.32	12.91	18.32	25.45	56.75
Global average	42.59	15.83	18.04	23.55	46.50

Notes: Population densities are from the WorldPop project, and administrative urbanization rates come from the United Nations Population Division for 85 low- and middle-income countries.

Agricultural potential

Vegetation indices based on remote sensing data are increasingly used as a proxy for agroecological potential to facilitate global comparisons (Jaafar and Ahmad, 2015; Chivasa et al., 2017). MODIS EVI, excluding built and forested areas, is used here to measure the influence of geography on the potential for productivity in farming (figure 1). Global EVI data covering all developing countries at 250 m × 250 m resolution were aggregated to the 1 km level to match the resolution of age-disaggregated population data. By focusing on land classified as cropland or pasture, the analysis spatially targets agricultural land to proxy agricultural production potential. Finally, average EVI values for the three-year period between 2013 and 2015 were calculated to minimize the impacts of seasonality and annual agro-climatic variation. EVI grids for all non-urban land were ordered from lowest to highest EVI, and all area was summed to create three groups (terciles) of equal total land area representing the low, medium and high agricultural potential categories on the horizontal axis.

Using the combination of the above data, the number and proportion of rural (non-urban) youth in each of the ROS categories were calculated and are presented below. For illustrations of where youth around the world live, we also draw on the population data and projections from the United Nations Population Division (UNDESA, 2017).

³ Table A.5 in Appendix A shows the population density threshold to define each quartile and the average population density within each quartile.

3.2 Merging global data with household-level data

To assess the economic engagement and opportunities of rural youth within the ROS, we look at three main groups of variables: sectoral and functional employment type, education status and welfare outcomes. To map these within the ROS, we merge the global ROS data with those of 12 household surveys from countries in Latin America, sub-Saharan Africa and Asia. These countries are Bangladesh, Cambodia and Nepal in Asia, Mexico, Nicaragua and Peru in Latin America, and Ethiopia, Malawi, Niger, Nigeria, Tanzania and Uganda in sub-Saharan Africa.⁴

Given the importance of a country's structural transformation level in facilitating the channels through which youth livelihoods are shaped, we group these countries in three categories: high, medium and low level of transformation. We use data on the proportion of non-agricultural GDP for all low- and middle-income countries to define these categories (IFAD, 2016). As a result, Peru and Mexico are in the group of high transformation; Nicaragua and Bangladesh are in the middle group; and the African countries as well as Cambodia and Nepal form the group of low structural transformation (table 2).⁵

Table 2. Study countries by level of structural transformation and region

<i>Region</i>	<i>Level of structural transformation</i>		
	Low	Medium	High
Latin America		Nicaragua	Mexico, Peru
Asia	Cambodia, Nepal	Bangladesh	
Sub-Saharan Africa	Ethiopia, Malawi, Niger, Nigeria, Tanzania, Uganda		

Using available geo-spatial information about enumeration areas (EAs) or other administrative sampling units, the ROS data were merged with the household survey data.⁶ Population density of each EA was calculated and then classified into the population density quartiles using the global thresholds defined above. The EVI for each EA was also calculated for the 2013-2015 period as described above. While there are differences between the administratively defined rural and urban areas and our spatially defined rural-urban gradients, these are small in most surveys of LAC and SSA. In Asia, many administrative rural areas are defined as peri-urban in our definition because of the high population density, especially in Bangladesh.⁷

Variables that measure welfare outcomes of rural youth

As mentioned above, most rural youth live in households as dependants, so they experience the challenges and opportunities determined by their household's welfare. We differentiate households based on their demographic structure to analyse youth welfare. Youth living in mostly younger households are expected either to have started their own households (with potential

⁴ A detailed list of all datasets and source of geolocation is presented in Appendix A, table A.7.

⁵ See appendix table A.1 for the thresholds of each tercile and the level of non-agricultural percentage of GDP for each of the 12 study countries.

⁶ See methodological appendix B for a detailed explanation of the merging procedure.

⁷ Table A.6 in Appendix A compares the population shares within each category of the rural-urban gradient with the administrative rural or urban category provided in each survey by region.

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challenges that are associated with being young as mentioned above) or to contribute substantially to the livelihood of this household. In contrast, youth in mostly older households might still be living with their parents and enjoy the freedom to continue to go to school and bear less responsibility for providing the household income. Among all households with at least one young member, mostly younger households are defined as those with a proportion of economically active young members above the national average; and mostly older households are those for which this proportion is below the national average.⁸ A similar approach is used by Abay et al. (2019) to discuss youth opportunities. The main variables of interest to measure the welfare of rural youth are household poverty status and per capita expenditure. Other variables of interest include education, gender of the household head, land ownership, access to credit and income sources. All variables are constructed in the same manner across all datasets to ensure comparability.

Education is an important determinant of employment and welfare outcomes at both the individual and household levels. The most comparable variable available in the survey data is whether an individual has completed secondary schooling or not. At the household level, we use the proportion of working-age household members with secondary education as an indicator of the household's education level.

Further variables of interest are the land ownership and income sources of households. We define a dummy for households owning any land and, if they do, we compute the size of land relative to household size. We define two variables to capture household livelihood structures: their level of diversification out of agriculture, measured by the proportion of non-farm income in total income, and their commercialization within agriculture, measured by the proportion of farm sales in total farm income. Farm income and total income are constructed based on the Rural Income Generation Aggregates (RIGA) methodology (Carletto et al., 2008; Davis et al., 2017).⁹

Table 3 shows the composition of younger and older households and their characteristics.¹⁰ Nearly 60 per cent of households are 'mostly younger', with the fewest young households in Asia and the most in Africa. Younger households are evenly distributed along the rural-urban gradient, with slightly more living in rural hinterland than in urban areas. In contrast, relatively more older households live in more densely populated areas. In terms of agricultural potential, similar proportions of younger and older households live in each category, most in areas with high or medium potential. While younger and older households both have middle-aged household heads, younger households have on average more members who are youth and, on average, almost all youth in a mostly younger household are economically active, while in mostly older households relatively fewer of them are working. This difference is most striking and expected to shape welfare outcomes differently, as is the smaller proportion of working-age household members with secondary education in younger households. If youth have to contribute to the household's income generation, fewer of them can continue their education.

⁸ We use the standard UN definition of youth as all individuals between 15 and 24 years old.

⁹ All monetary values are expressed per capita over a daily basis in PPP (constant 2011 international dollars). Imputation techniques to treat outliers have been applied, replacing all the values above the ninety-ninth percentile of the distribution of each income component with the highest value within the ninety-ninth percentile, while for the aggregate income variables all the extreme values (above the ninety-ninth percentile and below the first percentile) have been replaced with missing values.

¹⁰ Table A.8 in Appendix A presents the summary statistics of all characteristics for each country.

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Consequently, younger households seem to be poorer, but relatively more of them own land and larger areas of land than mostly older households. This does not necessarily mean that they have easier access to land, but it could reflect the fact that relatively more younger households in the sample live in more rural areas, where land ownership is more common than in more urban areas. This is also suggested by the higher proportion of household income from farming for the younger households and their higher commercialization in farming. There is no statistical difference in the proportions of younger and older households in terms of access to credit.

Table 3. Summary statistics of younger and older households (population weighted)

	Mean		Difference in means
	Younger households	Older households	
Number of observations	45 981	34 008	
Overall prevalence	0.58	0.42	0.16***
Prevalence by region:			
<i>Asia</i>	0.19	0.38	-0.19***
<i>Latin America</i>	0.22	0.25	-0.03***
<i>Sub-Saharan Africa</i>	0.59	0.37	0.23***
Prevalence by rural-urban gradient:			
<i>Rural</i>	0.30	0.14	0.16***
<i>Semirural</i>	0.27	0.20	0.07***
<i>Peri-urban</i>	0.26	0.39	-0.13***
<i>Urban</i>	0.18	0.27	-0.09***
Prevalence by agricultural potential:			
<i>Low</i>	0.24	0.27	-0.03
<i>Medium</i>	0.36	0.33	0.03***
<i>High</i>	0.39	0.40	-0.01***
Number of youth in household	1.85	1.38	0.47***
Economically active household members	3.26	1.65	1.60***
Economically active youth household members	1.44	0.10	1.34***
Young household head	0.08	0.03	0.06***
Age of household head	48.0	47.7	0.36***
Female household head	0.23	0.21	0.03***
Share of working age household members with secondary education	0.29	0.37	-0.09***

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	Mean		Difference in means
	Younger households	Older households	
Poor (\$1.90 per capita per day in 2011 international PPP dollars)	0.33	0.17	0.16***
Per capita expenditure (2011 international PPP dollars)	3.51	4.65	-1.13***
Land ownership, dummy	0.57	0.36	0.21***
Land owned, in hectares	0.76	0.36	0.39***
Land per capita, in hectares	0.24	0.19	0.05***
Household has received any credit	0.25	0.25	-0.00
Farming share of total income	0.36	0.22	0.14***
Share of farm sales in own farm income	0.31	0.33	-0.03***

3.3 Methodology to assess welfare of rural young households

Where do rural youth live and how does this shape their welfare outcomes? The first part of this question is assessed by combining various data sources to describe where rural youth live in the ROS. This is done first with global data and then with the household-level data. Then we use regression analysis to describe how the spatial variables that define the ROS as well as other characteristics influence the welfare outcomes of rural young households and compare this with older households. The opportunities available to youth in their ROS affect their welfare outcomes through various channels including school-to-work transitions and economic engagement (IFAD, 2019; Dolislager et al., 2019). Notwithstanding the importance of understanding these various channels, we model welfare outcomes using only the following equation:

$$W_h = \alpha + \beta_1 A_j + \beta_2 C_j + \beta_3 Y_h + \beta_4 E_h + \beta_5 Fl_h + \beta_6 A_j * Y_h + \beta_7 C_j * Y_h + \beta_8 E_h * Y_h + \beta_9 Fl_h * Y_h + \gamma C_c + e_h \quad (1)$$

The welfare outcome of household h , W_h , is measured by total expenditure or poverty and depends on the agricultural potential, A_j , and the commercialization potential, C_j , of location j as defined above. Y_h is the indicator variable for young households capturing the effects of the demographic structure on welfare outcomes. The proportion of adults with secondary education in the household (E_h) is expected to improve welfare outcomes. Households with female heads (Fl_h) are expected to have worse welfare outcomes than male-headed households. To assess how these variables differentially influence welfare outcomes, each variable is interacted with the young household indicator. C_c is a series of country fixed effects, and e_h is a normally distributed error term.

