European Commission

JRC TECHNICAL REPORT

Social Accounting Matrix for Ghana 2015

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2021

Joint Research Centre

EUR 30720 EN

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EU Science Hub
https://ec.europa.eu/jrc

JRC125199

EUR 30720 EN

PDF ISBN 978-92-76-38077-1 ISSN 1831-9424 doi:10.2760/432014

Luxembourg: Publications Office of the European Union, 2021

How to cite: Ferreira, V., Almazán-Gómez, M.Á., Nechifor, V. and Ferrari, E., *Social Accounting Matrix for Ghana 2015*, EUR 30720 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-38077-1, doi:10.2760/432014, JRC125199.

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Acknowledgements

We are grateful to Karl Pauw from the International Food Policy Research Institute (IFPRI) for his updates on the Ghana SAM produced by the Ghana Statistical Services (GSS), Institute of Statistical, Social and Economic Research (ISSER) and IFPRI.

A special thanks to our colleagues Arnaldo Caivano and Javier Castro to improve the diffusion of our work with the online application

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Abstract

A Social Accounting Matrix (SAM) is a comprehensive and economy-wide database recording data on all transactions between production activities, factors of production, institutions, and the rest of the world within a specific economy during a certain period. It has two principal objectives. First, it represents a complete snapshot of the economy showing the economic structure and the circular flow of income and expenditure in the country or region under analysis. Second, in order to analyse how the economy works and to predict the effects of policy interventions, it is used as a database in multisectoral linear models by calculating multipliers, and for the calibration and exploitation of Computable General Equilibrium (CGE) models. This report presents Ghana's SAM for 2015, with the main purpose of providing a suitable database for implementing and evaluating the country's own developmental, social and economic policies and initiatives. To this end, the structure of the SAM is presented in detail, explaining the meaning of each account and indicating some estimations and modifications made. Considering the characteristics of the Ghanaian economy, this SAM shows a special structure to reflect the Home Production for Home Consumption (HPHC) issue and a high disaggregation of the agricultural and food sector. Furthermore, considering the SAM as a database, a descriptive analysis of the Ghanaian economy and the linear multipliers analysis are presented. Annex 2 explains how to download the matrix available online.

1 Introduction

The European Commission is committed to cooperate with developing countries to provide solutions to problems related to inequality, nutrition and food security. This is carried out by evaluating related policies, facilitating the access of researchers in these countries to analytical tools that allow them to carry out such assessments on their own. In this sense, the Joint Research Centre (JRC), the European Commission's in-house science service, is committed to provide support for: i) improvement of information systems on agriculture, nutrition and food security, ii) policy and economic analysis to support policy decision-making process and iii) scientific advice on selected topics concerning sustainable agriculture and food and nutrition security.

In particular, the Economic of Agriculture Unit of the JRC Directorate D, Sustainable Resources, is responsible to elaborate the methodology and tools to provide economy-wide analysis related to sustainability of policies in the sectors of agri-food, sustainable resources and fight against food and nutrition insecurity. The analyses and tools proposed should support the EU institutions, and the partner countries for the elaboration and assessment of policies and demand-driven technical and scientific advice. Among possible scientific tools, economic simulation models represent interrelationships between selected economic variables and provide a simplified representation of economic reality to be used to quantify impacts of policy changes (i.e., ex-ante policy analysis).

The construction of databases to provide evidence-base policy support to partner countries is part of the objectives of the Pan-Africa Network for Economic Analysis of Policies (PANAP). PANAP is a network among academic/research and institutional partners collaborating with the JRC in developing research on agricultural economics and policy issues with a focus on Africa. PANAP is part of the Action Agenda of the Political Declaration of the 3rd AU-EU Agriculture Ministerial Conference held in Rome on 21 June 2019 (EC Decision C(2019) 4277).

At the launch and first meeting of PANAP (6-8 November 2019, Addis Ababa, Ethiopia) key stakeholders, researchers, data analysists, policy makers, from national and multilateral institutions engaged in fruitful discussion on the role of science in supporting policy decision making in Africa with focus on the farming and food sectors (Morokong & Ferrari, 2020). The general objective of PANAP is to strengthen the liaison between researchers/scientists and policy makers in Africa, including relevant multi-lateral African institutions, and to stimulate their cooperation on selected topics linked to policy priorities in Africa. PANAP will also contribute in understanding and resolving scientific issues in the fields of agriculture and food security to support efficient policies. It will also facilitate achieving sustainability of the agri-food sectors to enhance food and nutrition security in alignment with the Malabo Declaration Commitment 3 on ending hunger in Africa by 2025 and SDG 1 and 2.

Ghana is one of the countries analysed in this context, and the main pillar in the macroeconomic analysis is the use of a tailored version of a single-country Computable General Equilibrium (CGE) model to analyse some of the agricultural and rural policy priorities to reduce inequalities, considering the specificities of the economy in the country. In the case of Ghana, there are remarkable differences in employment and welfare between the southern and northern regions. Furthermore, there is particular interest in the agricultural, fishing, and forestry sectors. Therefore, the promotion of policies focus on the development of the norther region requires the elaboration of specific database that provide a description of the regional economies with the interlinkage between them and the disaggregation of the main sectors.

