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Youth and Adult Agrifood System Employment in Developing Regions: Rural (Peri-urban to Hinterland) vs. Urban

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ABSTRACT *Using a unique dataset covering 178,794 households with 460,654 individuals spanning Africa, Asia, and Latin America, we explore employment of youths across rural zones (peri-urban, intermediate, hinterland) and urban areas. Using full-time equivalents (FTEs), we compare own-farming versus farm-wage labour, and nonfarm wage- and self-employment. Nonfarm includes: (a) agrifood system (AFS) jobs post-farmgate, in food processing, wholesale, logistics, retail, and food service; (b) non-AFS. Key findings are noted in order by Africa, Asia, and Latin America (whose youth employment rates are 61%, 39%, and 48%). (1) AFS shares in FTEs of employed rural youths are substantial (21%, 21%, and 23%). Wage employment share of AFS is lower in Africa (25%) versus Asia and Latin America (75%). (2) Own-farming in FTEs of employed rural youths are higher in Africa (51%, 19%, and 12%). The share for adults in Africa is 36%. Regressions show youths' being in school does not reduce employment in own-farming (they are compatible), but reduces nonfarm labour. (3) Farm-wage employment shares in FTEs are small (4%, 13%, and 16%). (4) Regressions show that rural youths' being in a peri-urban area sharply increases AFS and non-AFS employment compared with hinterland youths who depend more on own-farming.*

1. Introduction

The past two decades have seen an explosion of interest and policy debate on youth employment in developing regions, where nearly 90% of the global youth live (ILO, 2017). In Africa, fertility is high and income growth is low; Africans are worried about political, social, and economic consequences of a working age population that has become younger (African Development Bank, 2016; Filmer & Fox, 2014; IDRC, 2015; World Bank, 2018). In Asia, youths' share of the working age population has stabilised and is declining, but the share of youths who are not employed nor in school is rising (World Bank, 2018). In most of Latin America, the workforce is ageing but youth unemployment remains high (Fox & Kaul, 2018).

Youth employment has been treated in two literatures. The first literature can be termed 'youth labour economics' (Filmer & Fox, 2014; Fox, Senbet, & Simbanegavi, 2016; O'Higgins, 2003). Fox and Kaul (2018) noted that most research and policy debate in this literature has focused on youth's participation in the formal wage sector and has rarely (with a few exceptions such as Filmer & Fox, 2014; Fox & Thomas, 2016) treated participation in the informal sector or agriculture. The formal wage sector emphasis has focused this literature on urban areas (as there is little formal wage

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employment in rural areas), despite more than half of the youth population in developing countries' living in rural areas.

The second literature treating youth employment is that on RNFE (rural nonfarm employment; for example, Barrett, Reardon, & Webb, 2001; Davis, Di Giuseppe, & Zezza, 2017; Davis et al., 2010; Haggblade, Hazell, & Reardon, 2007; Reardon, 1997; Reardon, Delgado, & Matlon, 1992). RNFE studies analysed off-farm employment in manufacturing and services, mostly in the informal sector, with differentiation by gender and subsector. RNFE accounts for a third to a half of rural incomes in developing regions, averaging 45% (Haggblade, Hazell, & Reardon, 2007). RNFE studies disaggregated rural areas by agroecological level and distance from cities, but has seldom treated youth employment per se.

The RNFE literature has highlighted the importance of employment generated by production linkages with agriculture, in particular, the postfarm segments of the AFS (the agrifood system) including food processing, wholesale, logistics, retail, and food service (Haggblade, Hazell, & Reardon, 2007). That dovetails with increasing attention to the rapid development and transformation of the AFS in Africa, Asia, and Latin America (Reardon, Delgado, & Matlon, 2019). However, the RNFE literature has not distinguished youth versus adult employment in AFS activities in rural areas, let alone urban areas.

In sum, the youth labour economics and RNFE literatures have left two important gaps which we address in this paper: (1) level and composition of youth employment in urban and rural areas, and in rural areas over peri-urban, intermediate, and hinterland zones, and in agroecologically favourable versus unfavourable rural areas; (2) youth employment in AFS employment compared with own-farm, farm-wage labour, and non-AFS nonfarm employment, over the spatial distinctions noted.

Much of the reference to employment in the policy debate cites the share of persons engaged in, or with primary employment in a sector such as own-farming. But comparisons of such measures with sectoral shares of income in rural areas of developing regions have shown a large empirical distance between the two measures. The main finding has been that the share of persons engaged in agriculture (own-farming) declaring it as primary employment, well exceeds its share in rural incomes (Haggblade, Hazell, & Reardon, 2007). We thus chose not to study the composition of youth employment with a measure of mere participation in various sectors, but instead to use a measurement of shares of total labour time the individual spends working in each of the sectors studied (own-farming, farm-wage labour, AFS employment, and non-AFS nonfarm employment), and in wage-employment versus self-employment in these sectors. It would have been ideal to use net incomes, but this proved intractable with our large array of data sets that had varying levels of reporting of gross revenues versus costs for activities. Thus, we used labour time in each sector and functional type (wage versus self-employment) measured in Full Time Equivalents (FTE). This allows us to calculate internationally comparable numbers on youth employment.

Moreover, we observe that much of the employment policy debate distinguishes simply between urban and rural areas. But the RNFE literature has shown that there is a lot of variation in household employment over different rural zones, such as near or far from cities which reflects infrastructural and population density differentiation, and thus different commercial and employment opportunities (Deichmann, Shilpi, & Vakis, 2009 for Bangladesh) and in different agroecological areas Reardon, Delgado, & Matlon, 1992; Reardon, Berdegué, & Escobar, 2001 for Africa and Latin America). One expects the latter from the intersectoral production linkages literature where favourable agroecological zones display strong production linkages between agriculture and nonfarm activities (including AFS activities) while poor agroecological zones have much less of such linkages (Haggblade, Hazell, & Reardon, 2007).

We thus expect youth employment to differ over urban and rural, and within rural, over different zones. In particular, we use data on population densities over survey areas to distinguish urban, peri-urban, intermediate, and hinterland zones (using a density classification of enumeration areas to map into zones along a 'rural-urban gradient' as laid out in Arslan, Tschirley, & Egger, 2020) as well as by agroecological zones (favourable and unfavourable).

Our data comprise the largest individual-level data set ever assembled for the analysis of youth employment, covering 460,654 working-age individuals in four age cohorts (early youth, later youth,

early adulthood, later adulthood) for males and females in 178,794 households in Africa, Asia, and Latin America.

The paper proceeds as follows. In section 2 we lay out definitions and data sources. In section 3 we present descriptive findings for labour force participation (LFP) and for composition of full time equivalents (FTEs) of individuals of all working age cohorts in all employment categories. We present our regression model in section 4, present the econometric results in section 5, and conclude in section 6.

2. Definitions and data

Employment in the agricultural sector consists of: (1) work on the family farm ('own-farm'); (2) farm-wage employment (hired by other farmers). Employment in the nonfarm sector consists of: (1) self-employment (in a home-or non-home based enterprise, consisting of the owner, hence self-employment, as well possibly as other family members or hired non-family members); (2) wage employment. These activities can be in the formal or informal sector, distinguished in theory by registration of the business, but in practice and in our data, not distinguished because the surveys did not indicate the legal status of the employing firm. Moreover, employment spans the sectors, from agriculture to non-agricultural or 'nonfarm', and within the latter, as defined in section 1, AFS versus non-AFS employment (with the latter in non-food related manufactures and services).

We analyse the composition of individuals' total time spent in employment in the following six categories:

(a) Own-farming
(b) Farm-wage
(c) (nonfarm) AFS wage
(d) (nonfarm) AFS self
(e) (nonfarm) Non-AFS wage
(f) (nonfarm) Non-AFS self

We analyse the time individuals in the labour force spend on an economic activity measured in Full Time Equivalents or FTEs. FTEs are calculated from the survey data as the amount of time that an individual works in an activity, relative to a standard benchmark of 40 h per week (FTE = 1.0). Working full time is assumed to be 12 months per year, 21 days per month, and 8 h per day. Someone who is not in the workforce has an FTE of zero,[1] while someone working half-time in an activity over the course of the past year would have an FTE of .5 for that activity.

We use the age range of 15–64 for the economically active population. We distinguish four age categories (older-adults, 35–64; younger-adults, 25–34; older-youths, 18–24; younger-youths, 15–17).