In all regressions, standard errors are clustered at the country level. For ease of comparing coefficients, we compute marginal effects to present the results of interest and predicted probabilities for graphical illustration. We also present results from various subsample regressions that follow the corresponding methodology and specification.

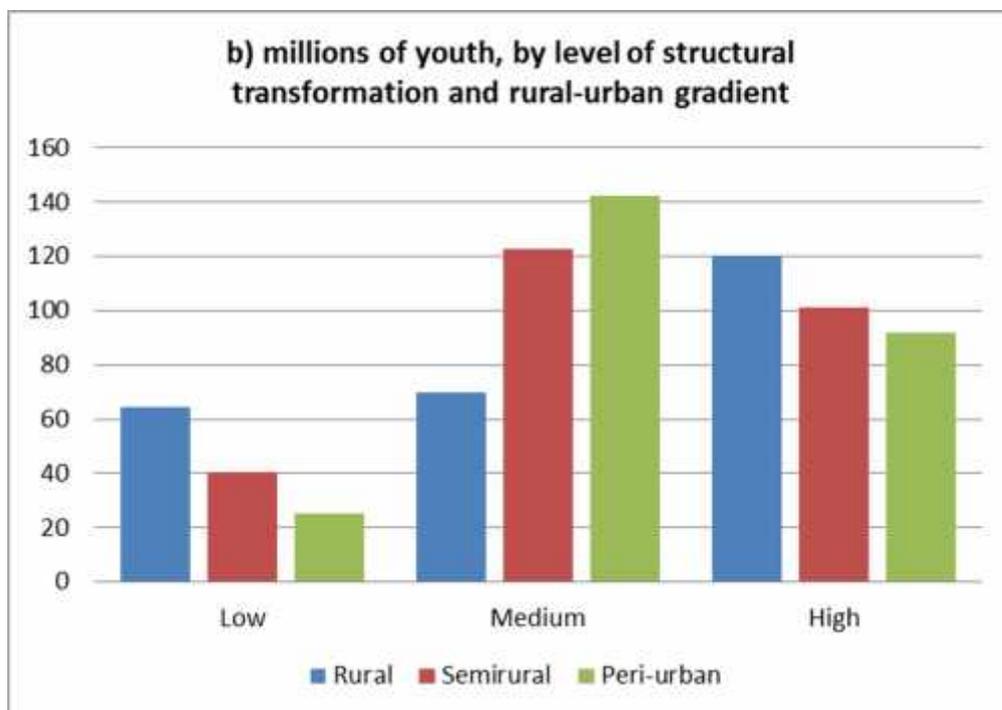
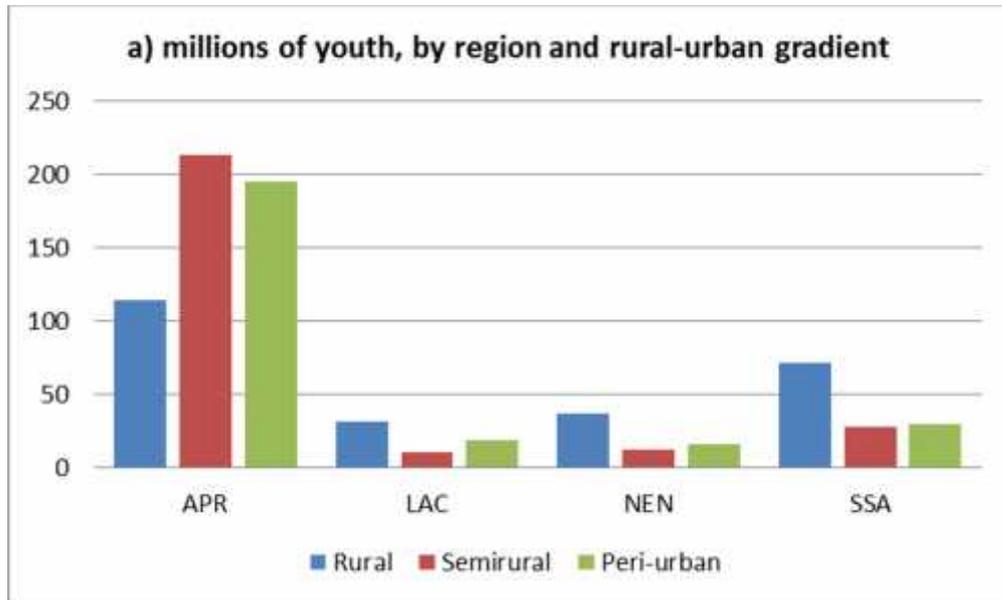
4. Results

4.1 Where do rural youth live?

While the political discourse centres on African youth, most of the world's rural youth currently live in Asia, with the numbers of youth in China and India alone surpassing those of all sub-Saharan countries together (figure 2). Only in Asian countries are the numbers of semirural and peri-urban youth higher than those in rural hinterland areas. However, population projections indicate that sub-Saharan Africa is the only region where numbers of youth are expected to continue to increase so that in 2050 the continent will hold the second largest share of all youth globally (UNDESA, 2017). In terms of level of transformation, countries with low levels of structural transformation have relatively more youth in rural hinterland areas than in semirural or peri-urban areas, pointing to the lack of connectivity youth are exposed to in these economies. In contrast, countries with medium levels of transformation show the opposite pattern. However, even the countries with relatively high levels of structural transformation in their economies have relatively more youth living in their rural than peri-urban areas.

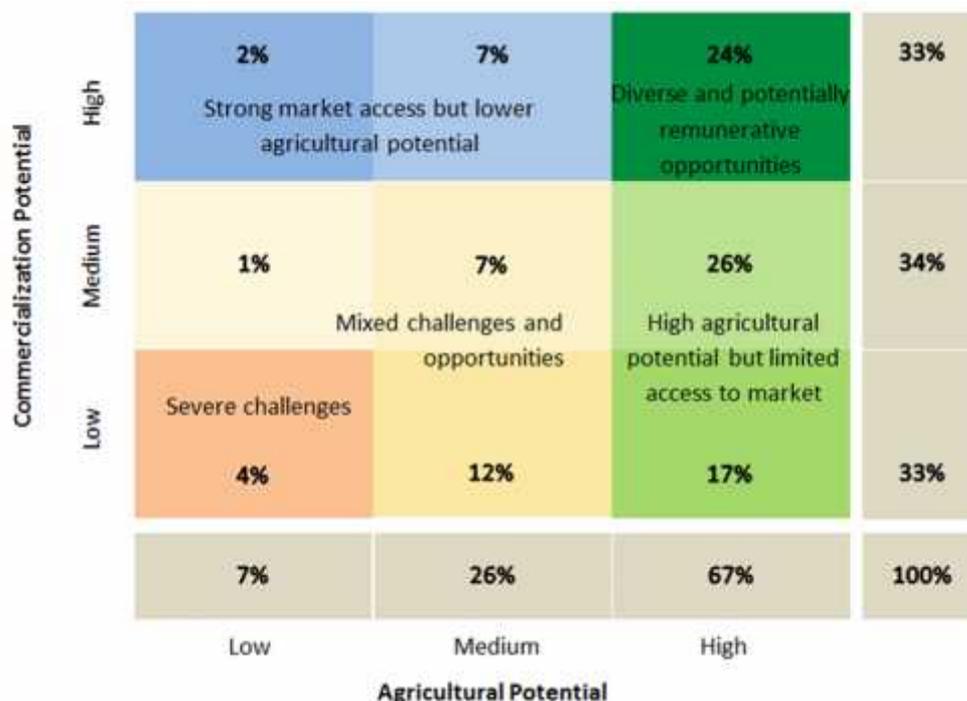
The ROS presents a valuable framework to understand the opportunities and challenges the world's rural youth face at both the global and country levels to identify policy and investment opportunities for their inclusion in rural transformation. Figure 3 displays the distribution of all 778 million non-urban youth from 85 low- and middle-income countries within the ROS as defined in section 2. Two in three of them live in areas with the highest agricultural potential. Only 7 per cent live in the lowest-potential areas. This concentration of rural population, and thus of rural youth, in the most productive areas is not surprising, as it reflects (especially in Africa) historical movement of agriculture-dependent populations to the most productive and least disease-prone areas of the world. This spatial pattern suggests that agricultural potential per se is not a primary constraining factor for a majority of rural youth. If their farming productivity is low, the reason most likely relates to lack of access to markets, both markets for inputs (e.g. improved seeds, fertilizer and credit) and markets for output to provide incentives to invest in increased productivity.

