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Identifying Priority Value Chains in Ghana

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ABSTRACT

Value chain development is increasingly perceived as an important approach for agricultural development in developing countries. The emerging value chain-oriented development approaches not only focus on interventions for developing input and output markets, but also on interventions to improve the competitiveness of selected commodities. In recent times, the Government of Ghana has planned various interventions to improve competitiveness, primarily of rice, maize, and soybean crops, which are important for Feed the Future strategy. However, increasing urbanization and changing dietary preferences have potentially opened-up the scope for high-value agriculture, beyond the traditional grain sector. In this context, this paper uses a Rural Investment and Policy Analysis (RIAPA) model for the Ghanaian economy to explore the poverty, employment, and nutrition impacts of alternative value chains and provides an assessment of the priority value chains for Ghana.

Keywords: Ghana; RAIPA; agricultural-food system; value chains

1. INTRODUCTION

This working paper identifies agricultural activities and value chains in Ghana whose expansion is most effective at generating economic growth, reducing national and rural poverty, creating jobs, and improving nutrition by diversifying diets. The Rural Investment and Policy Analysis (RIAPA) model of the Ghanaian economy is used to estimate how increasing production in different agricultural sectors leads to changes in national and household outcomes.[1] RIAPA captures linkages between sectors and rural-urban economies, as well as changes throughout the agriculture-food system (AFS). The sections below (1) situate agriculture within the national economy, (2) establish baseline expectations until 2025, (3) evaluate the impacts of promoting alternative value chains, and (4) provide a final assessment of priority value chains.

2. AGRICULTURE IN THE NATIONAL ECONOMY OF GHANA

RIAPA is an economy-wide model and its core database is a social accounting matrix (SAM) that captures all income and expenditure flows between all economic actors in the country, including producers, consumers, government, and the rest of the world (Box 1). The model for Ghana uses a 2015 SAM and the 2012/13 Ghana Living Standards Survey (GLSS6) to separate the economy into 56 sectors and 13 factors of production.[2] GLSS6 is the most recent household survey for Ghana. Table 2.1 describes RIAPA's base-year production and trade structure.

Box 1. The Rural Investment and Policy Analysis (RIAPA) model

The Rural Investment and Policy Analysis (RIAPA) model is a computable general equilibrium (CGE) model that simulates the functioning of a market economy, including markets for products and factors, i.e., land, labor and capital. RIAPA measures how impacts are mediated through prices and resource reallocations and ensures that resource and macroeconomic constraints are respected, such as when inputs or foreign exchange are limited. RIAPA provides a consistent "simulation laboratory" for quantitatively examining value chain interactions and spillovers at national, sub-national and household levels.

RIAPA divides the economy into sectors and household groups that act as individual economic agents. Producers maximize profits and supply output to national markets, where it may be exported and/or combined with imports depending on relative prices, with foreign prices affected by exchange rate movements. Producers combine factors and intermediate inputs using sector-specific technologies. Maize farmers, for example, use a unique combination of land, labor, machinery, fertilizer, and purchased seeds. Workers are divided by education levels, and agricultural capital is separated into crop and livestock categories. Labor and capital are in fixed supply, but less-educated workers are treated as underemployed. Producers and households pay taxes to the government, who uses these and other revenues to finance public services and social transfers. Remaining revenues are added to private savings and foreign capital inflows to finance investment; i.e., investment is driven by levels of savings. RIAPA is dynamic, with past investment determining current capital availability.

[1] The RIAPA model and analytical approach was developed by the International Fund for Agricultural Development (IFAD) and the International Food Policy Research Institute (IFPRI). RIAPA is funded by IFAD, IFPRI, the CGIAR Research Program on "Policies, Markets and Institutions" (PIM), and the Gates Foundation project "Advancing Research on Nutrition and Agriculture" (ARENA).

[2] RIAPA's SAMs follow standard "Nexus Project" data definitions and estimation procedures. The Nexus Project is a collaboration between IFAD, IFPRI, other international organizations, and national research and statistical agencies. Ghana's 2015 SAM was built by IFPRI.

RIAPA tracks changes in incomes and expenditures for different household groups, including changes in food and nonfood consumption patterns. Poverty impacts are measured using survey-based microsimulation analysis. Individual survey households map to the model's household groups. Estimated consumption changes in the model are applied proportionally to survey households, and post-simulation consumption values are recalculated and compared to a poverty line to determine households' poverty status.

Agriculture generates almost 20 percent of national GDP and total employment earnings in Ghana. It accounts for 13 percent of total export earnings. Crops dominate the agricultural sector, accounting for almost 16 percent of total GDP and around 80 percent of total agricultural value added. Livestock is a much smaller sub-sector and accounts for only 1 percent of GDP and 0.1 percent of employment earnings. Part of agricultural output is supplied to downstream agro-processing, but this generates only 1.8 percent of GDP, 1.6 percent of employment earnings, and 4.3 percent of exports. This is because most crops in Ghana are grown, prepared, and consumed within households. Ghana imports most non-agricultural manufactured goods, such as chemicals, metals, and machinery. Almost half of national GDP is generated by services, which are dominated by trade, transport and communication, and government services.