Our analysis is based on socioeconomic household surveys (LSMS in Africa and other national surveys in other regions) developed by national statistical services in 13 countries in: Africa (short for Sub-Saharan Africa), represented by Ethiopia, Malawi, Niger, Nigeria, Tanzania, and Uganda; Asia, represented by Bangladesh, Cambodia, Indonesia, and Nepal; and Latin America, represented by Mexico, Nicaragua, and Peru. These were selected for variation in country development and size[2] and by data availability. Table 1 shows the countries and the details of the survey data. With the exceptions of the Indonesia Family Life Survey (with a sample representing 83% of the population) and the Nicaragua National Household Living Standard Measurement Survey (rural households only), all the surveys are nationally representative and cover urban and rural areas. The regional descriptive statistics are population-weighted over countries; therefore countries with greater populations have a greater effect on the results.

The urban zone and the three rural zones (peri-urban, intermediate, and hinterland) used as the zones in this paper were derived as following. These zones are based on mapping households to four population density-based zones[3] created by Arslan, Tschirley, & Egger (2020) and termed by them a 'rural-urban gradient.' In

Table 1. Data sources and sample sizes

Region/ Country	Source	Year	N. of households
Africa			
Ethiopia	Ethiopian Socioeconomic Survey	2015/2016	4,954
Malawi	Fourth Integrated Household Survey	2016/2017	12,447
Niger	Second National Survey on the Living Conditions of Households and Agriculture	2014	3,617
Nigeria	General Household Survey- Panel	2015/2016	4,291
Tanzania	National Panel Survey	2014/2015	3,352
Uganda	The Uganda National Panel Survey	2013/2014	1,561
Asia			
Bangladesh	Household Income and Expenditure Survey	2010	12,240
Cambodia	Cambodia Socio-economic Survey	2014	12,090
Indonesia	Indonesia Family Life Survey	2014	15,881
Nepal	Nepal Living Standards Survey	2010	5,988
Latin America and the Caribbean			
Mexico	National Household Income and Expenditure Survey	2016	69,939
Nicaragua	National Household Living Standard Measurement Survey	2014	6,851
Peru	National Household Survey 2016 – Living Conditions and Poverty	2016	35,785

Africa, they drew artificial boundaries around the geo-referenced centroids for each Enumeration Area (EA) in the surveys. This captured the average EA population based on known densities from WorldPop.[4] In Asia and Latin America, the survey data do not include geo-referenced information, but the surveys provide centroids of municipalities/other small units with boundaries for relatively small administrative areas in DIVA-GIS.[5] They included (and thence we used) any data set with boundary data for an administrative unit whose average size is 1,000 square km or less. This size allowed the containing of the administrative unit within a circle of 50 km radius around the unit's centroid. The population densities of the study countries were divided into quartiles that correspond to the rural-urban gradients (our four zones). The densest quartile represents the urban zone. The rural areas are split into the second densest zone (peri-urban), the third most dense (intermediate), and the least dense (hinterland). Each EA or administrative unit has been classified into one of these four zones.

3. Descriptive statistics

3.1. Participation in the labour force

Labour force participation rates (LFPR) differ substantially across regions, gender, and youths versus adults. LFPR is the share of individuals of working age (15–64) who participated in the labour force at some point over the year recalled in the survey.

The LFPR of youths is 53% for three regions taken together, and 61% for Africa, 39% for Asia, and 48% for Latin America. Table 2 breaks LFPR down by cohort. The table shows that for the three regions taken together, most youth, especially the younger-youth (ages 15–17), remain outside of the labour force. Africa is an outlier, as 57 per cent of younger-youth were employed. LFPRs of older-youth are higher, although in all regions most young women are not employed.

Controlling for region and zone, LFPR rises fast from younger-youths to young-adults but levels off among older-adults. The initial two age-cohort LFPR increments are much higher for Asia and Latin America than for Africa.

For the three regions taken together the female LFPR of 53% is below males' 79%, a ratio of 1.5. The ratio in Asia (1.9 times) exceeds Africa's (1.2 times). Surprisingly, over age cohorts for the three regions taken together and by region the gender ratio is roughly the same. The lower female LFPR in

Table 2. Labour force participation rates

		Global			Africa			Asia			Latin America		
		Total	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females
All Ages	Total Sample	65	79	53	75	80	69	58	78	40	68	82	55
	Urban	60	73	48	58	65	52	57	73	42	66	79	55
	Rural	68	81	55	77	82	72	58	80	39	69	84	56
	Peri-Urban	57	78	38	68	74	63	52	79	28	67	82	54
	Intermediate	73	81	65	75	80	71	69	82	58	69	84	56
	Hinterland	79	88	71	83	89	77	74	83	65	72	87	57
ages 35–64	Total Sample	73	88	59	85	92	79	64	85	45	75	90	62
	Urban	67	83	53	73	84	62	62	79	45	74	89	60
	Rural	75	90	61	87	93	81	66	88	45	77	92	63
	Peri-Urban	66	89	45	84	90	79	60	88	33	75	90	62
	Intermediate	81	90	73	87	93	82	75	87	64	77	92	63
	Hinterland	84	93	76	88	96	82	78	86	71	79	94	66
ages 25–34	Total Sample	70	87	56	77	84	72	64	87	44	76	91	62
	Urban	69	85	55	62	74	55	66	84	50	77	91	64
	Rural	70	88	56	79	85	74	63	88	41	75	92	59
	Peri-Urban	61	85	40	69	74	65	56	88	31	76	93	60
	Intermediate	76	87	67	77	84	73	74	91	60	74	92	58
	Hinterland	82	92	74	86	93	80	77	89	66	74	92	58
ages 18–24	Total Sample	55	67	43	64	69	58	47	66	31	57	69	44
	Urban	48	57	39	43	45	40	47	58	36	53	63	44
	Rural	58	71	45	67	72	61	47	69	29	60	75	44
	Peri-Urban	45	65	28	53	59	46	40	66	19	56	71	42
	Intermediate	63	71	54	64	68	59	60	76	48	61	75	47
	Hinterland	73	82	64	78	83	71	66	78	57	62	80	44
ages 15–17	Total Sample	41	48	33	57	63	50	26	34	18	30	38	21
	Urban	21	26	15	26	30	22	20	26	14	18	24	13
	Rural	47	54	38	60	67	53	29	37	20	38	48	28
	Peri-Urban	29	38	19	46	53	39	21	31	9	30	38	22
	Intermediate	50	56	44	56	61	50	41	46	37	34	44	24
	Hinterland	66	74	57	73	79	65	51	56	46	48	59	36

Note: Calculations represent population weighted averages.

Asia in all age cohorts appears to reflect a lack of socially acceptable employment opportunities (Jacoby & Dasgupta, 2015). Female LFPR at all ages is lower in urban area and in rural areas, higher as one goes from peri-urban to hinterland areas. This correlation is sharpest in Asia.

For all regions and age cohorts taken together, the LFPR is similar between urban and peri-urban areas (around 60%) and then jumps to about 75% for the intermediate zone and to almost 80% for the hinterland. For age cohorts other than younger-youths, the share declines from urban to peri-urban and then increases towards intermediate and hinterland zones. For younger-youths the LFPR increases stepwise as one moves from urban areas to hinterland.

3.2. Shares of sectors in total FTEs

3.2.1. Overview of Employment by sector (own-farm, farm-wage labour, AFS, and non-AFS non-farm). Table 3 provides an overview of sectoral employment patterns. We order the findings by region and then importance of sectoral job sources to rural and urban youth and compare them with adults.

First, in Africa, employed rural youth spend 51% of their FTEs in own-farming – but only 4% on working in farm-wage labour. They spend 46% of their FTEs on nonfarm work (25% in non-AFS and 21% in AFS work). Youth employment is thus strikingly diversified beyond farming, and involves substantial time in AFS activities. Urban youth spend 88% of their FTEs on nonfarm work (59% in non-AFS and 29% in AFS). Rural adults are much less engaged (at only 36%) in own-farm employment compared with youths, and more engaged in rural nonfarm employment (at 61%) but are little different from youths in their engagement in AFS jobs (24%).