Figure 2. Non-urban youth populations in low- and middle-income countries in 2015 in millions, along the rural-urban gradient: (a) by region; (b) by level of structural transformation.



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Figure 3. Two out of every three rural youth in the developing world live in spaces with high agricultural potential



Note: Commercialization potential is defined using 2015 population density data for 85 low- and middle-income countries from the WorldPop project. All grids are ordered from least to most dense, and cut-offs are set to place 25 per cent of population in each of four groups. The highest-density quartile is called urban. The remaining three quartiles each hold one third of the non-urban population and define the three groups of the rural-urban gradient: rural, semirural and peri-urban. These represent respectively the low, medium and high commercial potential categories on the vertical axis. Agricultural potential is defined using MODIS EVI for the same grids ordered from lowest to highest. Each of the three groups (terciles) holds one third of all non-urban space and the represent the low, medium and high agricultural potential categories on the horizontal axis.

The vast majority of global rural youth live in relatively densely settled areas. What is not shown in the figure is that the least connected one third of the non-urban population (the bottom row of figure 3) occupy 92 per cent of non-urban land area, while the remaining two thirds live on the other 6 per cent of non-urban land. This means that two thirds of the rural youth population live in areas that are on average 23 times more densely populated than the least connected one third. What this means is that the vast majority of non-urban land in the developing world is very sparsely populated, while the vast majority of rural residents live in areas that are relatively densely populated. The potential for connectivity – with markets, information, ideas and possibilities – is thus relatively high for many of the developing world’s rural youth. If these youth are poorly connected and lack opportunities, the reasons do not relate to the potential productivity and connectivity of the land and spaces they occupy. Rather, they relate to the level of transformation in the broader economy in which they live (and thus the density of infrastructure and the size and dynamism of end markets), to the characteristics of the households in which they reside, and to constraints specific to youth and their individual characteristics.

The patterns identified above lend themselves to a classification of ROS in five groups that capture the broad challenges and opportunities faced by developing countries’ rural youth. Around one quarter of all rural youth in developing countries live in areas that combine the highest agricultural potential and the highest potential connectivity (top-right cell in figure 3). These youth face diverse and potentially

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remunerative opportunities, depending on the dynamism of the broader economy in which they reside. At the other extreme are the 4 per cent of rural youth who live in the least connected spaces with the lowest agricultural potential (bottom-left cell). They face severe challenges, again with the prospects of overcoming them depending in large measure on the broader economy in which they reside and the particular characteristics of the youth themselves and their families. Forty-three per cent of all rural youth live in spaces with high agricultural potential but limited access to markets, while those in spaces with strong market access but lower agricultural potential represent only 9 per cent of the total. The remaining one fifth of rural youth face an opportunity space with mixed challenges and opportunities. Since policy is made at the country level, we also highlight the county-level prevalence of the ROS for the most extreme cases. A detailed picture of this can be found in the RDR (IFAD, 2019).¹¹ Youth facing the greatest challenges from their geography – those in “severe challenges” and “mixed challenges” spaces – mostly live in Iran (22 per cent), followed by Brazil and China (around 10 per cent each). All three have high levels of structural transformation, but appear to suffer from small pockets of stubborn, persistent poverty, rather than widespread poverty. Ghani (2010) refers to this as the lagging region problem. These countries should have the capacity to invest in these isolated rural youth, as they have more fiscal resources to do so than low-income countries.

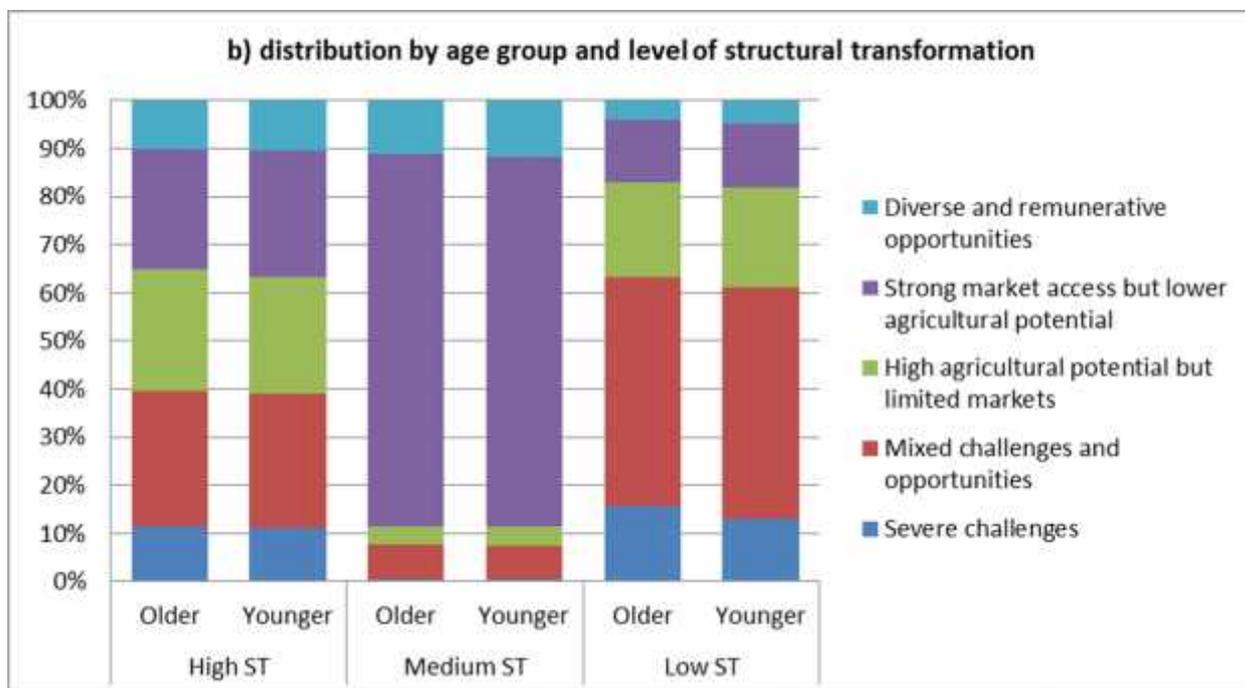
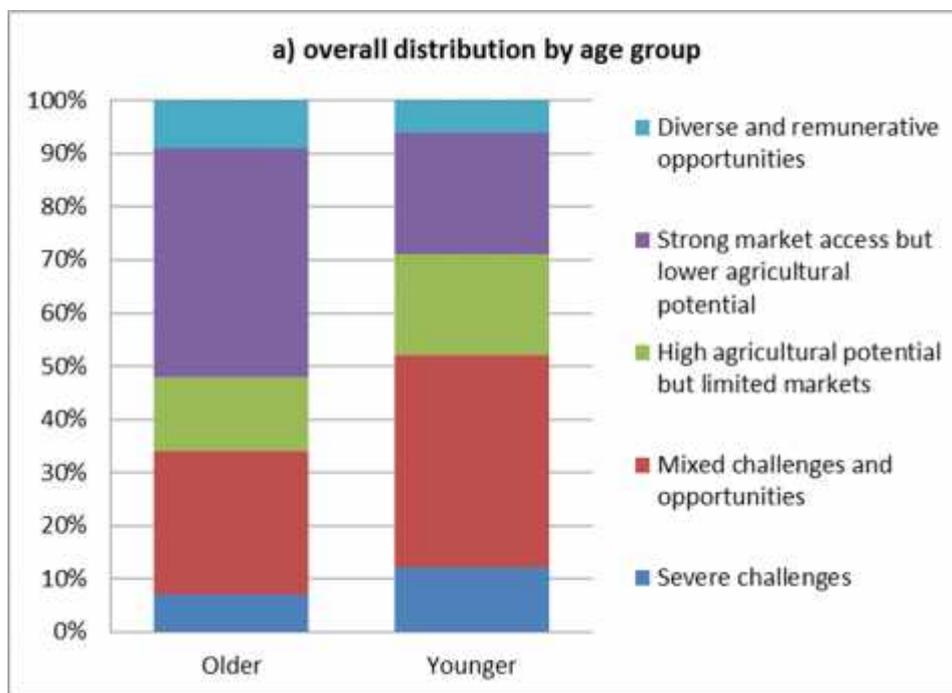
Even though groups with severe and mixed challenges are least prevalent in the countries with lowest income levels, 2 million youth in Afghanistan face severe challenges in their ROS – the largest country prevalence in this group, at 36 per cent. Regionally, the mixed challenges group is most prevalent in Africa: eight of the top 10 countries in terms of prevalence of youth with mixed challenges are in SSA. In the “diverse opportunities” space, six out of the 10 countries with the highest proportions of youth are in Asia. Nearly half of all rural youth – the largest group – enjoy high agricultural potential, but have limited access to markets. This type of youth dominates African economies: seven of the top 10 countries in this group are in Africa. Only 9 per cent of the developing world’s rural youth live in spaces with strong market access but poor agricultural potential. Put another way, it is rare to see non-urban dense populations of people living in areas of low and medium productive potential. This pattern again reflects historical settlement of migrating populations in areas of high farming potential. Regionally, although the top three countries with highest prevalence are in the Near East and Central Asia, Latin America has five of the top 10 countries. Most LAC countries are among the wealthiest in our group of countries with high urbanization rates, which could explain their dominance in this group with the highest commercialization potential. Zooming in to household-level characteristics, we find that the majority of mostly younger households in our household sample is found in the mixed challenges and opportunities space (figure 4a).¹² Comparing household location in the ROS within group of transformation level does not reveal any difference between younger and older households (figure 4b). In our sample of 12 countries, households are relatively evenly distributed across the ROS categories of mixed challenges, high agricultural but low commercial potential, and high commercial but low agricultural potential, in the high-transformation countries of Mexico and Peru. Bangladesh and Nicaragua (medium structural transformation group) host most households in areas of high population density but low agricultural potential, whereas in the countries with lowest levels of transformation (mostly in SSA) relatively more households live in areas of mixed or severe challenges than in other country groups. These findings underline the importance of a spatially explicit focus to policies and investments to improve youth inclusion in rural transformation.