Table 2.1. National economic structure of Ghana, 2015

	Share of total, %					
	GDP	Employment earnings	Exports	Imports	Export / output, %	Import / demand, %
All sectors	100.0	100.0	100.0	100.0	15.8	23.8
Agriculture	19.7	19.7	13.2	2.6	15.8	6.9
Crops	15.6	18.1	13.1	1.8	23.0	7.9
Livestock	1.0	0.1	0.0	0.7	0.0	13.6
Forestry	1.9	1.0	0.1	0.1	0.9	1.4
Fishing	1.2	0.5	0.0	0.0	0.0	0.3
Industry	30.6	15.2	72.5	80.1	28.9	41.6
Mining	6.7	4.3	59.2	2.2	76.5	14.8
Manufacturing	5.5	4.5	13.4	77.9	18.5	65.5
Agro-processing	1.8	1.6	4.3	11.2	16.4	46.5
Other manufacturing	3.9	3.1	9.1	67.8	18.9	70.5
Other industry	18.4	6.3	0.0	0.0	0.0	0.0
Services	49.7	65.1	14.3	16.8	5.0	7.6
Trade and hotels	12.1	15.2	8.6	3.7	11.5	7.0
Transport & communication	14.1	13.0	4.3	6.7	6.0	11.5
Finance & business	8.3	6.9	0.2	1.7	0.4	3.8
Government services	10.9	24.0	1.1	4.7	1.8	8.8
Other services	4.2	5.9	0.0	0.0	0.0	0.0

Source: RIAPA CGE Model and SAM.
Notes: GDP is gross domestic product; employment earnings are for primary jobs. The final two columns report the share of exports in total sectoral output and the share of imports in total commodity demand, respectively. Agro-processing includes beverages and tobacco, but not wood products; catering services includes restaurants and other meals prepared away from the home; and transport includes communications.

Agriculture's role in the economy extends beyond the sector itself, with industrial and service sectors forming parts of Ghana's AFS. Table 2.2 uses the national SAM to estimate the share of total GDP and employment earnings in Ghana's AFS. Agriculture and agro-processing together account for 21 percent of GDP and employment earnings each. These sectors use domestically-produced inputs, such as maize, whose production creates additional value-added and jobs within the AFS. A larger AFS component is moving agriculture-related products between farmers, processors, and markets –

this is depicted by trade and transport services in Table 2.2. Households also consume meals prepared outside the home, such as in hotels and restaurants. In total, the AFS accounts for 25.9 percent of national GDP and 26.4 percent of employment earnings. Just over a quarter of the economy, population, and workforce depend on agriculture, either directly or indirectly.

Table 2.2. Agriculture-food system GDP and employment earnings for Ghana, 2015

	Share of total, %	
	GDP	Employment earnings
National economy	100.0	100.0
Agriculture-food system	25.9	26.4
Direct production	21.4	21.3
Agriculture	19.7	19.7
Agro-processing	1.8	1.6
Input production	0.6	0.5
Agriculture	0.5	0.4
Agro-processing	0.1	0.1
Trade and transport services	3.9	4.6
Agriculture	1.8	2.1
Agro-processing	2.1	2.5
Hotels and catering	5.4	5.0

Source: RIAPA CGE Model and SAM.
Notes: GDP is gross domestic product; employment earnings are for primary jobs. Agro-processing includes foods, beverages, tobacco, paper products, and cotton yarn; and catering services includes restaurants and other meals prepared away from the home.

RIAPA is used to evaluate different agricultural value chains, including fishing and forestry. Table 2.3 provides summary production statistics for the 15 product categories analyzed in this working paper, as well as an "other agriculture" category that includes value chains not analyzed due to their very small size. The latter includes sugarcane, tobacco, cotton, and other crops. Appendix Table 1 lists in detail the products included in each category. Vegetables, fruit and nuts, and cocoa are the largest crops produced in Ghana collectively, accounting for 36 percent of total agricultural GDP. Maize is also a relatively large crop sector, accounting for 10 percent of total agricultural GDP. The agricultural sector accounts for 10 percent of total exports. This is largely due to cocoa exports, which accounts for 80 percent of agricultural exports and 8 percent of total exports. Total Ghana exports are dominated by mining. Livestock is a relatively small subsector and consists of mainly cattle, goats, and sheep.