In Asia, rural youth spend only 19% of their FTEs in own-farming (40% of that of African youth) – but only 13% in farm-wage labour. The latter is a minor share, but thrice that of Africans, perhaps due to Asians having smaller farms, multi-season cropping, and greater rural landlessness compared with Africa. Rural youth employment is extremely diversified beyond the farm sector in Asia: they spend fully 68% of their FTEs in nonfarm work (like Africans 21% in AFS work, but twice the non-AFS share compared with Africans, at 47%, indicating much more diversified rural economies than in Africa). Urban youth spend 96% of their FTEs on nonfarm work (slightly more than Africans at 32% in AFS and 64% in non-AFS). Rural Asian adults are a little more engaged (at 28%) in own-farm employment than are youths, but both are much lower than in Africa probably due to smaller farms, more mechanisation, and more extensive off-farm opportunities. Rural adults also

Table 3. Shares of full time equivalents

		Total Sample			Africa			Asia			Latin America		
		Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
All Working Age	Own-farm	2	29	20	6	39	34	2	27	19	0	16	8
	Farm wage	2	9	7	1	3	3	2	13	9	1	12	6
	AFS (post-farm)	25	20	22	31	24	25	27	18	21	22	21	22
	Non-AFS	71	41	51	62	34	39	68	43	51	77	50	64
Adults	Own-farm	2	29	20	5	36	31	3	28	20	0	17	8
	Farm wage	2	9	7	1	3	3	2	13	9	1	11	6
	AFS (post-farm)	25	20	22	31	24	25	26	17	20	21	21	21
	Non-AFS	72	42	52	62	37	41	69	42	51	78	51	65
Youth	Own-farm	2	30	22	11	51	46	1	19	14	0	12	7
	Farm wage	1	10	7	1	4	3	2	13	9	1	16	9
	AFS (post-farm)	29	21	24	29	21	22	32	21	25	26	23	24
	Non-AFS	67	39	47	59	25	29	64	47	52	73	49	60

spend 13% of their labour in farm-wage labour (like the youths) and spend like youths 59% of their FTEs in nonfarm work, with a little lower share (17%) than youths in AFS jobs.

In Latin America, similar to Asians, rural youth depend little on farm sector jobs: they spend only 12% of their FTEs in own-farming – and only 16% in farm-wage labour. But like Africans and Asians, they spend 23% of their FTEs in AFS work, and like Asians (but twice that of Africans), they spend another 49% in non-AFS nonfarm jobs.

In sum, there is remarkable constancy at roughly one-quarter of rural youth FTEs spent in AFS employment in all three regions. In general, farm-wage labour has a small share in all three regions. The numbers that see-saw between Africa versus Asia and Latin America are: (1) a high share of dependence on own-farming for African youth (at half) while that is a fifth or less in the other regions; (2) nearly half of youth employment is in non-AFS nonfarm work in Asia and Latin America, versus only a quarter in Africa. These patterns make sense in a 'development continuum' where the rural economies of Asia and Latin America have diversified beyond farming much more than Africa, but the rural economies of all three regions have aggregated 'value added' activity to farming in roughly similar amounts which are reflected in youth activity in AFS. But even in Africa, the share of FTEs to own-farming is only a third for adults and half for youths, much less than the oft-cited figure of 80% of people 'in farming', that is, with farming as their declared principal activity.

Below we explore the sectoral patterns in more detail over age cohorts and rural zones, and add functional (wage versus self-employment) differentiation to the analysis.

3.2.2. On-Farm Employment across rural zones and age cohorts. As expected, the highest shares of own-farm employment for all ages within each region are in the hinterland zones, ranging from 32% (in Latin America) to 49% (in Asia) to 53% in Africa. The share falls rapidly in all regions from the hinterland zone to urban areas. However, the speed of the fall differs over age cohorts. For all three rural zones, there is a J-shaped curve from older-adults to younger-youths, with moderate shares among the oldest, dropping fast to younger-adults and older-youths and then sharply back up for younger-youths. This makes sense as own-farming is the easiest entry activity for the employed younger-youths in the rural areas, and older-adults tend to be the farm owners and work on their own farms.

For urban areas, the share of own-farm labour is very low for Asia and zero for Latin America. Interestingly there is a sharp J curve in Africa with urban younger-youths allocating around 17% of their FTEs to own-farming. These youths could be commuting to home villages (if their families are migrants) for the harvest or to farm areas near (or pockets inside) the urban areas. It may also indicate that for some youths it is hard to compete for low-skilled nonfarm jobs in the cities.

As noted above, farm-wage employment in total FTEs is very minor overall for all the regions, although the shares in Asia and Latin America are some four times that of Africa where it is only 3%. Table 4 shows that this holds over all age cohorts. For all ages taken together, the farm-wage labour shares in rural zones of Africa and Asia do not vary much over rural zones. However, in Asia, farm-wage labour is twice as important in the peri-urban zone compared with the hinterland and intermediate zones.

The results for youths make sense in all three regions given the low entry requirements and barriers to get a job in farm-wage labour, the least skilled job. In the hinterland zone, for Asia and Africa, there is an inverted U curve over ages for the farm-wage labour share. For Latin America, the share slowly rises from old to young with a jump up to older-youths and younger-youths. In the intermediate zones, in Asia and Africa, all ages have similar behaviour but there is a lower plateau for adults with a step up for youth. For Latin America there is similar pattern but a sharper step up for the younger-youths. For peri-urban areas, in Asia, there is a very shallow U curve and the shares are nearly twice those in Latin America (and seven times those in Africa).

Table 4. Shares of full time equivalents

		Total Sample				Urban				Rural				Rural Zones											
														Peri-Urban				Intermediate				Hinterland			
		Global	Africa	Asia	L.A.	Global	Africa	Asia	L.A.	Global	Africa	Asia	L.A.	Global	Africa	Asia	L.A.	Global	Africa	Asia	L.A.	Global	Africa	Asia	L.A.
All Ages	Own-farm	20	34	19	8	2	6	2	0	30	40	26	16	18	26	18	3	33	35	40	11	46	53	49	32
	Farm-wage	7	3	9	6	2	1	2	1	9	3	13	12	10	2	14	6	7	3	10	12	10	4	12	18
	AFS wage	10	5	12	13	16	11	17	16	8	4	10	11	11	5	12	16	5	4	5	11	4	4	3	6
	Non-AFS wage	34	20	34	52	53	36	48	64	25	16	27	38	32	25	30	51	24	18	24	40	15	9	17	24
	AFS self	11	20	9	8	10	20	10	6	12	20	8	10	11	21	8	10	14	21	8	12	13	18	8	9
	Non-AFS self	16	19	17	12	18	26	20	12	16	18	16	11	18	22	18	12	16	20	13	14	11	13	12	9
ages 35–64	Own-farm	22	33	23	10	3	7	3	0	33	40	32	20	21	26	23	5	37	35	47	14	49	52	56	38
	Farm-wage	7	2	9	6	1	1	2	1	9	3	13	11	11	2	14	6	7	3	10	11	9	3	10	16
	AFS wage	8	4	8	11	12	8	13	13	5	3	6	8	8	3	8	12	4	3	3	8	3	3	2	4
	Non-AFS wage	31	20	29	48	49	32	44	61	22	17	22	34	28	26	25	48	21	19	18	35	13	10	12	20
	AFS self	13	21	10	10	12	23	12	8	13	20	9	13	12	21	9	13	15	21	9	15	14	19	8	11
	Non-AFS self	19	20	20	15	22	29	25	16	17	18	18	14	20	23	20	15	17	19	13	17	12	13	12	10
ages 25–34	Own-farm	15	27	13	5	1	2	2	0	23	33	19	12	12	18	12	2	26	28	31	6	38	45	38	25
	Farm-wage	7	3	9	6	2	1	3	1	9	3	12	13	10	3	12	6	8	3	11	13	11	4	15	19
	AFS wage	13	6	14	15	18	14	19	17	9	5	12	13	14	7	15	18	6	5	6	12	5	4	4	8
	Non-AFS wage	39	22	39	58	57	43	51	69	30	17	33	45	37	28	35	57	28	19	30	48	19	11	22	31
	AFS self	11	21	8	5	7	18	8	4	13	22	8	7	10	22	8	6	15	23	8	8	14	21	8	8
	Non-AFS self	16	21	16	9	15	22	17	9	16	20	16	10	17	22	17	10	17	23	13	12	13	15	13	9
ages 18–24	Own-farm	19	41	13	5	2	10	1	0	27	46	18	10	14	35	11	1	30	41	28	6	45	59	41	21
	Farm-wage	7	3	9	8	1	1	2	1	10	4	12	15	10	2	13	7	8	4	11	13	12	5	13	24
	AFS wage	16	8	20	20	24	16	27	22	13	6	16	17	19	9	20	23	9	5	8	18	7	5	6	11
	Non-AFS wage	40	18	44	57	60	42	56	70	30	13	38	45	39	21	39	57	29	15	38	48	18	8	25	32
	AFS self	7	15	5	4	5	14	4	2	9	16	5	5	6	16	4	5	11	17	5	7	10	13	6	4
	Non-AFS self	10	15	11	6	9	18	10	5	11	15	11	7	11	16	12	6	14	18	10	8	9	10	8	6
ages 15–17	Own-farm	34	59	18	16	3	17	2	0	40	60	23	20	19	49	12	3	45	56	36	15	62	71	62	38
	Farm-wage	9	3	12	13	2	1	2	1	10	3	16	18	12	1	17	8	8	4	14	18	9	4	9	25
	AFS wage	14	3	21	22	29	6	33	34	10	2	17	18	19	3	23	30	5	2	5	18	4	3	4	9
	Non-AFS wage	23	7	34	35	46	28	47	53	18	5	30	28	28	6	34	41	16	7	28	30	7	3	13	15
	AFS self	10	16	6	7	9	22	7	6	11	16	5	9	9	23	4	9	14	17	8	12	9	11	5	6
	Non-AFS self	10	13	9	6	11	27	9	6	10	13	9	7	11	18	10	9	12	14	8	7	8	9	7	5