¹¹ Table A.10 in Appendix A presents the data for each country from which the results are drawn.

¹² Table A.9 in Appendix A compares how rural youth in the sample of 12 countries are distributed across the rural opportunity space with the distribution using global data about all low- and middle-income countries.

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Figure 4. Prevalence of mostly younger and older households across the rural opportunity space categories: a) overall distribution by age group; b) distribution by age group and level of structural transformation



ST, structural transformation.

Source: Authors' calculation based on household survey data from 12 countries using population weights.

4.2 How do younger households fare and how does this depend on where they live?

The ROS combines two elements of opportunity: commercialization potential and agricultural potential. To understand which of these has the larger impact on young households' welfare, we first present summary statistics of welfare outcomes for younger and older households within the ROS and then estimate the determinants of the probability of being poor and per capita expenditures, contrasting younger and older households. Table 4 presents the summary statistics of welfare outcomes for younger and older households within the ROS. As expected, households in the severe challenges space are poorest, followed by areas with mixed challenges and opportunities. Areas with high agricultural potential but limited markets show a mixed picture. Disaggregated by the level of structural transformation (see table A.2 in appendix), this ROS category has the highest rates of poverty in countries with high levels of transformation, even higher than areas of severe or mixed challenges. In countries with medium and low transformation levels, poverty rates are lower and expenditure is higher in areas of high agricultural potential than in areas of severe or mixed challenges, as one would expect. In the full sample across all categories of the ROS, younger households are significantly poorer than older households and ROSs with higher commercialization potential are associated with relatively lower poverty rates and higher expenditures.

Table 4. Summary statistics of welfare outcomes for younger and older households within the rural opportunity space categories

ROS categories	Poor (\$1.90 per capita per day in 2011 international PPP dollars)			Daily per capita expenditure (2011 international PPP dollars)		
	Younger households	Older households	Difference in means	Younger households	Older households	Difference in means
Severe challenges	0.51	0.44	0.07**	2.42	2.88	-0.46***
Mixed challenges and opportunities	0.49	0.31	0.18***	2.73	3.73	-1.00***
High agricultural potential but limited markets	0.40	0.26	0.14***	2.85	3.80	-0.94***
Strong market access but lower agricultural potential	0.19	0.12	0.07***	3.98	4.65	-0.68***
Diverse and remunerative opportunities	0.16	0.11	0.05**	3.96	4.46	-0.49**

PPP, purchasing power parity.

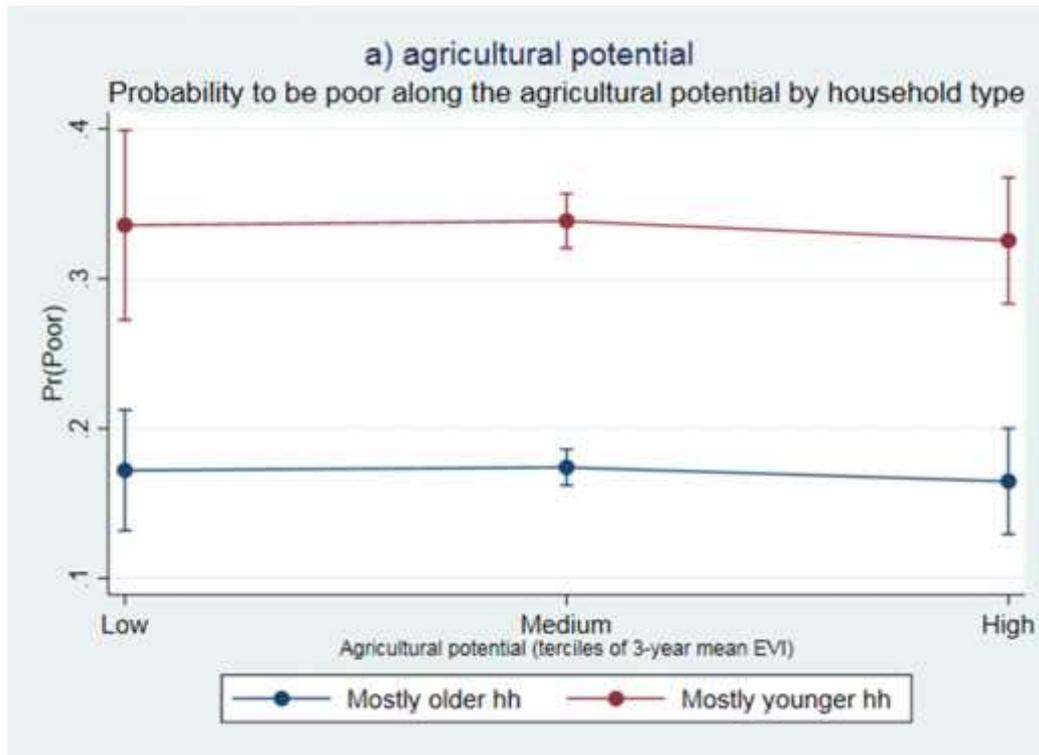
***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Population-weighted means.

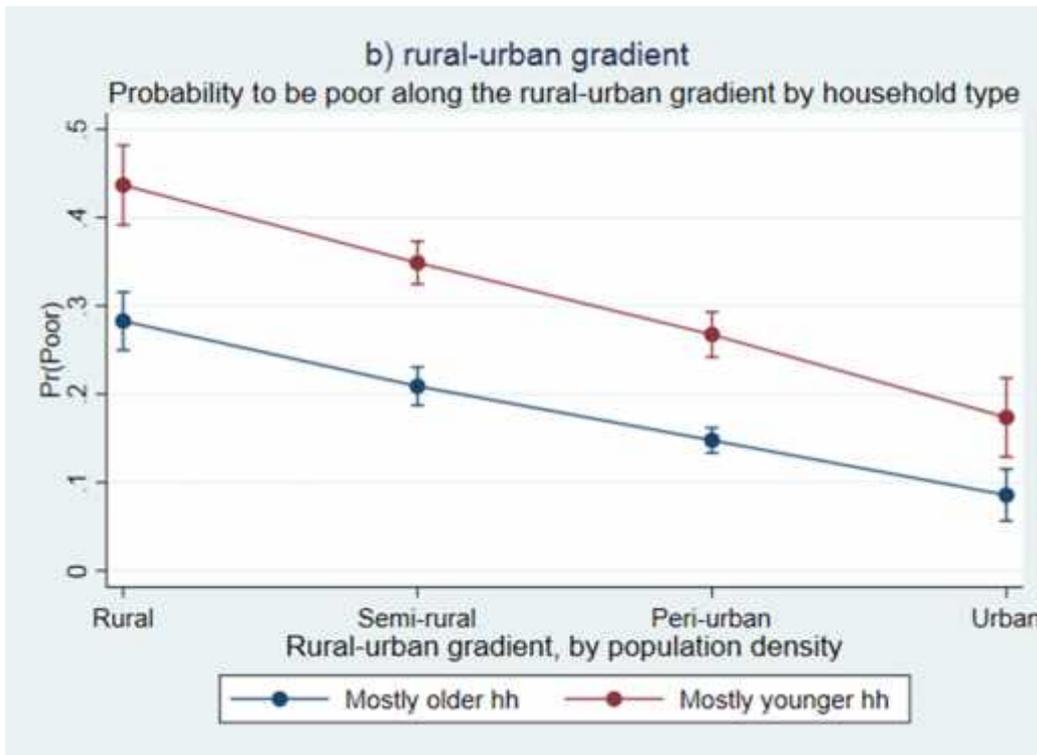
The models in equation (1) allow us to assess the statistical differences between the determinants of welfare for younger and older households. We present predicted probabilities and marginal effects in what follows for a better illustration, while table A.3 in the appendix presents full regression results. Young households display significantly lower levels of expenditure, and they have higher poverty incidence, although this is not significant in the overall regression. Moving up along the rural-urban gradient, which corresponds to an increase in commercialization potential, significantly and largely increases welfare outcomes whereas increases in agricultural potential have a much weaker effect.

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Young households face similar levels of poverty probabilities in areas with the lowest potential on both dimensions of the ROS (figure 5). However, the decline is much larger as commercialization potential (figure 5a) increases compared with agricultural potential (figure 5b).

Figure 5. Predicted probabilities of being poor for younger and older households depending on their location along the axes of the rural opportunity space: (a) agricultural potential; (b) commercialization potential





Notes: Predicted probabilities with confidence intervals from probit regressions as specified in equation (1). Regression results are presented in table A.3. Controls are the agricultural potential, commercialization potential, proportion of secondary schooling among working-age household members, whether the household head is female, interaction of the young household dummy with these covariates and country dummies.