Finally, RIAPA contains 15 representative household groups, separated into rural and urban consumption quintiles, with rural households separated into farm and nonfarm groups. Table 2.4 describes aggregate income and consumption patterns. The total population of 27.4 million people consumes, on average, US$878 of goods and services per person each year (at market exchange rates unadjusted for purchasing power parity). Consumption levels are much lower in rural areas and amongst the poor. Poor households tend to spend more of their earnings on food consumption. Starches from cereals and roots dominate the consumption patterns of rural and rural poor households, accounting for more than a third of food consumption. Cereals and roots also make-up a fairly large share of urban household food consumption, although urban households do consume more meat, fish, and eggs. Finally, poor rural households are, on average, more reliant on incomes from farming (see land) and from less-educated labor, suggesting that agriculture and the rural nonfarm economy play crucial roles in the livelihoods of the poorest population.

Table 2.3. Agricultural production statistics for Ghana, 2015

	GDP share, %	GDP per worker, USD	Cultivated area, 1000s ha	Hectares per worker	Crop yield, mt/ha
Agriculture	100.0	766	6,852	1.2	-
Maize	10.0	652	1,019	1.0	1.7
Sorghum & millet	3.4	430	389	1.3	1.1
Rice	4.7	452	224	3.0	2.7
Pulses	1.2	327	262	0.9	0.1
Groundnut	2.0	592	334	0.7	1.3
Other oilseeds	4.4	711	423	1.0	7.5
Cassava	7.3	562	889	1.0	18.6
Other roots	9.1	801	629	1.2	13.4
Vegetables	13.4	1,244	337	2.1	3.6
Fruits and nuts	12.7	863	602	1.6	9.2
Cocoa	10.2	480	1,684	0.8	0.5
Cattle	2.8	11,502			
Poultry, other livestock	2.3	3,635			
Other agriculture	0.9	623	61	1.5	3.2
Forestry	9.5	1,477			
Fishing	6.0	1,674			

Source: RIAPA CGE Model and SAM.
Note: Appendix Table 1 lists the crops or products included in each value chain category.

Table 2.4. Household incomes and consumption in Ghana, 2015

	National	Rural	Rural Poor	Urban
Population, millions	27.4	13.7	6.2	13.7
Consumption per capita, USD	878	563	374	1,191
All foods, %	100.0	100.0	100.0	100.0
Cereals, roots	28.2	37.3	40.9	22.6
Vegetables	9.2	10.1	10.7	8.7
Fruits	7.1	7.4	5.0	6.9
Meat, fish, eggs	18.8	17.4	16.4	19.6
Pulses, oilseeds	4.6	5.8	6.0	3.9
Other foods	32.1	22.0	21.0	38.3
Food consumption share, %	49.8	59.1	64.0	45.4
Processed share, %	44.1	43.2	46.5	44.7
All income, %	100.0	100.0	100.0	100.0
Land	6.9	19.4	27.9	2.1
Labor	35.6	42.8	48.8	32.9
Less educated	23.2	36.1	46.7	18.1
More educated	12.5	6.7	2.1	14.7
Capital	52.2	33.2	19.3	59.6
Other	5.2	4.6	4.0	5.5

Source: RIAPA CGE Model and SAM.
Notes: Food consumption excludes meals prepared outside the household. Processed foods exclude products processed and consumed within the household. Better-educated workers are those who have at least completed primary schooling. Capital income includes gross operating surplus. Other income sources include social and foreign transfers. Appendix Table 1 lists the crops or products included in each value chain category.

3. FUTURE OUTCOMES UNDER CURRENT TRENDS

RIAPA first establishes a baseline scenario for 2016 to 2020 assuming recent trends continue. Table 3.1 summarizes this "business-as-usual" scenario. Initial values are for 2015, which is the simulated base year for the analysis derived by imposing trends on the model. Population and labor supply grow at about 2 percent and 3 percent per year, respectively, and crop land area expands at roughly 1 percent. Overall, national GDP in the model grows at 5.9 percent per year, which is faster than the population, implying rising GDP per capita. This growth rate is in line with the outlook for Ghana by the International Monetary Fund and assumes a continuation in the existing sector structure of the economy.[3] Productivity growth is adjusted to achieve this growth rate given the assumptions made above.

Table 3.1. Baseline "business-as-usual" scenario results, 2016 to 2025

	Initial value, 2015	Baseline scenario, average annual change, %
Population, '000s	27,410	2.2
Rural	13,673	2.2
Urban	13,737	2.2
GDP, % share	100.0	5.9
Agriculture	19.7	5.3
Industry	30.6	6.7
Agro-processing	1.8	9.0
Services	49.7	5.6
Labor earnings	43	2.8
Cropland, '000s ha	6,852	1.0
Capital	70	4.3
Household consumption	878	3.1
Rural	563	3.1
Urban	1,191	3.1
Poverty headcount rate, %	36.5	-5.0
Rural	54.4	-4.1
Urban	18.6	-8.3
National SPGE	-	-0.4

Source: RIAPA CGE Model and SAM.
Note: SPGE = semi-poverty-growth elasticity.