Note: Calculations represent population weighted averages. 'L.A.' represents 'Latin America'.

3.2.3. AFS employment by age cohorts and wage- vs self-employment. For the three regions taken together, AFS employment's share rises gradually from 18 to 19 to 22% over the rural zones (hinterland to intermediate to peri-urban areas), and then rises slightly to 26% in urban areas. Two things are striking in that pattern: (1) the similarity of the share of AFS employment across regions, controlling for zone; (2) the lack of a sharp change in its share over zones, even between rural and urban areas. The reasons for the surprising lack of sharp differences over regions and zones cannot be discerned from employment data; they have to do with the structure of the food economy. But the results suggest that the development of food supply chains stretching over rural to urban areas in all three regions has sufficient similarities that it has a similar effect on employment patterns. The similarity over regions in patterns of agrifood value chain development transformation is indeed becoming apparent from food system research in the past several decades (Reardon et al., 2019).

For the three regions taken together, the older-youths have more than double the shares of AFS wage-employment in hinterland and intermediate zones compared with older-adults. However, in the urban and peri-urban areas, youths depend much more on AFS wage employment than do adults: younger-youths and older-youths are roughly in the 19–29% range compared with adults in the 8–12% range.

In the peri-urban and hinterland zones, youths participate less than adults in AFS self-employment, and more in wage employment. There are few differences over age cohorts in the intermediate zone. We surmise that these youth-adult differences reflect both push and pull factors. Young people have more education, and education is sometimes a prerequisite for nonfarm wage work, at least in the formal sector. Self-employment requires capital and know-how, both of which youth are less likely to have (Filmer & Fox, 2014).

Taking the regions together, the share of wage-labour FTEs in AFS employment is positively related to the density of the zone and proximity to cities. It rises from a third in the hinterland and intermediate zones to a half in the peri-urban zone; it jumps to two-thirds in urban areas. But the shares vary by region. Wage employment in AFS has a lower share in Africa than in Asia and Latin America. For all ages and zones taken together, there is a sharp drop from Asia and Latin America (12% and 13%) to Africa (5%). By contrast, AFS self-employment rises sharply from Asia and Latin America (8–9%) to Africa (20%). This inter-regional pattern is similar for all the zones.

Reliance on AFS wage-employment compared with self-employment is correlated with overall development of a zone or region (Bhalla, 1997; Fox & Kaul, 2018; Reardon, Berdegué, & Escobar, 2001). With development comes infrastructure, capital accumulation, and the formation of larger denser markets which encourage new firm entry and hiring of wage workers. By contrast, more hinterland, poorer areas rely more on low-capital and low-productivity self-employment for a longer period of time.

3.2.4. Non-AFS wage- and self-employment. For the three regions taken together, non-AFS nonfarm jobs dominate employment; they are correlated with the density and proximity to urban areas of the zone: from 26% of FTEs in the hinterland, to 40% in the intermediate zone, to 50% in peri-urban areas, and 71% in urban areas. Non-AFS employment is around twice that of AFS except in the hinterland, where they are close.

The share of wage employment in non-AFS FTEs rises from half in the hinterland and intermediate zones to two-thirds in peri-urban and urban areas. Youths depend more on wage employment in the peri-urban and urban areas. Controlling for zone, non-AFS wage employment traces an inverted U from younger-youths to older-adults. As with AFS wage jobs, youths depend 2–3 times more on non-AFS wage employment in the peri-urban and urban zones than in the hinterland and intermediate zones.

The share of non-AFS wage employment drops sharply from Asia and Latin America (34% and 52%) to Africa (20%). Moreover, the shares of non-AFS wage work in the hinterland and intermediate zones of Asia and Latin America are 2–3 times higher than in those zones in Africa. However, that inter-regional gap greatly narrows for peri-urban and urban areas. As with AFS wage employment, the upshot

is that non-AFS wage employment is less developed in Africa compared with Asia and Latin America, and the difference is most telling in hinterland and intermediate zones.

Non-AFS self-employment is only about half of that of non-AFS wage work. Of those in non-AFS self-employment, there is an inverted U curve over age cohorts. In the hinterland zone of Africa, the share rises from younger-youths to older-adults. As with AFS wage jobs, these patterns suggest that non-AFS wage jobs are less plentiful for African youths compared with their counterparts in Asia and Latin America, especially in the hinterland.

4. Econometric Modelling of the labour supply of individuals

4.1. Theoretical framework

The theoretical framework for the labour supply model derives from the basic agricultural household model (Singh, Squire, & Strauss, 1986). In general form this applies to both rural households typically operating some farm land as well as urban households, as a special case, typically with no farm land. Given the heterogeneity of the countries we study (in which it is highly unlikely that all relevant markets are complete), we assume a non-separable model in which household production decisions are not separable from household preferences. That is, production decisions are functions of not only input and output prices, technology, and household assets, but also of individual and household characteristics.

Following Singh, Squire, & Strauss (1986), under separability, the household is assumed to maximise its utility subject to a full income constraint:

$$\max_{X_a, X_m, X_l, L} U(X_a, X_m, X_l) \text{ subject to } p_a X_a + p_m X_m + w X_l = p_a Q(L, \bar{A}) - wL + wT \tag{1}$$

where X_a is consumption of the agricultural good (also produced by the household), X_m is consumption of the market good, X_l is consumption of leisure, L is total labour supply to agricultural production, p_a is the price of agricultural good *a,* p_m is the price of market good *m,* w is the wage, $Q(L, \bar{A})$ is output given technology $Q()$, labour input is L, exogenous household land is $\bar{A}$, and T is the household's total endowment of time.

In a world characterised by incomplete markets for some inputs and outputs, the household faces a shadow price for labour, endogenous to the household, which is a function of both preferences (for example, age and education level, and the size of the household) and technology (Rizov & Swinnen, 2004; Singh, Squire, & Strauss, 1986).

Benjamin (1992) lays out a non-separable model of labour demand from and supply to own-farming by an agricultural household, and the supply of labour to non-agricultural activities by that same household. The solution to the constrained utility maximisation problem outlined above results in the following heuristic labour demand:

$$\begin{aligned} L^{D\_On} &= L^{S\_On} = F(w*,\ M*; \mathbf{a}) \\ &= F(w, p_a \bar{A}; \mathbf{a}) \end{aligned} \tag{2}$$

where $w*$ is the shadow wage for the household (which itself is a function of the market wage w and household characteristics ***a)***, $M*$ is full income (a function of p_a, $\bar{A}$, and technology Q) evaluated at $w*$, and ***a*** is a vector of household characteristics.[6] Supply of household off-farm labour is a function of the same variables:

$$\begin{aligned} L^{S\_Off} &= F(w*,\ M*; \mathbf{a}) \\ &= F(w, p_a, \bar{A}; \mathbf{a}) \end{aligned} \tag{3}$$

4.2. Specification of the econometric model

We apply the general form equations of own-farm and off-farm labour from the theoretical framework to each of our dependent variables that represent labour supply: LFP and FTEs of labour for each of the six labour categories discussed above. LFP (labour force participation) is represented with a dummy variable equal to one if an individual participated in the labour market during the past year (the survey recall period), and zero otherwise. The FTE variables are the individual's FTEs in each of the six sector categories, which are continuous variables with a lower bound of zero. We model only the labour of working age individuals 15–64.