Regional differences not presented here show that, in African countries, the predicted probability of being poor for young households is on average 42 per cent in rural hinterland areas, falling drastically to 9 per cent in urban areas, an almost fivefold decline. In Asia, the decline from rural to urban areas is around eight times and in LAC three times, but in both regions at much lower levels of poverty than in Africa. Although the interaction variables between the ROS and young household indicator by themselves are not significant in the regression, the combined effect of being a mostly younger household and location is expected to be significant, as the confidence intervals in the figures 5 a) and b) above indicate. Thus, we take the total derivatives of being a young household in a specific category of the commercialization potential and we predict the marginal effects at the means for the full sample as well as for each structural transformation group (table 5). We find that young households' welfare outcomes differ significantly across levels of structural transformation of the national economy. The overall disadvantage of being a mostly younger household compared with a mostly older household is largest in least transformed countries, with an expenditure gap of 46 per cent in rural hinterland areas falling to 16 per cent in urban areas. In the most transformed countries of our sample, the young household penalty is insignificant in every category. In the middle ground, younger households are significantly disadvantaged but the gap in rural and semirural areas is less than half of the gap in the least transformed countries, yet it is similar in the peri-urban and urban areas.

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Table 5. Marginal effects of being a young household, by level of structural transformation (ST) and rural-urban gradient

Level of structural transformation	Rural and young	Semirural and young	Peri-urban and young	Urban and young
% decrease in income (expenditure per capita)				
ST high	26	19	21	17
ST medium	14***	18***	27***	15***
ST low	46***	37***	26***	16***
Full sample	28***	26***	23***	16***
Percentage point difference in probability of being poor				
ST high	0	-1	0	-1
ST medium	-14***	-12***	3	-11***
ST low	30***	35***	35***	38***
Full sample	15	18**	16*	15

Notes: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Marginal effects are computed from separate regressions of younger and older households. Changes are computed based on marginal effect at the mean of being a mostly younger household and living in a rural, semirural, peri-urban or urban area, holding all other variables constant. Other controls are the agricultural potential, commercialization potential, proportion of secondary schooling among working-age household members, whether the household head is female and country dummies.

These patterns are somewhat different with regard to the likelihood of being poor (lower panel of table 5). It appears that younger households are overall significantly more likely to be poor than older households, yet with little variation across rural-urban categories but a stark difference between levels of transformation. Similarly to the case for expenditure, there is no significant young household penalty in any category of the rural-urban gradient in the most transformed countries. The countries with a medium level of transformation include Nicaragua and Bangladesh, which have very different population densities and poverty levels, hence when combined in poverty analysis using the international poverty line they reveal a surprising penalty for older households even though younger households were disadvantaged in terms of expenditure. The least transformed countries show large and significant differences in poverty incidence between younger and older households, from 30 percentage points in rural to 38 percentage points in urban areas. While commercialization potential helps to reduce the income gap between younger and older households, it does not seem to be sufficient to lift younger households out of poverty in these countries. These results underline the importance of the overall development of the broader economy as well as investments in connectivity to address the livelihood challenges rural youth face.

4.3 Exploring potential correlates of welfare outcomes

The finding that younger households tend to have lower expenditures per capita and to be more likely to be poor than older households, especially in more remote areas, may be driven by a set of variables that capture the potentially differential access to productive assets and livelihood options. In this subsection, we explore the roles of education, land ownership, credit access, income diversification and commercialization in driving welfare outcomes (see summary statistics in table 3). One important driver of welfare outcomes is education, and especially secondary education is promising high returns

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in developing countries (Shimeles, 2016). Having more economically active members with secondary schooling is thus expected to improve household welfare. The average proportion of working-age household members with secondary schooling in our sample is 0.29 for younger and 0.37 for older households, indicating a disadvantage for younger households. To test the effect of increasing secondary schooling, we run separate regressions for only younger or only older households and estimate the percentage point change in per capita expenditure and poverty incidence of adding one more working-age member with secondary education (table 6). Overall, it seems that older households gain relatively more than younger households from secondary education in terms of per capita expenditure increase, with the exception of households in most transformed countries. This indicates other constraints and challenges for younger households to realize their potential aside from education. By level of transformation, the largest increases in per capita expenditure could be found in the sample of countries with medium and low levels of transformation. Within countries, expenditure gains from education are estimated to be largest in semirural and peri-urban areas; less so in very remote areas, especially for younger households.

Table 6. Increasing the number of working-age household members with secondary schooling by one person: changes in expenditure and poverty

		Full sample	Rural-urban gradient				By level of structural transformation		
			Rural	Semirural	Peri-urban	Urban	High	Medium	Low
Percentage point change in expenditure	Younger households	23***	16**	25***	24***	19***	25**	36*	21**
	Older households	34***	29***	31***	36***	22***	20**	46**	31***
	<i>Difference</i>	-10	-13	-6	-12	-4	5	-10	-10
Percentage point change in poverty incidence	Younger households	-7***	-9***	-10***	-5***	-2***	-4***	-6***	-9***
	Older households	-6***	-10***	-9***	-5***	-2***	-3***	-1***	-12***
	<i>Difference</i>	-1	1	-1	0	0	-1	-6	2

Notes: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Changes are computed based on marginal effect of increasing proportion of working-age household members with schooling from the mean to the proportion that reflects one more working-age person with secondary schooling in the household, holding all other variables constant. Regressions are run separately for younger and older households. Other controls are the agricultural potential, commercialization potential and whether the household head is female.

In contrast, the decline in poverty incidence due to more education appears to affect younger and older households equally across the rural-urban gradient. The effect is largest in the least transformed countries and in the most remote areas. Having one more working-age member with secondary education would reduce the likelihood of being poor by 9 or 12 percentage points for younger or older households respectively in the least transformed countries. In the most remote areas poverty is relatively high (above 50 per cent for younger households) and having one more household member with secondary schooling is associated with a 9 percentage point decline in the likelihood of being a poor household. These results point to the potential returns to education in these areas, even though in the most remote areas opportunities to realize these returns might be sparse, which these results do not take into account.

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Younger households may also face greater constraints on accessing land to farm, especially during the demographic transition phase, during which age of inheritance is delayed by low death rates but the birth rates remain high (Stecklov and Menashe-Oren, 2019) and in places where land markets are constrained with little rental activity (Kwame Yeboah et al., 2019). More remote areas present other challenges due to lack of connections to markets (e.g. for outputs or credit) and other livelihood opportunities. Table 7 presents the prevalence of land ownership, credit access and income shares from farming and farm sales by country group and household category, revealing interesting patterns.

Table 7. Land ownership, access to credit and income sources of younger and older households by level of transformation

Household characteristics	Younger households	Older households	Difference in means
	High ST		
Land ownership, dummy	0.18	0.08	0.10***
Land per capita, in hectare (for those owning)	0.58	0.82	-0.24***
Household has received any credit, dummy	0.33	0.34	-0.01
Farming share of total income	0.07	0.04	0.03***
Share of sales in own farm income	0.30	0.27	0.03***
	Medium ST		
Land ownership, dummy	0.39	0.45	-0.06***
Land per capita, in hectare (for those owning)	0.14	0.18	-0.04**
Household has received any credit, dummy	0.35	0.28	0.07***
Farming share of total income	0.23	0.25	-0.02**
Share of sales in own farm income	0.37	0.36	0.01
	Low ST		
Land ownership, dummy	0.75	0.44	0.32***
Land per capita, in hectare (for those owning)	0.24	0.19	0.05***
Household has received any credit, dummy	0.20	0.19	0.01
Farming share of total income	0.50	0.30	0.20***
Share of sales in own farm income	0.29	0.32	-0.02**

ST: structural transformation

Notes: Authors' calculation based on household survey data from 12 countries. ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Population-weighted means. Information on land area is not available for Mexico. Information on credit availability is not available for Nicaragua and Peru.

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Younger households are more likely to own land than older households in all country groups but the medium-level countries, where they are 6 percentage points less likely to own land. Overall, land ownership is very low in the most transformed (Latin American) sample, as land consolidation and movement out of agriculture are highly correlated with structural transformation. The gap between younger and older households in terms of size of the land owned relative to household size, in contrast, is strikingly large in these transformed economies. While relatively more younger households own land, older households own on average 0.24 hectares more than younger households in per capita terms. Within the ROS presented in table A.4 in the appendix, this gap is primarily found in spaces with mixed challenges and opportunities, but also in those with high agricultural potential, putting younger households at a disadvantage in making the most of the most productive land in these otherwise relatively rich economies. In the least transformed countries, younger households do not seem to face a disadvantage in accessing land independent of their position within the ROS (see appendix table A.4).

There is no indication of a disadvantage for younger households in accessing credit, but credit access is very low (around 20 per cent) in the least transformed countries, whereas a third of households in the other two regions have received credit. In terms of the importance of farming for income generation, only a few households in the most transformed countries appear to depend on farming as their primary income source, as one would expect in these economies. In mid-level transformed economies, farming comprises around a quarter of household income, for younger and for older households. In the low-transformation countries, younger households' income depends significantly on farming, with 50 per cent of income compared with 30 per cent for older households, but both household types commercialize their products, with around 30 per cent of their farm income generated through sales. In the high-transformation countries, households that have a farm sell similar proportions. In the medium-transformation countries, younger and older farming households alike gain almost 40 per cent of their farm income from sales, pointing to a higher commercialization potential including in areas with agricultural potential.