RIAPA measures how the pace and sectoral pattern of GDP growth affects household incomes and consumption levels. This is based on the differing resource demands of sectors and the differing factor endowments and consumption patterns of households. Poor households are often more dependent on incomes from less-educated workers, so expanding production in sectors that employ these workers more intensively is more likely to benefit the poor. Similarly, expanding production and lowering prices of products that poor households consume can also raise their total consumption and move some households to levels above the poverty line.

Rural and urban household consumption grows at a higher rate than population growth, indicating an increase in per capita consumption in both rural and urban households. Higher per capita consumption causes the poverty headcount rate to fall. This is the share of the population

[3] IMF (International Monetary Fund). 2017. World Economic Outlook, April 2017. Washington, DC. Available at https://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx Accessed: 10 August 2017.

with consumption levels below the official poverty line. RIAPA's microsimulation analysis estimates that the national poverty rate would fall by 5 percent per year in the baseline scenario. Note that this is a percentage, not percentage point, change in the poverty rate.

The pace of poverty reduction should be assessed in relation to economic growth. Box 2 describes RIAPA's main outcome indicators. The baseline semi-poverty-growth elasticity (SPGE) is -0.4, which means that a one percent increase in per capita GDP causes the poverty headcount rate to decline by 0.4 percentage points.[4] The baseline provides a plausible reference scenario for evaluating the further expansion of agricultural value chains.

Box 2. Main outcome indicators of the Rural Investment and Policy Analysis model

Value chains are compared based on their impacts on economic growth, employment earnings, poverty, and nutrition. These headline outcome indicators are defined below.

Economic growth is measured by real GDP at factor cost, either for all sectors (total GDP) or for the agriculture-food system GDP (see Table 2.2).

Employment earnings are for paid and unpaid work, including home enterprises. Workers may have multiple jobs, but only their primary job is considered.

Poverty is measured by the poverty headcount or the poverty gap. The former is the share of the population with consumption below the poverty line, while the latter is the cumulative distance between poor people's consumption levels and the poverty line, i.e., depth of poverty.

Dietary diversity score (DDS) is calculated for household groups using food expenditure shares. Diversity is estimated using a cross-entropy measure across six food categories (cereals and roots; vegetables; fruits; meat, fish and eggs; milk and dairy; and pulses and oilseeds) relative to an estimated "ideal" food budget allocation. A more diverse diet is assumed to be associated with improved nutrition outcomes.

Poverty-growth elasticity (PGE) is the percentage change in the poverty rate divided by the per capita GDP growth rate. SPGEs are preferred and use percentage *point* changes in the poverty rate.

Dietary-diversity-growth elasticity (DDGE) is the percentage change in the dietary diversity score of poor households divided by the per capita GDP growth rate.

Economywide growth (employment earnings) elasticity is the percentage in either total or AFS GDP (employment earnings) divided by the percentage change in agricultural GDP.

4. EVALUATING ALTERNATIVE VALUE CHAINS

RIAPA is used to simulate the effects of expanding farm production within existing agricultural value chains. Total factor productivity growth in each group of agricultural products is accelerated beyond baseline growth rates, such that, in each value chain scenario, total agricultural GDP is one percent higher in 2025 than it is in the baseline scenario.[5] Expanding agricultural production increases supply

[4] On why the SPGE is preferable to the standard PGE, see:
Arndt, C., K. Mahrt, and C. Schimanski. 2017. *On the poverty–growth elasticity*. WIDER Working Paper 2017/149. Helsinki: UNU-WIDER.

[5] The choice to target one percent increase in agricultural GDP is somewhat arbitrary, since results are largely unaffected by the magnitude of the target growth acceleration.

to downstream processing activities and generates demand for agricultural trade and transport services. Agricultural subsectors differ in size. So, to achieve the same absolute increase in total agricultural value-added, it is necessary for smaller value chains to expand more rapidly than larger ones. Table 2.3 listed the value chains analyzed in this working paper, including their initial GDP shares. Poultry, for example, is a small agricultural subsector contributing only 0.3 percent to agricultural GDP. It therefore needs larger productivity gains to match the effects of even modest average cereal yield gains. While such rapid growth may be difficult for these crops to achieve, targeting the same absolute increase in agricultural GDP allows us to compare results across the different value chain scenarios. The poultry sector is coupled with other livestock as the sector is too small to be evaluated by itself.

Table 4.1 reports the estimated SPGEs for each scenario. Expanding maize production reduces the national poverty headcount rate by 0.38 percentage points for every one percent increase in agricultural GDP, making maize a "pro-poor" value chain. Cocoa, rice, and cassava have the largest SPGEs, and so growth in these value chains is most effective at reducing national poverty. These products also have strong linkages to rural poverty reduction. Note that value chain SPGEs are often larger than the baseline's overall SPGE, implying that agricultural growth is more pro-poor than nonagricultural growth. Rural SPGEs also tend to be larger than national SPGEs, indicating that, as expected, agricultural growth favors the rural poor.