We do not include an explicit off-farm wage rate (w) because we lack data on the net income per day for the various off-farm activities, and expect a great deal of heterogeneity of wages across countries. Instead of an off-farm wage as a determinant, we proxy it with spatial variables that are expected to condition the demand for and returns to off-farm labour:

(a) population density zones (urban, peri-urban, and intermediate, with hinterland as the base category, and corresponding shares of the data: 29%, 32%, 21%, 19%) as wages, social support, and the quantity and variety of job opportunities are expected to vary by zone;
(b) agricultural potential (high and medium, with low as the base category, each representing one third of the sample) that conditions the returns to agricultural labour and the demand for labour in activities with production and consumption linkages with farming[7];
(c) travel time to the centre of the nearest urban area (averaging 45 minutes) that affects workers' capacity to access jobs;
(d) country dummy variables (with Niger as the base category) reflecting overall development and thus demand for off-farm labour.

We analyse individual-level data and therefore expand the theoretical framework to include both individual and household demographics ($\bar{A}$, $\boldsymbol{a}$) that determine the shadow wage for own-labour.

We include the following individual-level dummy variables: age cohorts (younger-youth, ages 15–17, older-youth, 18–24, younger-adults, 25–34, leaving older-adults, 35–64, as the base category, and representing shares of the data: 10%, 19%, 24%, 46%), female (52%), in-school (13%), completed primary school (65%), completed secondary school (47%), and being a married male (27%) or a married female (32%). Age cohorts control for varying incentives and capacities of individuals in varying life stages. Female controls for gender discrimination and differences in expectations to engage in types of labour. Being in school limits one's time for employment. The completion of primary school and secondary school increase chance for employment as well as access at least to formal sector wage employment. Being married affects one's incentive to seek employment.

The household-level variables include: (1) the dependency ratio (averaging 33%) which is calculated as the share of household members younger than 15 or older than 64; this is expected to increase the need to earn income to pay for dependents but create home chores that may limit time to work outside the home; (2) receiving remittances (29%); this may increase the capacity to invest in self-employment enterprise, but also might reduce the incentive to work; (3) owning farm land (42%). The effect of landholding can be complex. It may increase one's own-farm work (although it may also induce hiring of farm workers); as a measure of wealth it can facilitate investment in self-employment enterprise, but it can also act as a substitute for working off-farm (Reardon, Delgado, & Matlon, 1992).

4.3. Estimation method

We use a probit model with LFP as the dependent variable to estimate the independent variables' marginal effects on the likelihood that an individual would be employed. We use a tobit model with FTEs for each

of the six employment categories as the dependent variables to account for the clustering of zeros due to the lower bounded nature of the labour category variables. To account for the potential selection bias caused by the two-step decision making process of LFP and the amount of one's FTEs in an employment category, we use a two-stage model with the probit as the first stage and the tobit as the second stage (Heckman, 1979).We use the control function approach, where we include an instrumental variable (IV) in the LFP equation and an estimated inverse mills ratio (IMR) in the second stage equations.

Our IV is observed share of working age persons who are employed (the employment density) in the enumeration area (or local administrative unit) where the individual resides. We divide the number employed by the sample of working age persons within the enumeration area, excluding the observation for which the share is calculated. This IV proxies for the incentive (such as wanting to have the status of employment) and capacity (such as reassurance of finding a job) to get a job. Our exclusion restriction relies on the observation that upon controlling for other spatial, household, and individual factors, the observed density of general employment should not influence one's decision to participate in a particular employment category except through its effect on LFP.

The two stage model is represented by the following equations:

$$LFP_i = \beta_0 + \beta_1 S_i + \beta_2 I_i + \beta_3 H_i + \beta_4 D_i + \varepsilon_i^1 \tag{4}$$

$$FTE_{ic} = \gamma_{0c} + \gamma_{1c} S_i + \gamma_{2c} I_i + \gamma_{3c} H_i + \gamma_{4c} \hat{\lambda}_i + \varepsilon_{ic}^2 \tag{5}$$

where LFP_i is equal to one if individual i has worked positive hours during the year before the survey, FTE_{ic} are the FTEs of individual i's participation in each of the six sector categories, S_i are spatial variables, I_i are individual characteristics, H_i are household characteristics, D_i is the observed employment density in the enumeration area, and $\hat{\lambda}_i$ is the IMR found in Equation (5) that is estimated with the estimated coefficients (β) in Equation (4) for each individual i.

Testing the validity of the IV in the first stage regressions resulted in chi squared values of 19.6, 30.4, and 18.0 respectively for the full sample, male sample, and female sample. These values are greater than the recommended value of 10 (Staiger & Stock, 1997).

Table 5 presents statistics on the observations of the explanatory variables for the overall, male-only, and female-only samples. Males have a 50% higher chance of being employed. Among the sample of males and females, males have twice the FTEs (work twice the hours) of females for: own-farming, AFS wage work, non-AFS wage-work, and non-AFS self-employment. By contrast, for farm-wage FTEs, males have six times that of females; but for AFS self-employment, males and females are about equal (reinforcing the greater reliance females have on this compared to males).

Table 5. Dependent variables in the regression analysis

Percentage Labour Force Participation			Average Levels of Full Time Equivalents			
				Total	Male	Female
			Own-farm	0.11	0.15	0.07
Total	Male	Female	Farm-wage	0.04	0.06	0.01
65.4	79.1	52.6	AFS wage	0.06	0.08	0.04
			Non-AFS wage	0.19	0.27	0.11
			AFS self	0.06	0.06	0.07
			Non-AFS self	0.09	0.12	0.06
			Total	0.55	0.74	0.36

5. Regressions findings

The two-step regression results are presented in Tables 6–8, for the whole sample, for males only, and females only, respectively. We first discuss the effects of key variables on LFP and then move to sectoral FTE results grouped by farm, wage and self-employment categories.

5.1. Spatial effects

First, urban areas and rural zones affect participation in employment, but primarily for males. For the whole sample (Table 6), LFP is 2–3% lower in peri-urban and intermediate zones (relative to the hinterland intercept), but insignificant in urban areas. In the males-only regression (Table 7) the marginal effects are all significant at 3–4% lower than the hinterland. But in the 'females only' regression (Table 8), none of the zone effects are significant.

Second, by and large 'zone' has a significant effect on FTE allocation across the employment categories, although the effects are stronger for males than females. As expected, 'urban' is sharply negative on own-farm and farm-wage FTEs. In rural areas, peri-urban and intermediate also have negative effects, but much weaker than the effect of urban, with the weakest negative effect on female own-farming. The upshot is that relative to the hinterland zone (the intercept), much less own-farming and farm-wage labour is done in peri-urban and intermediate zones. This is important as we feel that the policy debate about rural areas often takes them as spatially homogeneous, while the reality is that the importance of farming to employment rises steeply as one moves out to hinterland areas, while nonfarm activity competes with and often dominates own and hired farm employment in much of the denser rural areas.

Third, the effects of urban on nonfarm (AFS and non-AFS) wage employment are strong and positive. Many MSMEs (Micro, Small and Medium Enterprises, which also include single individual enterprises) that employ labour and most large employers, including the public sector, are in urban areas, due to agglomeration of consumers and workers and density of commercial infrastructure. The urban effects on AFS wage and non-AFS wage FTEs are similar. The peri-urban effect on these sectors' wage employment is similar to that of urban areas, just a third less strong. Then the intermediate zone's effect is a third again below the peri-urban effect. Thus wage jobs in the AFS sector are concentrated in urban and peri-urban zones, with much less in rural intermediate and hinterland zones. The correlation between proximity to urban areas and rural wage employment is consistent with the rural nonfarm employment literature (Anderson & Leiserson, 1980; Reardon, Henson, & Berdegué, 2007). The zone effects in males-only and females-only regressions are similar in their patterns, but the marginal effects on males are stronger.