Along the rural-urban gradient, table 8 confirms expected patterns. Land ownership is most common in rural areas, more so among younger households, but they own smaller areas. Land size declines with population density, while access to credit increases with it. Farming contributes most to incomes in rural areas, especially for younger households, but still comprises a quarter of household incomes in peri-urban areas. Interestingly, the proportion of farm income coming from sales is around a third in rural, semirural and peri-urban areas, with a small difference between younger and older households, although there is a slightly higher proportion of farm income from sales in peri-urban than rural areas. This finding, combined with the observation that the proportion of total income from farming is much lower in these areas, suggests that improvements in connectivity over the ROS mostly explain income diversification rather than farm commercialization.¹³ While farming appears to contribute an important proportion of younger households' income, they do not seem to be able to achieve high income from it, potentially because of the lack of connectivity.

¹³ Note that table 8 does not differentiate between processed and non-processed farm sales, and that processing of farm produce is found to be higher in secondary cities and small towns than in remote areas (Reardon, 2015).

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Table 8. Land ownership, access to credit and income sources of younger and older households by rural-urban gradient

Household characteristics	Younger households	Older households	Difference in means
	Rural hinterland		
Land ownership, dummy	0.83	0.58	0.25***
Land per capita, in hectare (for those owning)	0.40	0.53	-0.14***
Household has received any credit, dummy	0.19	0.17	0.01
Farming share of total income	0.58	0.43	0.14***
Share of sales in own farm income	0.30	0.32	-0.02
	Semirural		
Land ownership, dummy	0.70	0.46	0.24***
Land per capita, in hectare (for those owning)	0.20	0.16	0.04***
Household has received any credit, dummy	0.22	0.20	0.02
Farming share of total income	0.46	0.32	0.14***
Share of sales in own farm income	0.29	0.33	-0.04***
	Peri-urban		
Land ownership, dummy	0.46	0.41	0.05***
Land per capita, in hectare (for those owning)	0.14	0.15	-0.01
Household has received any credit, dummy	0.30	0.28	0.02
Farming share of total income	0.25	0.23	0.02*
Proportion of sales in own farm income	0.34	0.36	-0.02

Notes: Authors' calculation based on household survey data from 12 countries. ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Population-weighted means. Information on land area is not available for Mexico. Information on credit availability is not available for Nicaragua and Peru.

5. Conclusion

Where do rural youth live, what challenges or opportunities do the areas where they live provide and how are these associated with welfare outcomes? The current policy debate around the youth challenge in developing countries lacks robust evidence addressing these questions. This study (resulting from extensive analytical work for the Rural Development Report 2019) offers such evidence at the global and household levels by drawing on innovative use of geo-spatial data combined with nationally representative household data from 12 countries. Conceptualizing youth's challenges and opportunities in the national, geographical and family contexts, we assess how these contexts shape rural (non-urban) youth's welfare outcomes. The level of structural transformation of the national economy is expected to broaden or narrow the opportunities for rural youth in more or less transformed countries respectively, resulting in lower or higher youth penalties in welfare outcomes. The level of commercialization and agricultural potential of a location within a country forms the ROS of rural youth, while the demographic structure of a household is expected to ease or complicate youth's transition into adulthood in older or younger households respectively.

By combining the results of our descriptive and regression analyses we provide a rich account of where rural youth live and how this shapes their welfare outcomes, highlighting the importance of a spatially disaggregated approach to policy prioritization to include them. The results indicate that connectivity (commercialization potential) and education play a significant role in poverty reduction for young households, which seem to fare worse overall than older households. The gaps between younger and older households and between less and more educated young households are starkest in the least transformed countries, of which the majority are in sub-Saharan Africa.

These findings point to heterogeneity in investment priorities depending on the level of transformation of a country and the opportunity space rural youth live in within the country. As discussed extensively in the RDR 2019 (IFAD, 2019) and supported by the results of this paper, countries with low levels of transformation should focus on improving fundamental capabilities in rural areas, among them especially infrastructure and education to improve youth livelihoods and enable rural transformation. More transformed economies face the challenge of ensuring that the transformation of their rural areas does not lag behind and is inclusive of rural youth, avoiding pockets of poverty.

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Appendix A

Table A.1. Non-agricultural percentage of GDP in 12 study countries

Country	Non-agricultural percentage of GDP
Bangladesh	85
Cambodia	73
Ethiopia	63
Malawi	72
Mexico	96
Nepal	67
Nicaragua	83
Niger	59
Nigeria	79
Peru	92
Tanzania	68
Uganda	74

Note: The tercile thresholds are 78 per cent and 89 per cent.

Data source: World Development Indicators

Table A.2. Poverty incidence and expenditure of younger and older households within the rural opportunity space, by level of structural transformation

Rural opportunity space	Poor (\$1.90 per capita per day in 2011 international PPP dollars)			Daily per capita expenditure (2011 international PPP dollars)		
	Younger households	Older households	Difference in means	Younger households	Older households	Difference in means
	High ST					
Severe challenges	0.11	0.13	-0.02	4.67	4.89	-0.22*
Mixed challenges and opportunities	0.12	0.09	0.03***	5.04	5.85	-0.81***
High agricultural potential but limited markets	0.26	0.24	0.03*	3.87	4.06	-0.20*
Strong market access but lower agricultural potential	0.08	0.07	0.02*	6.25	6.54	-0.30
Diverse and remunerative opportunities	0.17	0.13	0.04	4.50	4.75	-0.25
	Medium ST ^a					
Severe challenges	0.00	0.03	-0.03	6.13	7.14	-1.02
Mixed challenges and opportunities	0.10	0.11	-0.01	4.00	5.38	-1.37***
High agricultural potential but limited markets	0.01	0.03	-0.02	4.24	6.06	-1.82***
Strong market access but lower agricultural potential	0.14	0.09	0.04***	3.48	4.23	-0.75***
Diverse and remunerative opportunities	0.09	0.08	0.01	3.44	4.34	-0.90***
	Low ST					
Severe challenges	0.58	0.53	0.05	2.02	2.21	-0.19
Mixed challenges and opportunities	0.54	0.37	0.17***	2.41	3.14	-0.73***
High agricultural potential but limited markets	0.45	0.31	0.15***	2.54	3.27	-0.73***
Strong market access but lower agricultural potential	0.33	0.21	0.11***	3.70	5.15	-1.44**
Diverse and remunerative opportunities	0.19	0.15	0.04	4.00	4.44	-0.44

PPP, purchasing power parity; ST, structural transformation.

***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Point estimates are population means.

a, This group is formed of only two countries, of which one does not have any population categorized as living in areas with severe challenges (Bangladesh), so that the values presented for this category come from Nicaragua only.

Table A.3. Welfare regressions: expenditure and poverty regressed on the two variables of the rural opportunity space and household characteristics

Right-hand side variables	Per capita expenditure		Poor (dummy)	
	Coef.	S.E.	Coef.	S.E.
Young household (dummy)	-0.059***	0.016	0.036	0.025
<i>Commercialization potential (Base = Urban)</i>				
Rural	-0.507***	0.046	0.231***	0.034
Semirural	-0.348***	0.053	0.152***	0.026
Peri-urban	-0.193***	0.047	0.081***	0.021
Agricultural potential (3-year mean EVI)	-0.034	0.234	-0.042	0.170
Share of adults with secondary education	0.006***	0.001	-0.003***	0.000
Female household head	0.091***	0.019	-0.052***	0.014
Young household*Rural	-0.006	0.049	-0.002	0.043
Young household*Semirural	-0.062	0.034	0.031	0.025
Young household*Peri-urban	-0.017	0.025	0.007	0.026
Young household*Ag. potential	-0.016	0.144	-0.065	0.048
Young household*Secondary education	-0.001	0.001	0.001	0.000
Young household*Female household head	-0.009	0.035	0.022***	0.006
Constant	1.267***	0.088		
Country dummies	Yes		Yes	
Number of observations	79 360		79 472	
Adjusted R^2	0.430			

Notes: Per capita regression is ordinary least squares, poverty regression a probit estimation, and in both cases standard errors were clustered at country level and population weights applied.

***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.

Coef., coefficient; S.E., standard error.

Table A.4. Land ownership of younger and older households within the rural opportunity space, by level of transformation

Rural opportunity space	Land ownership, dummy			Land per capita, in hectare		
	Younger households	Older households	Difference in means	Younger households	Older households	Difference in means
	High ST					
Severe challenges	0.44	0.27	0.17***	0.62	0.38	0.24***
Mixed challenges and opportunities	0.34	0.19	0.16***	0.30	0.51	-0.20**
High agricultural potential but limited markets	0.57	0.39	0.18***	0.95	1.46	-0.50***
Strong market access but lower agricultural potential	0.07	0.04	0.03***	0.31	0.53	-0.23
Diverse and remunerative opportunities	0.19	0.14	0.05*	0.21	0.00	0.21
	Medium ST					
Severe challenges	0.38	0.23	0.15	11.27	2.00	9.27
Mixed challenges and opportunities	0.40	0.34	0.05	0.70	1.19	-0.50**
High agricultural potential but limited markets	0.39	0.31	0.08	0.43	0.61	-0.19
Strong market access but lower agricultural potential	0.44	0.52	-0.09***	0.10	0.12	-0.02***
Diverse and remunerative opportunities	0.41	0.48	-0.07*	0.10	0.14	-0.04*
	Low ST					
Severe challenges	0.88	0.71	0.17***	0.36	0.33	0.04
Mixed challenges and opportunities	0.80	0.53	0.28***	0.25	0.18	0.08***
High agricultural potential but limited markets	0.86	0.66	0.20***	0.22	0.18	0.04*
Strong market access but lower agricultural potential	0.64	0.33	0.31***	0.09	0.11	-0.02
Diverse and remunerative opportunities	0.74	0.46	0.28***	0.13	0.13	0.00

***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$. Point estimates are population means.

ST, structural transformation.