Table 4.1. Semi-Poverty-Growth Elasticity results, 2016 to 2025

	Estimated Semi-Poverty-Growth Elasticity (sectoral rank in parenthesis)					
Baseline or targeted sector within agriculture	**National poverty headcount**		**Rural poverty headcount**		**National poverty gap**	
Baseline	-0.40		-0.51		-0.17	
Maize	-0.38	(14)	-0.43	(13)	-0.19	(13)
Sorghum & millet	-0.47	(12)	-0.59	(12)	-0.26	(11)
Rice	-1.94	(2)	-3.67	(2)	-0.77	(2)
Pulses	-0.55	(10)	-0.91	(11)	-0.36	(8)
Groundnut	-0.74	(9)	-1.32	(5)	-0.44	(3)
Other oilseeds	-0.75	(8)	-1.18	(7)	-0.39	(7)
Cassava	-1.02	(3)	-1.86	(3)	-0.43	(4)
Other roots	-1.01	(4)	-1.74	(4)	-0.42	(5)
Vegetables	-0.82	(7)	-0.95	(10)	-0.30	(10)
Fruits and nuts	-0.86	(6)	-0.98	(9)	-0.24	(12)
Cocoa	-12.34	(1)	-25.95	(1)	-5.75	(1)
Cattle	-0.41	(13)	-0.17	(14)	-0.09	(14)
Poultry, Other livestock	-0.22	(15)	0.26	(15)	-0.06	(15)
Forestry	0.64	(16)	1.39	(16)	0.23	(16)
Fishing	-0.96	(5)	-1.21	(6)	-0.40	(6)

Source: RIAPA CGE Model and SAM.
Notes: The Semi-Poverty-Growth Elasticity (SPGE) is the percentage point change in the poverty rate per one percent increase in GDP per capita driven by GDP growth originating from within the targeted sector. Poverty headcount rate is the share of the national or rural population with consumption levels below the official poverty line. Poverty gap rate is the cumulative distance between poor people's consumption levels and the poverty line.

The cocoa value chain has a significantly larger impact on the national and rural poverty headcount rate than all of the other value chains considered. This is driven in significant measure by strong linkages to global markets. The share of cocoa output exported is more than 90 percent. It is assumed that, given the size of the Ghana economy, it is not large enough to significantly influence global prices. The increase in cocoa production, therefore, does not affect the export price of cocoa.

Revenues accruing to the cocoa sector are less affected by price declines, due to increased production, than revenues accruing to less traded sectors, such as maize. So, while most sectors shed factors of production due to decreasing output prices, the cocoa sector attracts substantially more land, labor, and capital than other sectors, thus leveraging the increase in total factor productivity (TFP). The cocoa sector is also labor intensive, particularly of low-skilled rural workers.

We highlight that this result assumes constant world prices, which were relatively favorable in 2015. It is likely overly optimistic with respect to the cocoa supply response. The result suggests, in general terms, that linkages to world markets that allow the economy to profit from productivity gains by selling large supplies into global markets are positive, particularly if the goods exported are labor-intensive. With specific respect to cocoa, the results are perhaps cautionary in that they also indicate that low income households are quite vulnerable to changes in the world price of cocoa.

Poverty headcount rates focus on people living just below the poverty line, whereas poverty gaps measure how far poor households are from the poverty line. Poverty gaps therefore better reflect the conditions of the poorest. These households may have different consumption patterns and asset endowments than the less poor, such as limited access to land, and so we do not expect value chains to be equally effective at reducing poverty headcounts and gaps. In Table 4.1, for example, rice is more effective at reducing the poverty headcount rate than the poverty gap relative to other value chains, indicating that households closer to the poverty line benefit more from rice expansion than do the poorest households. Generally, the results indicate a larger reduction in poverty headcount rates than the poverty gap across value chains. The results overwhelmingly indicate that cocoa has the largest impact on reducing all poverty measures presented in Table 4.1. This is followed by rice and cassava.

Table 4.2. Dietary-Diversity-Growth Elasticity results, 2016 to 2020

Baseline or targeted sector within agriculture	Estimated Dietary-Diversity-Growth Elasticity (sectoral rank in parentheses)					
	All households		Rural households		Poor rural households	
Maize	-0.05	(13)	-0.08	(12)	-0.11	(14)
Sorghum & millet	-0.04	(12)	-0.08	(13)	-0.12	(15)
Rice	-0.03	(10)	-0.04	(11)	-0.05	(11)
Pulses	0.12	(3)	0.18	(2)	0.19	(2)
Groundnut	0.16	(1)	0.23	(1)	0.23	(1)
Other oilseeds	0.15	(2)	0.13	(3)	0.13	(4)
Cassava	-0.06	(15)	-0.10	(15)	-0.08	(12)
Other roots	-0.05	(14)	-0.08	(14)	-0.08	(13)
Vegetables	0.05	(5)	0.07	(5)	0.06	(5)
Fruits and nuts	0.08	(4)	0.10	(4)	0.14	(3)
Cocoa	-0.15	(16)	-0.11	(16)	-0.13	(16)
Cattle	-0.02	(9)	0.00	(7)	0.01	(6)
Poultry, Other livestock	-0.01	(8)	-0.01	(9)	0.00	(9)
Forestry	0.01	(6)	0.01	(6)	0.01	(7)
Fishing	-0.04	(11)	-0.03	(10)	-0.03	(10)