For AFS self-employment, the zone effects are similar in direction but not in magnitude to those on wage-employment but with several differences. The effects of being in the urban areas and the peri-urban zone are less than half as strong on AFS self-employment as on AFS wage employment; in the female regressions, the effects are only a third as strong. The positive effects are, as with wage employment, explained by MSME location and growth correlated with areas with denser infrastructure, and more purchasing power and commercial connections. But as noted above, larger MSMEs and large firms that employ labour tend to be in urban and peri-urban areas, achieving relative scale by the size of the market, the availability of capital, and so on. But the weaker effects of these zones on AFS self-employment are due to there also being a development of MSMEs in intermediate and hinterland zones; however, these MSMEs tend to be oriented towards self-employment – much smaller, often just one person or an owner and a family member, with start-up and operation requirements that are more modest, commensurate with the thinner market and lower purchasing power of clients in the hinterland. For example, Elbers and Lanjouw (2001) found in Ecuador that wage work is mainly in the peri-urban and urban areas, and tiny enterprises limited to an individual's self-employment are mainly in the hinterland. In the AFS, women tend to be their operators there.

Table 6. Regression analysis – Probit on Labour Force Participation and Tobit on Full Time Equivalents

		Full Time Equivalents by Occupation Type					
VARIABLES	Labour Force Participation	Own-farm	Farm-wage	AFS wage	Non-AFS Wage	AFS Self-employment	Non-AFS Self-employment
Location – Urban	−0.020	−0.110***	−0.072***	0.221**	0.259***	0.065**	0.144**
Location – Peri-Urban	−0.034**	−0.048***	−0.022*	0.158**	0.180***	0.064***	0.114***
Location – Intermediate Rural	−0.017**	−0.019*	−0.010	0.091	0.121***	0.043***	0.080***
Agricultural potential – High	0.026***	0.029	0.005	−0.006	−0.014*	0.002	−0.010
Agricultural potential – Medium	0.024***	0.025	0.004	0.003	−0.011	−0.002	−0.013
Travel Time to City (log)	0.002	0.001	−0.004	−0.024	−0.022	−0.011	−0.020
Ages 15–17	−0.164***	0.022	0.007	0.047	−0.099**	−0.044***	−0.076***
Ages 18–24	−0.088***	−0.004	0.008	0.080***	0.005	−0.049***	−0.070***
Ages 25–34	−0.002	−0.025***	0.004	0.048***	0.038***	−0.019**	−0.027***
Female	−0.144***	0.001	−0.061**	−0.008	−0.085***	0.079***	−0.010
In School	−0.231***	0.064***	−0.043***	−0.087***	−0.136***	−0.020**	−0.032**
Primary School Completed	0.019	−0.017**	−0.036**	−0.008	0.039**	0.011	0.039***
Secondary School Completed	0.000	−0.062***	−0.035***	0.011	0.130***	−0.030**	−0.013
Married Male	0.162***	−0.000	−0.031***	−0.011	−0.005	0.039***	0.005
Married Female	−0.079**	0.030**	0.004	−0.049***	−0.062***	0.009	0.023***
Dependency Ratio	0.036*	0.009***	0.026***	0.001	−0.032***	0.010	0.008**
Remittances Received	0.011	0.011	0.002	−0.007	−0.012	−0.007	−0.013
Own Land	0.064**	0.135***	−0.023***	−0.049***	−0.082***	−0.025*	−0.044***
Employment Density	0.494***						
Inverse Mills Ratio		−0.284***	−0.092**	−0.094**	−0.101***	−0.090**	−0.131**

Notes: Statistical significance indicated by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Country dummy variable marginal effects are located in the Appendix.

Table 7. Regression analysis – Probit on Labour Force Participation and Tobit on Full Time Equivalents (Males Only)

VARIABLES	Labour Force Participation	Full Time Equivalents by Occupation Type					
		Own-farm	Farm-wage	AFS wage	Non-AFS Wage	AFS Self-employment	Non-AFS Self-employment
Location – Urban	−0.037***	−0.152***	−0.114***	0.244**	0.302***	0.086*	0.185**
Location – Peri-Urban	−0.036***	−0.077***	−0.046**	0.163**	0.205***	0.073**	0.138**
Location – Intermediate Rural	−0.026***	−0.031**	−0.025**	0.094	0.137***	0.050**	0.102**
Agricultural potential – High	−0.002	0.027	0.015	0.002	−0.013	−0.002	−0.008
Agricultural potential – Medium	0.003	0.025*	0.013	0.007	−0.011	−0.003	−0.012
Travel Time to City (log)	0.001	0.007**	−0.003	−0.028	−0.025*	−0.014	−0.023
Ages 15–17	−0.102***	−0.018	0.001	0.053	−0.110*	−0.038**	−0.106***
Ages 18–24	−0.029	−0.036***	0.015*	0.095***	0.020	−0.041***	−0.094***
Ages 25–34	0.035**	−0.044***	0.014***	0.058***	0.046***	−0.014	−0.034**
In School	−0.255***	0.056*	−0.075***	−0.106***	−0.188***	−0.031***	−0.062***
Primary School Completed	−0.015	−0.017	−0.054**	0.001	0.050***	0.007	0.045***
Secondary School Completed	−0.004	−0.076***	−0.044***	0.009	0.132***	−0.019	−0.013
Married	0.124***	0.007	−0.008	−0.003	0.003	0.036***	0.012
Dependency Ratio	0.119***	0.000	0.036***	0.011	0.001	0.009	0.015
Remittances Received	0.020	0.017	0.004	−0.011	−0.014	−0.010	−0.020
Own Land	0.062**	0.206***	−0.025***	−0.064***	−0.122***	−0.016	−0.044***
Employment Density	0.336***						
Inverse Mills Ratio		−0.255***	−0.058	−0.106*	−0.165**	−0.065**	−0.114**

Notes: Statistical significance indicated by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Country dummy variable marginal effects are located in the Appendix.

Table 8. Regression analysis – Probit on Labour Force Participation and Tobit on Full Time Equivalents (Females Only)

		Full Time Equivalents by Occupation Type					
VARIABLES	Labour Force Participation	Own-farm	Farm-wage	AFS wage	Non-AFS Wage	AFS Self-employment	Non-AFS Self-employment
Location – Urban	−0.003	−0.072***	−0.036***	0.208**	0.234***	0.046***	0.092**
Location – Peri-Urban	−0.034	−0.028***	−0.005	0.168**	0.176***	0.053***	0.080***
Location – Intermediate Rural	−0.009	−0.012*	−0.001	0.095	0.121**	0.035***	0.052***
Agricultural potential – High	0.049*	0.034	−0.005	−0.015**	−0.018**	0.006	−0.006
Agricultural potential – Medium	0.045	0.029	−0.002	−0.004	−0.016	−0.001	−0.008
Travel Time to City (log)	0.004	−0.002	−0.003	−0.021	−0.020	−0.007	−0.014
Ages 15–17	−0.227***	0.031**	0.005	0.054	−0.078**	−0.050***	−0.059***
Ages 18–24	−0.138***	0.006	0.002	0.076***	0.002	−0.054***	−0.052***
Ages 25–34	−0.024	−0.011**	−0.001	0.040***	0.034***	−0.023***	−0.017***
In School	−0.168***	0.030***	−0.022**	−0.069***	−0.078***	−0.029***	−0.026***
Primary School Completed	0.042*	−0.015***	−0.017**	−0.022	0.027	0.011	0.027***
Secondary School Completed	0.007	−0.047***	−0.020***	0.016**	0.131***	−0.036**	−0.011*
Married	−0.061**	0.019***	−0.012**	−0.049***	−0.065***	0.014**	0.012*
Dependency Ratio	−0.036	0.015**	0.018***	−0.010	−0.066***	0.017	0.004
Remittances Received	0.005	0.009	0.001	−0.003	−0.009	−0.003	−0.004
Own Land	0.059**	0.078***	−0.015**	−0.038***	−0.053***	−0.027*	−0.032**
Employment Density	0.569***						
Inverse Mills Ratio		−0.195***	−0.050**	−0.094**	−0.104***	−0.072***	−0.071***

Notes: Statistical significance indicated by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Country dummy variable marginal effects are located in the Appendix.

5.2. Farming potential

First, high and medium agricultural potential zones (relative to low potential zones) positively affect LFP, as expected, due to employment induced by production and consumption linkages from agricultural development (Hazell, Haggblade, & Reardon, 2007). But in gender-specific regressions, this is only significant for females in high agricultural potential zones. This result dovetails with Liverpool-Tasie, Adjognon, and Reardon (2016), who show in Nigeria that women are extensively engaged in off-farm employment in better agricultural potential zones. A review of RNFE surveys found this correlation in Africa and Asia; the favourable zones are where first-stage processing, packing, commerce, and food preparation take place that link to a bustling local farm economy, and tend to be low-entry barrier, low investment employment (Reardon, Henson, & Berdegué, 2007).