Table A.5. Population density thresholds and resulting average population density to define the categories of the rural-urban gradient from global WorldPop data.

	Pop. Density Threshold (1,000 people per sqkm)	Average population density
Rural	<=0.16	0.05
Semi-rural	>0.16 & <=0.58	0.32
Peri-Urban	>0.58 & <=2.39	1.20
Urban	>2.39	7.56

Table A.6. Distribution of youth: world quartiles compared to administrative rural definition by region.

		Population density based rural-urban gradient			
		Rural	Semi-Rural	Peri-Urban	Urban
LAC	Urban	7.18	9.76	22.46	60.60
	Rural	68.52	22.46	8.66	0.36
SSA	Urban	6.90	36.25	26.83	30.03
	Rural	45.95	35.36	15.40	3.28
APR	Urban	0.15	4.05	45.22	50.58
	Rural	7.61	16.46	70.53	5.40

Table A.7. Data sources for household level data.

Country	Survey Name	Source	Year	Geo-locations
Sub-Saharan Africa				
Ethiopia	Ethiopian Socioeconomic Survey	Central Statistical Agency of Ethiopia - CSA	2015/2016	Enumeration Areas (EA) geocoded
Malawi	Fourth Integrated Household Survey	National Statistical Office (NSO) - Ministry of Economic Planning and Development (MoEPD)	2016/2017	EAs geocoded
Niger	National Survey on Household Living Conditions on Agriculture - Panel	Survey and Census Division - National Institute of Statistics	2014	EAs geocoded
Nigeria	General Household Survey- Panel	National Bureau of Statistics (NBS) - Federal Government of Nigeria	2015/2016	EAs geocoded
Tanzania	National Panel Survey	National Bureau of Statistics - Ministry of Finance and Planning	2014/2015	EAs geocoded
Uganda	The Uganda National Panel Survey	Uganda Bureau of Statistics - Government of Uganda	2013/2014	EAs geocoded
Latin America				
Mexico	Encuesta nacional de ingresos y gastos de los hogares	Instituto Nacional de Estadística y Geografía, MEX-INEGI.40.202.03-ENIGH-2016-NS	2016	EAs geocoded
Nicaragua	Encuesta nacional de hogares sobre medición de nivel de vida	Instituto Nacional de Información de Desarrollo	2014	Municipality geocodes identified
Peru	Encuesta nacional del hogares 2016 (Anual) – Condiciones de vida y pobreza	Instituto Nacional de Estadística e Informática	2016	EAs geocoded
Asia				
Bangladesh	Household Income and Expenditure Survey	Bangladesh Bureau of Statistics - Ministry of Planning	2010	Upazila geocodes identified
Cambodia	Cambodia Socio-Economic Survey	National Institute of Statistics - Ministry of Planning	2014	Village geocodes identified
Nepal	Nepal Living Standards Survey	Central Bureau of Statistics - National Planning Commission Secretariat, Government of Nepal	2010	Village geocodes identified

Table A.8. Summary statistics by country.

Region	Asia			Latin America			Sub-Saharan Africa					
Country	Bangladesh	Cambodia	Nepal	Mexico	Nicaragua	Peru	Ethiopia	Malawi	Niger	Nigeria	Tanzania	Uganda
Observations (households)	6535	4521	3317	29652	3741	15444	2689	6944	1795	2470	1840	1041
Population represented	17465962	1278227	3154330	14170557	787705	3823407	10937562	2096040	1365475	15474244	5491722	454044 4
Share of population living along the rural-urban gradient												
<i>Rural</i>	0.01	0.21	0.24	0.14	0.69	0.34	0.49	0.23	0.64	0.19	0.55	0.26
<i>Semi-rural</i>	0.05	0.49	0.40	0.10	0.08	0.21	0.34	0.55	0.17	0.37	0.15	0.49
<i>Peri-urban</i>	0.76	0.20	0.23	0.21	0.06	0.13	0.12	0.13	0.14	0.27	0.12	0.16
<i>Urban</i>	0.18	0.09	0.13	0.55	0.17	0.31	0.05	0.08	0.06	0.17	0.18	0.09
Share of population living along agricultural potential (excl. those living in urban areas)												
<i>Low</i>	0.06	0.09	0.21	0.45	0.10	0.57	0.25	0.10	0.98	0.33	0.12	0.04
<i>Medium</i>	0.41	0.46	0.39	0.26	0.24	0.22	0.40	0.77	0.02	0.36	0.47	0.08
<i>High</i>	0.53	0.45	0.39	0.30	0.67	0.21	0.35	0.13	0.00	0.31	0.41	0.88
Number of youth in household	1.54	1.71	1.66	1.51	1.65	1.47	1.66	1.53	1.61	1.90	1.60	2.00
Number of working household members	1.56	3.19	3.18	2.14	2.41	2.53	2.93	2.84	3.13	3.23	2.89	3.54
Number of working youth household members	0.48	1.24	1.10	0.70	0.87	0.79	1.09	1.19	0.90	0.99	1.09	1.39

Region	Asia			Latin America			Sub-Saharan Africa					
Country	Bangladesh	Cambodia	Nepal	Mexico	Nicaragua	Peru	Ethiopia	Malawi	Niger	Nigeria	Tanzania	Uganda
Youth household head	0.04	0.05	0.07	0.09	0.09	0.05	0.07	0.18	0.04	0.02	0.11	0.05
Age of household head	46.71	48.70	46.89	46.30	46.38	48.82	47.10	41.73	47.32	53.52	43.46	48.15
Female household head	0.13	0.21	0.24	0.27	0.37	0.26	0.26	0.28	0.14	0.18	0.29	0.33
Share of working age household members with secondary schooling	0.09	0.20	0.19	0.75	0.51	0.61	0.10	0.14	0.08	0.47	0.12	0.16
Poor (\$1.90 per capita per day in 2011 PPP)	0.1	0.0	0.2	0.1	0.0	0.0	0.6	0.6	0.3	0.4	0.3	0.3
Daily per capita expenditure (in 2011 PPP)	4.11	7.31	3.06	5.51	7.93	8.38	1.81	2.13	3.19	3.28	3.79	3.20
Owns land	0.44	0.69	0.78	0.12	0.19	0.20	0.72	0.71	0.70	0.54	0.62	0.72
Land owned in hectare	0.23	1.02	0.48	0.00	2.92	0.56	0.95	0.43	3.84	0.48	1.49	0.88
Land owned per household member in hectare	0.11	0.31	0.12		3.15	0.63	0.24	0.14	0.79	0.13	0.40	0.19
Received credit	0.31	0.30	0.39	0.33			0.25	0.25	0.05	0.18	0.16	0.09
Share of income from farming	0.24	0.35	0.50	0.06	0.20	0.07	0.57	0.53	0.36	0.34	0.39	0.43
Share of farm income sold	0.37	0.38	0.36	0.24	0.23	0.41	0.27	0.19	0.19	0.29	0.35	0.35

Table A.9. Share of all youth within the Rural Opportunity Space, as represented by the 12 household surveys and by the global data set of 85 low and middle income countries.

	12 surveys	Global
Severe challenges	10%	4%
Mixed challenges and opp.	36%	20%
High ag. potential but limited markets	17%	43%
Strong market access but lower ag. potential	29%	9%
Diverse and remunerative opp.	7%	24%

Table A.10. Rural youth shares and population within the ROS at country level

Country	Youth population by ROS at country level					Rural youth at country level TOTAL
	Diverse opportunities	High agricultural potential	Strong market access	Mixed challenges	Severe challenges	
Afghanistan	210166	396710	250960	2797178	2034230	5689243
Algeria	616102	504554	2903309	2239063	342444	6605472
Azerbaijan	32272	679389	197483	525228	46720	1481091
Bangladesh	18931926	2536278	2119637	493924	29731	24111496
Belize	3077	20677	13598	10500	1994	49846
Benin	204413	664346	36868	116125	456	1022208
Bhutan	9149	154804	3085	7196	647	174881
Bolivia	41879	420357	493845	553842	677419	2187341
Brazil	232601	3416053	7206093	10036772	2721204	23612722
Burkina Faso	6471	236888	121490	2035188	36581	2436618
Burundi	829687	1082003	9101	10457	278	1931527
Cambodia	627927	2264921	49481	74337	7503	3024170
Cameroon	390362	1647091	216646	518411	2223	2774733
Central African Republic	72202	669684	4018	13106	280	759290
Chad	27362	274092	198207	1331044	75159	1905865
China	35366480	91705640	19998854	29932374	2649292	179652640
Colombia	287447	1720195	955777	1862456	326552	5152428
Costa Rica	53326	291093	171936	75557	2685	594598
Cote d'Ivoire	514271	2547074	64146	25341	1120	3151953
Democratic Republic of the Congo	845580	8480734	123871	67582	7515	9525282
Dominican Republic	103256	429829	349360	384669	35050	1302164
Ecuador	31063	192465	569728	943858	237574	1974688
Egypt	2427199	627816	890135	227249	164088	4336487
El Salvador	162180	427408	161586	210734	2852	964760
Equatorial Guinea	13038	119879	10170	17026	418	160530
Eritrea	169	1419	161136	426568	326129	915420
Ethiopia	1225621	6130253	916550	7509156	355277	16136857
Gambia	9580	44284	31196	117761	505	203325
Georgia	71319	299708	26018	42270	8828	448142
Ghana	1284611	1388173	331214	372842	5277	3382118
Guatemala	115246	812201	548629	1057648	27190	2560913
Guinea	107149	1100611	48625	101076	916	1358376
Guinea-Bissau	19719	192181	5410	20581	898	238788
Honduras	141288	670269	247346	691448	18670	1769021
India	72301464	91576632	5202874	25549552	931224	195561744