Source: RIAPA CGE Model and SAM.
Notes: The Dietary Diversity Score (DDS) measures the unevenness of the real value of consumption across major food groups (i.e., negative entropy distance from an estimated ideal food budget shares). The Dietary-Diversity-Growth Elasticity (DDGE) is the percentage change in the DDS per one percent increase in GDP per capita driven by GDP growth originating within the targeted agricultural sector.

Table 4.2 reports estimated dietary-diversity-growth elasticities (DDGE), which show how effective value chains are at diversifying the dietary patterns of household groups. Diversity is

measured by food expenditures across six major food groups (Box 2). Cereals and roots are already the dominant food group (Table 2.4), so expanding the supply of maize, sorghum and millet, and rice reduces dietary diversity by increasing availability and reducing prices.

Cocoa does not produce food for domestic consumption in Ghana, so expanding its production does not directly affect food availability and diets. Instead, this value chain affects food access by raising incomes, thereby indirectly affecting diets. [6] Overall, the value chains that are most effective at promoting dietary diversity amongst poor rural households are groundnut, pulses, other oilseeds and fruits. Note that fruits include nuts and other tree crops.

Table 4.3 reports the growth and employment earnings effects of expanding agricultural production in different value chains. Although the scenarios are labeled by the names of the value chains in which productivity growth originates, it does not imply that all GDP and employment earnings growth occurs only within these value chains. Increasing maize productivity, for example, may allow farmers to diversify production by reallocating resources to other crops and activities, including nonfarm enterprises. Increasing incomes of workers in specific value chains also allows their households to purchase products from other sectors or value chains, thereby generating economy-wide spillovers. The table reports GDP growth and employment earnings elasticities for the total economy and for the AFS only. The former is an indicator of agriculture-led development, whereas the latter is an indicator of agricultural transformation.

Table 4.3. Economy-wide growth and employment earnings linkages, 2016 to 2020

Targeted sector within agriculture	GDP growth elasticity (rank in parentheses)				Employment earnings elasticity (rank in parentheses)			
	Total		Agriculture-food system only		Total		Agriculture-food system only	
Maize	0.34	(5)	1.21	(5)	0.07	(5)	0.08	(9)
Sorghum & millet	0.32	(6)	1.16	(7)	0.03	(11)	-0.06	(15)
Rice	0.14	(15)	0.73	(14)	0.06	(7)	0.34	(5)
Pulses	0.29	(8)	0.79	(9)	0.12	(3)	0.12	(7)
Groundnut	0.22	(11)	0.76	(12)	0.01	(13)	-0.06	(14)
Other oilseeds	0.29	(7)	1.16	(6)	0.04	(10)	-0.01	(11)
Cassava	0.19	(14)	0.76	(11)	0.00	(14)	0.02	(10)
Other roots	0.20	(13)	0.74	(13)	0.00	(15)	-0.01	(12)
Vegetables	0.23	(9)	0.80	(8)	0.05	(9)	0.09	(8)
Fruits and nuts	0.22	(10)	0.77	(10)	0.01	(12)	-0.02	(13)
Cocoa	0.06	(16)	-0.02	(16)	0.35	(1)	3.75	(1)
Cattle	0.47	(3)	1.67	(2)	0.08	(4)	0.55	(3)
Poultry, Other livestock	0.59	(1)	2.88	(1)	0.07	(6)	0.79	(2)
Forestry	0.21	(12)	0.42	(15)	-0.05	(16)	-0.83	(16)
Fishing	0.48	(2)	1.62	(3)	0.06	(8)	0.28	(6)

Source: RIAPA CGE Model and SAM.
Notes: AFS is agriculture-food system; total is the whole economy. GDP (employment earnings) elasticity is the percentage increase in total or agriculture-food system GDP (employment earnings) given a one percent increase in agricultural GDP.