Second, controlling for selection into the labour force, the effect of agricultural potential has little effect on FTEs over employment sectors. There are only small negative effects of the high agricultural potential zone on non-AFS wage labour, small positive effects on own-farming for males of the medium agricultural potential zone, and small negative effects of the high agricultural potential zone on female wage labour. One can say that in the more dynamic agricultural zones, 'all ships rise with the tide' in that all sorts of employment rise together so that intersectoral composition of jobs does not differ much from the lower potential zones.

5.3. Youth

First, being a younger-youth reduces sharply the LFP, less so for older-youths. This effect disappears at the end of youth, age 25. The effect is stronger for females, suggesting that demanding home chores and child bearing constrain the LFP of young women. Young adult males are more likely to participate than adult males over 35, suggesting a need to provide for a young family, as well the negative effect of advancing age on LFP of males owing to increasing incidence of disability.

Second, although the descriptive analysis shows youths being disproportionately in own-farming, in the regressions, where being in school and other factors are controlled for, the youth effect disappears. This suggests that the youth effect seen in the descriptive statistics is mainly selectivity. Being a younger-youth female slightly increases the FTEs in own-farm work (relative to older females), whereas there is no significant effect for younger-youth males. Females at that age are expected to be more involved in home chores which can be combined with farm work while young men tend to work in off-farm jobs.

Third, being an older-youth or younger-adult male has a strong effect on doing farm-wage work. That group likely lacks the capital to start a farm, but is physically strongest to do demanding hired work on others farms, and has a need to support a young family.

Fourth, being older-youths and younger-adults makes it more likely one is in wage work – especially in AFS and less so in non-AFS – than are older adults. These effects are consistent across gender.

Fifth, youths, male or female, are less likely to engage in self-employment, either AFS or non-AFS. For males only, being young reduces much more strongly self-employment in non-AFS than in AFS, but for females, the effects of youth on AFS self-employment do not differ from those on non-AFS self-employment. The likely explanation is that younger people lack skills and capital to start MSMEs especially in the non-AFS activities.

5.4. Education

First, as expected, being in school lowers LFP and FTE levels in all job categories except for own-farm work. These results are particularly strong for women. Van den Broeck and Kilic (2019) also found that being in school most reduced off-farm employment in urban areas dominated by wage jobs.

We explored these regression results further with descriptive analysis. An initial point is to note that the shares of youth in school are 46% in Africa, 33% in Asia, and 45% in Latin America. Moreover, as expected, youths with employment who are also in school show much lower shares than average as expected (39%, 15%, and 26% for the three regions). By contrast, youths without

employment are in school at much higher shares than youth overall (57%, 44%, and 63% for the three regions).

However, the trade-off of being in school and working is much less if the youth is employed in own-farming. The shares of youths combining these are 42% in Africa, and 32% in each of Asia and Latin America. This combination is possible simply in part by the design of the school year, which historically is scheduled to leave open the farming season for rural youth to help their farm families.

Second, the completion of schooling, either primary or secondary, has little effect on LFP, except for females who complete primary education. This mirrors findings in Filmer and Fox (2014), and Van den Broeck and Kilic (2019). However, completing school does have strong effects on the supply of FTEs to non-AFS wage jobs as these jobs sometimes has higher education requirements such as for service businesses such as banks or schools.

Third, the female-only sample shows positive effects of secondary schooling (but not primary schooling) on AFS and non-AFS wage employment. Females with only primary school have a hard time finding wage jobs, at least in the formal sector (Filmer & Fox, 2014). Higher average physical strength benefits young men's ability to acquire manual labour jobs even if they have little education.

Fourth, the completion of primary school raises the probability of self-employment for both males and females in non-AFS self-employment, while the effect on AFS self-employment is insignificant. Completion of secondary school reduces the probability of self-employment. Having a secondary education allows people (females particularly) to get wage work, especially in the formal sector, where pay is higher and less risky (Filmer & Fox, 2014).

5.5. Other control variables

First, the dependency ratio increases FTEs in own-farming and farm-wage labour. For males, higher dependency ratios increase LFP and FTEs in farm-wage labour. This could be because the family is in an early lifecycle stage and poorer, and usually the poorer households resort to low paying farm wage labour (Haggblade, Hazell, & Reardon, 2007). It could also be that with a higher dependency ratio there are more children to do own-farm tasks like weeding which may free the youths and adults to work on others' farms. For females, higher dependency ratios increase their own-farm and farm-wage labour and reduce non-AFS wage work. The farm wage labour result could be for the reasons noted for males, but also because females with children can take them with them to farm work nearby and the children are watched collectively, or strapped on their backs, as women hoe and weed.

Second, the household's receiving remittances did not significantly affect LFP. This could be for several reasons: (1) remittances might be used as seed money for MSMEs or travel or living funds to get established in a commuting wage job; (2) despite widespread attention to remittances and migration, RNFE studies (see Haggblade, Hazell, & Reardon, 2010) show that in all three regions, on average, a small share of households have migrants or migrant remittances,[8] and that overall, remittances form a tiny share on average of rural household incomes.

Third, employment density in enumeration areas has a much greater effect on females than on males. Controlling for other factors, this effect may reflect a socio-cultural condition that reduces transaction costs and increases (or reflects a longstanding) social acceptability of women working outside the home.

6. Conclusions

We contribute to the debate on youth employment by singling out and comparing AFS employment (in activities post-farmgate, such as food processing, logistics, wholesale, retail, and food service) with other employment (in own-farming, farm-wage labour, and non-AFS employment). While so doing we distinguish wage versus self-employment in the sectoral job categories.

Studying AFS employment of youth is important because the rural nonfarm employment literature has been pointing to the ease of access, and the low entry requirements and barriers to entry of AFS jobs in rural areas, which are of potential interest for addressing the pressing need of youth

employment. The agrifood systems literature has been pointing to the recent burgeoning of AFS activity as rural-urban food supply chains grow with urbanisation and rural-rural supply chains grow with rising purchases of food in rural areas. Given that countries go through both an employment transformation (from mostly self-employment to wage work) and an AFS transformation (from traditional to transitional to modern) during rural transformation, understanding where and how much rural youth work is the first step in designing policies and programmes for their inclusion.

Our analysis over Africa, Asia, and Latin America of youth versus adult employment, using actual hours worked rather than simply participation in sectors, and comparing employment patterns between urban and rural, and within rural, over peri-urban, intermediate, and hinterland zones, has yielded striking findings.

First, there are four key sectoral patterns of youth employment over the three regions studied. (1) There is a relatively high share of dependence on own-farming for African employed rural youth (at around 50%) while that is a fifth or less in Asia and Latin America. (2) In all regions farm-wage labour is very minor for employed rural youth (4% in Africa and about 15% in Asia and Latin America). (3) There is remarkable similarity over Africa, Asia, and Latin America of roughly a fifth to one-quarter of employed rural and urban youth FTEs being spent in AFS employment. (4) Nearly half of employed youths' work is in non-AFS nonfarm work in Asia and Latin America, versus only a quarter in Africa. Overall, these patterns show that rural youth employment is very diversified beyond agriculture. Nonfarm activities, which include AFS, are very important to youth.

These four patterns make sense in a 'development continuum' where the rural economies of Asia and Latin America have diversified beyond farming much more than Africa, but the rural economies of all three regions have aggregated 'value added' activity to farming in roughly similar amounts reflected in youth activity. But even in Africa, the share of FTEs to own-farming is only a third for adults and half for employed youths, much less than the oft-cited figure of 80% of people 'in farming', that is, with farming as their declared principal activity.

Second, in all regions there is substantial variation in youth employment patterns between urban and rural areas, and in rural areas, over peri-urban, intermediate, and hinterland zones. In general, the big divide is between on the one hand urban and peri-urban areas (in which a large share of rural people live in these regions) and in some regions also in the intermediate rural zone, where there is a relatively high share of nonfarm wage employment and a lower share of own-farming employment among youths, and on the other hand the hinterland zone, where self-employment and own-farming employment are dominant. Controlling for the zone, better agroecological zones have more jobs for youth than do poor ones; urban proximity has the same effect on youths.

Third, employment patterns differ between age cohorts and genders within 'youths.' The rural younger-youths tend to be more in school, and if they work, more in own-farming, while the older-youths tend to be very focused on wage employment in both AFS and non-AFS. Fewer female youths are employed because of home chores and starting families.