Country	Youth population by ROS at country level					Rural youth at country level TOTAL
	Diverse opportunities	High agricultural potential	Strong market access	Mixed challenges	Severe challenges	
Indonesia	15087535	16695277	408481	236514	29063	32456868
Iran	321974	1523821	1256647	7879547	6023107	17005096
Iraq	242699	435696	1524725	2799485	671984	5674590
Jordan	10943	50135	516490	367667	129165	1074400
Kazakhstan	39881	193786	376268	1810064	203445	2623444
Kenya	2633169	3477060	186470	1098911	79984	7475594
Kyrgyzstan	215263	178521	199074	344455	113871	1051184
Laos	70303	1043621	10229	14940	5418	1144511
Lesotho	0	1997	81344	411512	366	495219
Liberia	63649	553069	7440	3132	53	627343
Madagascar	30658	1791277	131117	1279254	4149	3236455
Malawi	204830	734185	383459	1871868	5966	3200308
Malaysia	443783	2099279	30605	18983	2680	2595331
Mali	3890	200821	143725	1389234	89735	1827405
Mauritania	0	249	54542	394454	100436	549681
Mexico	262336	2169381	5282843	4125938	2314798	14155296
Morocco	94974	373747	754300	2519310	396771	4139103
Mozambique	276563	3376338	171664	537826	5052	4367443
Myanmar	1629091	6146821	124893	599683	64825	8565313
Namibia	973	19490	97971	355075	20100	493609
Nepal	1477742	3196199	5918	51412	8910	4740182
Nicaragua	77400	413637	291088	493995	41720	1317840
Niger	0	1291	273460	1145962	203059	1623772
Nigeria	4038864	7561403	3405799	6746900	23214	21776180
Pakistan	5504903	12297474	947500	5694965	1744038	26188878
Paraguay	18546	240256	252435	481781	15300	1008318
Peru	2656	553915	702846	1137120	2159540	4556078
Philippines	4575359	7967001	154167	107556	9187	12813270
Republic of Congo	38616	365742	15154	19175	301	438988
Rwanda	860275	1098370	21919	21973	1375	2003912
Senegal	11513	231113	293255	1529147	13642	2078671
Sierra Leone	56897	744813	11009	15040	737	828496
Somalia	47992	60556	399043	526301	34960	1068852
South Africa	1198463	2167132	2885224	3529253	36051	9816123
Sri Lanka	873267	1569083	11249	16517	2054	2472170
Suriname	3069	27779	20159	18418	2905	72330
Swaziland	28347	148127	3688	57299	169	237629

Country	Youth population by ROS at country level					Rural youth at country level TOTAL
	Diverse opportunities	High agricultural potential	Strong market access	Mixed challenges	Severe challenges	
Tajikistan	188420	348348	110499	555435	155112	1357815
Tanzania	941118	6149127	287470	2430339	15865	9823918
Thailand	1626836	6882962	62176	82338	7080	8661390
Timor-Leste	53970	135388	1629	2267	51	193305
Togo	103769	427786	16768	149085	121	697530
Tunisia	45699	115541	543429	595408	84018	1384095
Turkey	1544052	5258666	1177370	4163935	151842	12295865
Turkmenistan	1695	12884	15312	447898	540719	1018507
Uganda	1451459	4167477	27017	75544	6745	5728242
Uzbekistan	6288	1559831	7076	2869414	1018872	5461480
Vietnam	6337506	6842430	423898	516410	52944	14173188
Zambia	67953	1232378	274024	770244	2582	2347180
Zimbabwe	48454	559935	445512	1303321	672	2357894

Appendix B

Methodological details for merging of global and household level data

1. Merging EVI and WorldPop data

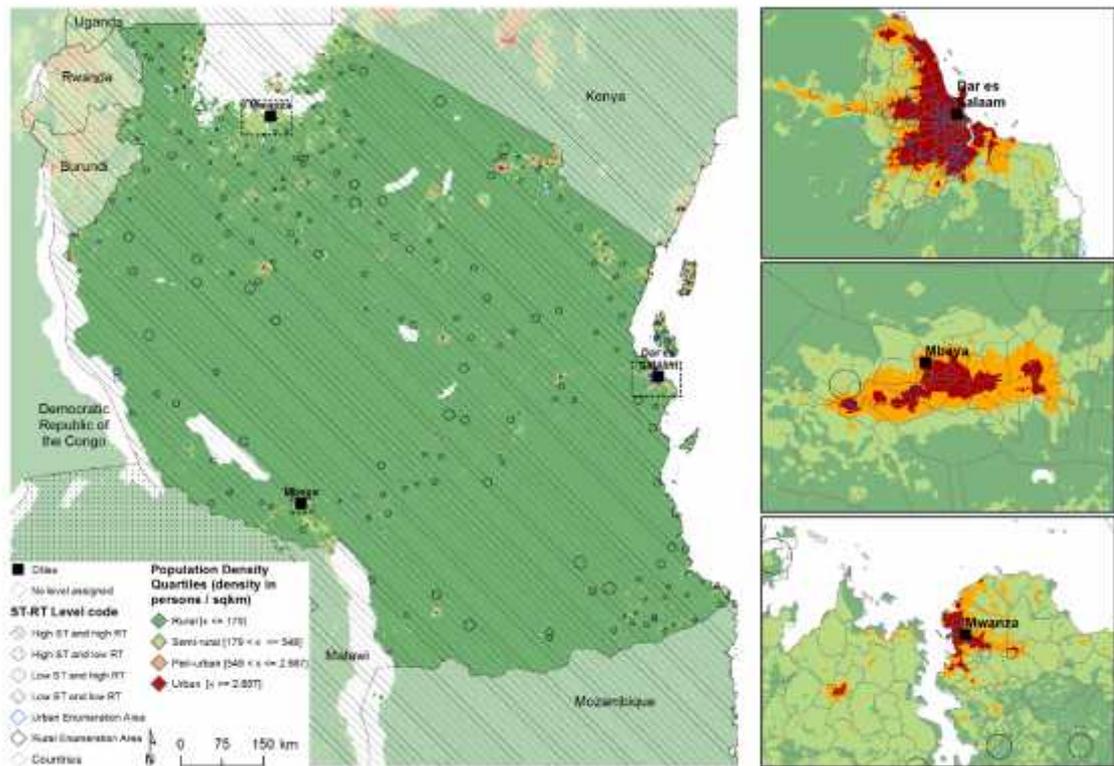
For the agricultural potential axis of the ROS, Moderate Resolution Imaging Spectroradiometer Enhanced Vegetation Index (MODIS EVI) grids were resampled from 250m resolution to 1km using a nearest neighbour algorithm to match the resolution of age-gender disaggregated WorldPop grids. EVI values were used only for land classified as cropland or pasture land. To do so, a new global map of cropland / pasture was created by fusing two existing maps (Waldner et al. 2016; GFSAD 2010). In doing so, the analysis was spatially targeted to agricultural land and production potential could be proxied for agricultural land. Finally, average EVI values for the 3-year period between 2013 and 2015 were calculated to avoid seasonality and agro-climatic variation. EVI grids (same as WorldPop grids) were ordered from lowest to highest, and each of the three groups (terciles) hold one-third of all non-urban space and represent the low, medium, and high agricultural potential categories on the horizontal axis.

2. Merging global EVI and WorldPop data with household survey data

Household data for Sub-Saharan Africa (SSA) come from the Living Standards Measurement Surveys - Integrated Surveys on Agriculture (LSMS-ISA) data, all of which provide geo-referenced information (i.e. the centroids) for each Enumeration Area (EA) in the sample. Using the number of dwellings and the average household size in each EA, the total population of the average EA in each country was calculated. Using the known population distribution from the WorldPop data, a boundary was then drawn around the EA centroid to capture a population of this size, which created "artificial EA boundaries." The population density of each EA was calculated and then classified along the categories of population density quartiles along the rural-urban gradient using the global threshold: Rural, Semi-Rural, Peri-Urban and Urban. The artificial boundaries created for each EA were also used to calculate the average value of the EVI for the 2013-2015 period (because most LSMS-ISA data were collected in 2014 or 2015) as described above. An example map of Tanzania of the resulting overlay of population density categories and artificial boundaries of enumeration areas is presented in below (Figure B.1).

For APR and LAC not all household data sources included geo-referenced information, therefore centroids of municipalities or other small administrative units were used and in some cases boundaries (polygons) for relatively small administrative areas from DIVA were used to repeat the process above to create the ROS variables for each household. For our purposes, we have included any data set with boundary data for an administrative unit whose average size is 1,000 square km or less. This was the case for Bangladesh (318 km²), Nepal (37 km²), Cambodia (115 km²) and Nicaragua (938km²).

Figure B.1. Map of Tanzania with enumeration areas and rural-urban gradient categorization of grids



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