Agricultural activities with downstream processing generate larger growth multiplier effects within the AFS. Other oilseeds, for example, supply downstream fats and oils processing industries amongst others which in turn supply to many other industries including food, beverages and food services. The AFS growth elasticity of the other oilseeds is 1.16; implying that a one percent increase in agricultural GDP driven by other oilseed productivity increases AFS GDP by 1.16 percent. Oilseeds

[6] Income elasticities are estimated for rural and urban households using the 2010/11 household survey.

and related industries in the AFS tend to be more capital-intensive activities, at least compared to other value chains, so oilseeds is one of the least effective value chains at creating jobs outside of agriculture. Cocoa has an AFS employment earnings elasticity of 3.75, implying that a one percent increase in agricultural GDP driven by productivity gains for cocoa causes AFS employment to increase by 3.75 percent. It, however, has a small negative impact on AFS GDP. Overall, the value chains with the largest AFS growth effects are poultry and other livestock, cattle, and fishing.

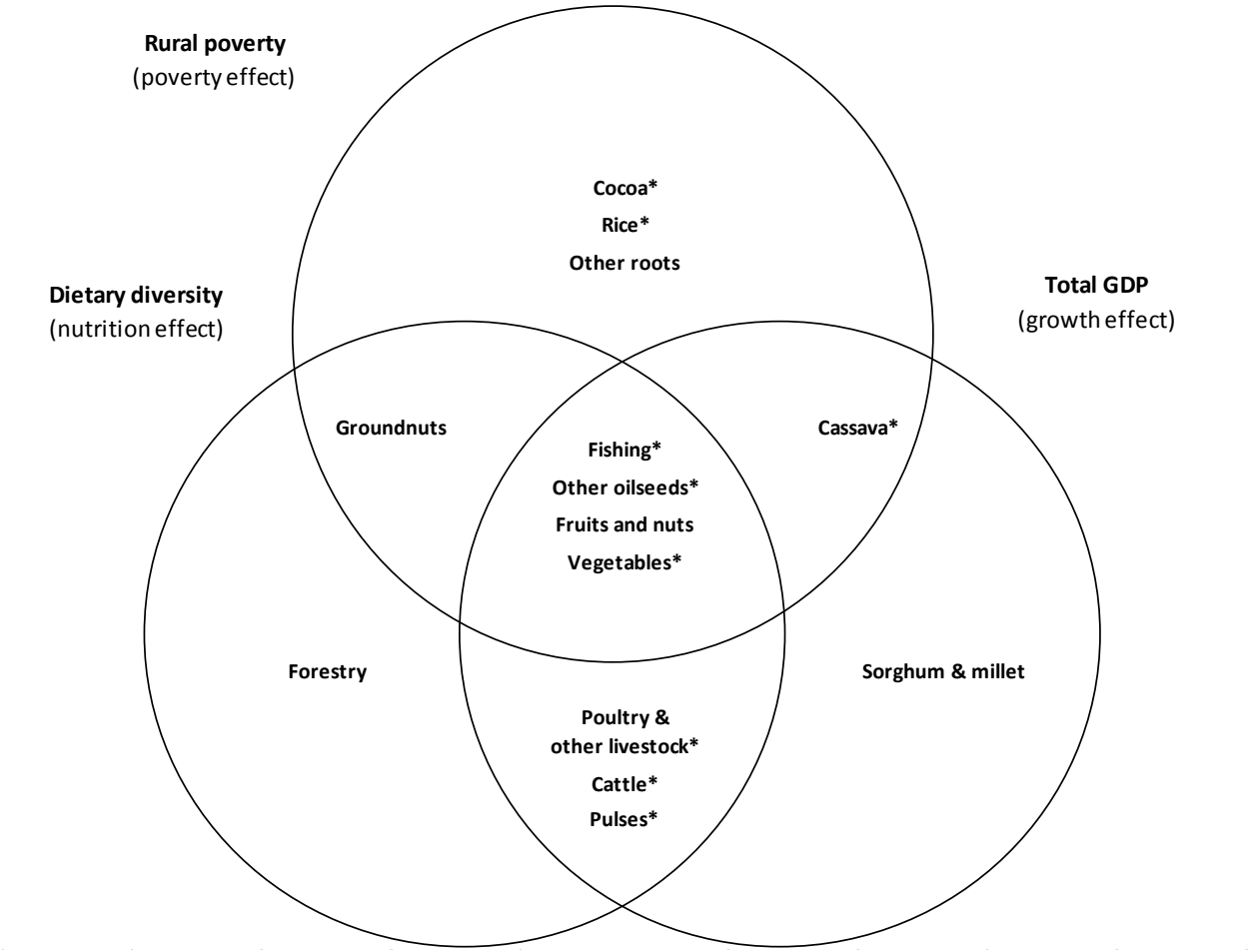
Table 4.3 also shows how growth effects may differ when considering the whole economy rather than just the AFS. Forestry, for example, is more effective at generating economy-wide growth than AFS growth. This is because there is relatively little downstream processing of pulses within the AFS, but it is an income source. Raising the incomes of households which are employed in the forestry sector generates demand for non-AFS products. Forestry also directly benefits consumers. The Ghana agrarian economy, however, is dominated by the AFS, implying that whatever is beneficial for the AFS tends also to be beneficial for the broader economy.