The implications for policymakers are the following.

First, there is great heterogeneity of youth employment patterns over regions, over urban versus rural, over rural zones, over genders, and even over age cohorts within youths. Policy and programme approaches to youth employment need to be differentiated: one should not employ a 'one size fits all' approach.

Second, farm employment is important for employed youths, but is far from being a strongly dominant source of their employment. Even in Africa it is only about 50% of rural youth employment, and in Asia and Latin America, not even 25%. Adding farm-wage labour to this does not change these points as it turned out to be a minor source of jobs (and with increasing mechanisation will be more and more minor). Policymakers can work to spur youth involvement in farming, but this will address only about one-third[9] of current youth FTE, therefore it cannot be the singular answer to low youth employment.

Third, nonfarm employment is the main job of rural and urban youth in these regions. This is importantly in AFS jobs, in processing, wholesale, logistics, and retail of food, with about a quarter of youth employment in all regions. In Africa, another quarter is in non-AFS nonfarm jobs, and in Asia and Latin America, another half. A heavy programme and policy emphasis on youth involvement in nonfarm jobs is crucial, at least as important as in farming.

Youths are heavily engaged in nonfarm jobs as wage workers in urban areas and most of the rural zones except the hinterland (where in fact a small share of youths live). We found that secondary education helps males and females get wage jobs. Readying youths for wage work and not just farming or self-employment, is a key need, with education as a key part of that.

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Notes

1. Given the 12 month recall period of FTEs, unemployment is not defined.
2. National shares of the data: Bangladesh 16%, Cambodia 1%, Ethiopia 9%, Indonesia 28%, Malawi 1%, Mexico 14%, Nepal 3%, Nicaragua 1%, Niger 1%, Nigeria 14%, Peru 4%, Tanzania 4%, and Uganda 4%.
3. 1.1. Shares of data by population density: hinterland 19%, intermediate rural 21%, peri-urban 32%, and urban 29%. Population density thresholds (1,000 people per sqkm): hinterland < = 0.16, intermediate rural > 0.16 & < = 0.58, peri-urban > 0.58 & < = 2.39, and urban > 2.39.
4. http://www.worldpop.org.uk/.
5. DIVA-GIS is a free computer program for mapping and geographic data analysis (a geographic information system (GIS)). For more information see: https://www.diva-gis.org/.
6. We argue that our limited set of household characteristics (dependency ratio, receive remittances and own land) affect an individual’s employment decisions and not merely their consumption decisions. Therefore the inclusion of these household characteristics would be consistent with a fully separable model as suggested by the 2016 paper by LaFave and Thomas. Dependency ratio affects an individual’s ability to provide labour away from their home. Receiving remittances affects an individual’s reservation wage. Owning land affects an individual’s capacity to earn an income from own farming.
7. We use the MODIS Enhanced Vegetation Index (EVI) as a proxy for agricultural potential to facilitate global comparisons (Jaafar & Ahmad, 2015).
8. Regional levels of households receiving remittances are: Africa 15%; Asia 45%; Latin America 13%. In Asia, the high share of households with remittances is driven mainly by Indonesia: Indonesia, 58%; Cambodia, 34%, Nepal, 33%; Bangladesh, 21%.
9. For the three regions together, the youth FTE share of own-farm and farm-wage labour combined was 29%.

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Appendix

Table A1. Regression analysis – Probit on Labour Force Participation and Tobit on Full Time Equivalents (Country Variables)

		Full Time Equivalents by Occupation Type					
VARIABLES	Labour Force Participation	Own-farm	Farm-wage	AFS wage	Non-AFS Wage	AFS Self-employment	Non-AFS Self-employment
Bangladesh	−0.074***	0.150***	1.106***	0.963***	0.552***	−0.048**	0.092*
Cambodia	0.073***	−0.059**	0.092***	−0.103***	0.260***	−0.142***	−0.166***
Ethiopia	0.085***	−0.009	0.520***	1.480***	0.704***	0.121***	0.214***
Indonesia	−0.035***	0.153***	1.051***	0.911***	0.404***	0.112***	0.166***
Malawi	0.144***	−0.052***	0.903***	−0.093***	−0.179***	−0.136***	−0.166***
Mexico	0.035	−0.122***	0.310***	0.285***	0.305***	−0.147***	−0.176***
Nepal	0.097***	0.031**	0.832***	0.430***	0.432***	−0.054***	−0.046***
Nicaragua	−0.003	−0.130***	0.057***	−0.124***	0.037*	−0.142***	−0.158***
Nigeria	0.043***	0.161***	0.787***	1.083***	0.522***	0.238***	0.329***
Peru	0.066***	−0.099***	−0.003	−0.092***	0.031**	−0.140***	−0.131***
Tanzania	0.087***	0.005	1.027***	0.966***	0.624***	0.152***	0.241***
Uganda	0.096***	0.022	0.962***	1.057***	0.614***	0.059*	0.063*

Notes: Statistical significance indicated by: *** p < 0.01, ** p < 0.05, * p < 0.1.

Table A2. Regression analysis – Probit on Labour Force Participation and Tobit on Full Time Equivalents (Males Only) (Country Variables)

		Full Time Equivalents by Occupation Type					
VARIABLES	Labour Force Participation	Own-farm	Farm-wage	AFS wage	Non-AFS Wage	AFS Self-employment	Non-AFS Self-employment
Bangladesh	0.057***	0.132***	0.985***	0.695***	0.445***	−0.053*	0.032
Cambodia	0.003	−0.062**	0.024	−0.135***	0.184***	−0.151***	−0.211***
Ethiopia	−0.007	0.023	0.492***	1.233***	0.563***	0.124***	0.115***
Indonesia	−0.067*	0.208***	0.993***	0.687***	0.339***	0.086***	0.072
Malawi	0.034*	−0.054***	0.925***	−0.122***	−0.242***	−0.146***	−0.208***
Mexico	0.054***	−0.152***	0.413***	0.144***	0.307***	−0.164***	−0.232***
Nepal	0.015	0.033***	0.691***	0.395***	0.469***	−0.035***	−0.075***
Nicaragua	0.041**	−0.144***	0.149***	−0.158***	−0.019	−0.150***	−0.207***
Nigeria	−0.016	0.241***	0.762***	0.826***	0.419***	0.213***	0.240***
Peru	0.034**	−0.135***	0.002	−0.146***	0.040*	−0.152***	−0.175***
Tanzania	−0.003	0.015	0.943***	0.781***	0.560***	0.147***	0.160***
Uganda	−0.022	0.046*	0.941***	0.866***	0.511***	0.058**	0.006

Notes: Statistical significance indicated by: *** p < 0.01, ** p < 0.05, * p < 0.1.

Table A3. Regression analysis – Probit on Labour Force Participation and Tobit on Full Time Equivalents (Females Only) (Country Variables)

		Full Time Equivalents by Occupation Type					
VARIABLES	Labour Force Participation	Own-farm	Farm-wage	AFS wage	Non-AFS Wage	AFS Self-employment	Non-AFS Self-employment
Bangladesh	−0.280***	0.131	2.349***	2.012***	1.135***	−0.079***	0.055**
Cambodia	0.107***	−0.044**	1.154***	−0.037***	0.628***	−0.135***	−0.097***
Ethiopia	0.141***	−0.025	1.697**	2.418***	1.266***	0.128***	0.359***
Indonesia	−0.027	0.089**	2.005***	1.713***	0.738***	0.129***	0.262***
Malawi	0.215***	−0.042***	2.175**	−0.022	−0.097***	−0.128***	−0.110***
Mexico	−0.002	−0.086***	0.860***	0.919***	0.552***	−0.125***	−0.109***
Nepal	0.139***	0.028	2.231**	0.704***	0.644***	−0.061***	0.028
Nicaragua	−0.063*	−0.094***	0.046***	−0.078***	0.294***	−0.134***	−0.083***
Nigeria	0.079***	0.084***	1.962***	2.030***	1.006***	0.255***	0.449***
Peru	0.075**	−0.062**	0.452***	0.134***	0.165***	−0.119***	−0.060***
Tanzania	0.141***	−0.002	2.410**	1.787***	1.042***	0.171***	0.385***
Uganda	0.184***	0.001	2.333**	1.850***	1.115***	0.069*	0.171***

Notes: Statistical significance indicated by: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.