5. FINAL ASSESSMENT

No single value chain is most effective at achieving all policy objectives. Figure 5.1 shows the ten highest ranked value chains across three selected outcomes: (1) reducing the rural poverty headcount rate, (2) diversifying poor rural households' diets, and (3) promoting AFS GDP growth. Four products are in the top-ten for all three indicators: fishing; other oilseeds; fruits and nuts; and vegetables. Cassava is effective at reducing poverty and generating growth, but narrows rather than diversify diets. Groundnut diversifies diets and reduce rural poverty, but has more limited growth effects. Poultry and other livestock, cattle and pulses promote growth and diversify diets, but are less effective at raising poor households' consumption either directly as a supplier of food or indirectly as a source of income. Of these value chains, those with one of the ten strongest employment earning effects are marked with an asterisk. Cocoa is a strong job-creating value chain, but groundnuts are not.

A portfolio of value chains is needed to achieve all policy objectives. Figure 5.1 does not convey the relative strengths of a value chain across outcome indicators. For example, groundnut is far more effective at diversifying diets than most other value chains (see Table 4.2). Such a strong nutrition effect might outweigh concerns about groundnut's weaker growth effect. One approach to evaluating these kinds of trade-offs is to combine growth, poverty, and nutrition outcomes into a weighted or composite indicator. Table 5.1 reports the final prioritization of value chains using different weighting schemes. The first column assigns equal weights across outcomes, whereas the other columns give greater weight to each indicator, i.e., attributing half of the weight to one outcome and a quarter to the other two, thus creating a bias towards specific outcomes. The final analysis suggests that poultry and other livestock; groundnut; other oilseeds; cocoa; and pulses should be considered "priority" value chains, since these are highly-ranked irrespective of how outcomes are weighted. Other value chains that rank highly on multiple outcomes include cattle; fruits and nuts; and fishing.

Figure 5.1. Value chains with strong poverty, nutrition, and growth effects



Source: RIAPA CGE Model and SAM.
Notes: Poverty effect uses rural headcount SPGE (column 2 in Table 6); nutrition effect uses poor rural households' DDGE (column 3 in Table 7); and growth and employment earnings effects are for AFS only (columns 2 and 4 in Table 8).

Table 5.1. Final rankings of value chains under different weighting schemes

Rank	Equal weights	Poverty Bias	Nutrition Bias	Growth Bias
1	Poultry, Other livestock	Cocoa	Groundnut	Poultry, Other livestock
2	Groundnut	Poultry, Other livestock	Pulses	Cattle
3	Other oilseeds	Groundnut	Other oilseeds	Other oilseeds
4	Pulses	Other oilseeds	Poultry, Other livestock	Fishing
5	Cocoa	Pulses	Fruits and nuts	Groundnut
6	Cattle	Fruits and nuts	Cattle	Pulses
7	Fruits and nuts	Cattle	Vegetables	Fruits and nuts
8	Fishing	Fishing	Fishing	Vegetables
9	Vegetables	Vegetables	Cocoa	Cocoa
10	Rice	Rice	Rice	Maize

Source: RIAPA CGE Model and SAM.
Notes: Rankings based on weighted sum of outcome indicators. Equal weighting is one-third each; biased weighting favors one indicator (one-half) at the expense of others (one-quarter each).

In conclusion, Ghana's dominant agricultural activities – fruit and nuts; cocoa – contribute positively to national pro-poor growth. While these remain important, the analysis presented in this working paper suggests that a more balanced portfolio of value chains would not only enhance agriculture's future contribution to poverty reduction and economic growth, but also promote faster rural transformation and dietary diversification, both of which are needed to create job

opportunities and improve nutrition outcomes over the longer-term. This working paper has identified new priority value chains based on the potential contributions to national development. Further analysis of these value chains' growth and market potential is needed.

APPENDIX

Appendix Table 1. Composition of value chain product categories

Category	Detailed agricultural products in the product category or value chain
Maize	Maize
Sorghum & millet	Sorghum and millet
Rice	Rice
Pulses	Beans; pigeon peas; chick peas; cow peas; dry peas; dry lentils; other pulses
Groundnut	Groundnut
Other oilseeds	Soybean; sunflower seed; tung nuts
Cassava	Cassava
Other roots	Roots excluding cassava, e.g., potato, yam, etc.
Vegetables	Vegetables and derived products
Fruits and nuts	Plantains; banana; mango; guava; other fresh, citrus and tropical fruits; tree nuts
Cocoa	Cocoa
Cattle	Cattle
Poultry, Other livestock	Poultry and eggs; sheep; goats; camels; other livestock products
Forestry	Forestry products
Fishing	Fishing and aquaculture

Source: RIAPA CGE Model and SAM.

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