The calibration of CGE model requires a complex database system, called Social Accounting Matrix (SAM). The estimation of a new SAM for Ghana is an important achievement itself, because it provides detailed information about the economic structure of the country and serves, also, as main database for linear multisectoral models. The latest Ghana SAM for 2015 has been estimated jointly by the Ghana Statistical Services (GSS), the Institute of Statistical, Social and Economic Research (ISSER) and the International Food Policy Research Institute (IFPRI). This report presents the modifications and extensions to the SAM to obtain a database for the analysis of different policies at stake.

The rest of the report is structured as follows: the concept, general issues and the accounts description of Social Accounting Matrices are presented in Section 2, while section 3 describes the structure and estimation of the Ghana SAM 2015. That section begins with a kind of introduction of the Home Production for Home Consumption issue, a key aspect of this new SAM. Later, description of structure and estimations of the Ghana SAM is presented, detailing the accounts and data basis used and the final adjustments, SAM balancing and disaggregation procedures. The Section 4 shows a description of the Ghana Economy structure using SAM data and a simple multiplier analysis is presented to illustrate the usefulness of the SAM linear models in policy impact assessment. Finally, section 5 includes some conclusions and Annex shows some additional tables and presents the downloadable application.

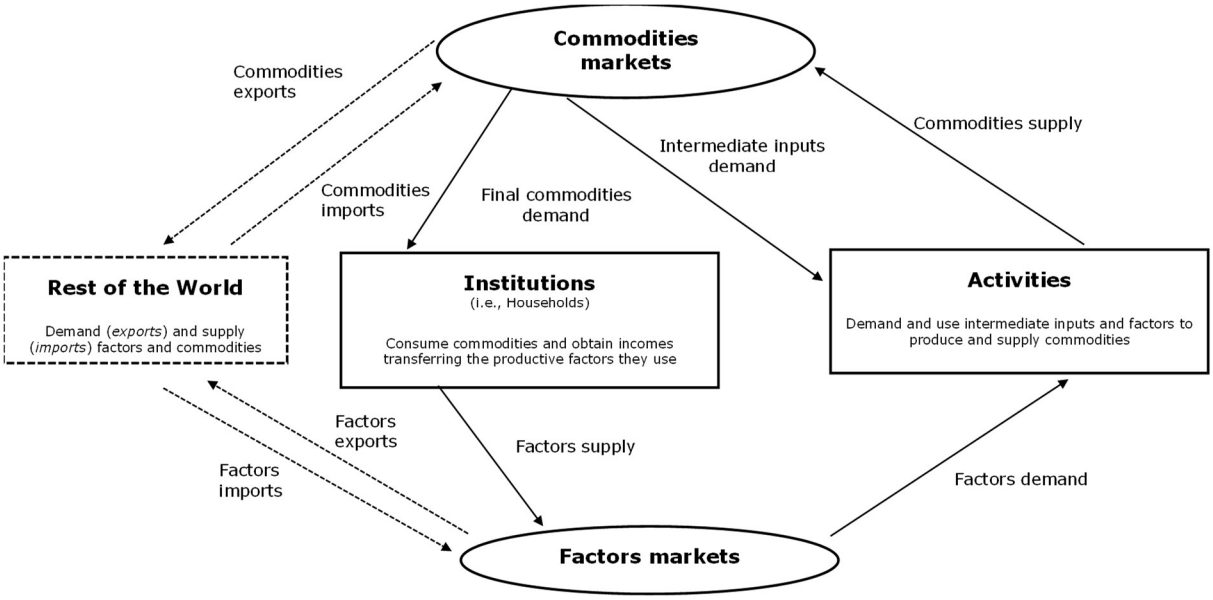
2 Social Accounting Matrices. Concept and general issues.

A Social Accounting Matrix (SAM) is a comprehensive and economy-wide database that enables the representation of economic and social information on all the transactions carried out among the agents of a specific economy over a period of time, generally one year. A SAM includes the relationships between economic agents in terms of production, trade, income generation, consumption, saving, and investment. As such, a SAM is a very useful tools to understand the structure of an economy and as a standard database for economic modelling. In this sense, SAM can be used as a database for multisectoral linear models allowing the calculation of multipliers or it can also be used as a database for the application of more complex Computable General Equilibrium (CGE) models (Mainar-Causapé et al., 2018a).

The origins of SAMs are found in the pioneering works of Stone (1947) among others, and subsequent advances in their use as a model for economic analysis (Defourny & Thorbecke, 1984; Pyatt & Round, 1985). A SAM extends the information provided by the Input-Output table by incorporating all economic transactions, using a more disaggregated accounting structure. This allows closing the circular flow of income and expenditure among production, consumption, employment, taxes and savings, and trade. For this reason, the elaboration of a SAM requires the use of many statistical sources, mainly the statistical systems of National Accounts, data on trade, as well as socio-economic data related to household income, employment and expenditure that can be obtained from household budget surveys and labour force surveys. With this information, households can be disaggregated using socio-economic characteristics (e.g. income, education, rural-urban division, etc.) to analyse income distribution. The need for further information depends on the disaggregation required for each account depending on the type of analysis to be carried out.

The underlying basis of a SAM is the concept of a circular flow of income represented ([1]) in Figure 1.

Figure 1. The circular flow (simple version)



Source: Mainar-Causapé et al., 2018b.

The circular flow of income of a SAM reflects the interlinkages among production, trade, demand, income generation and its redistribution between institutional sectors (Pyatt & Round, 1985), providing the opportunity to analyse the distribution of wealth and income. ([2])

On the one hand, a SAM shows a descriptive detail of the economy under analysis. On the other hand, it is a suitable database for economic modelling that considers the analysis of socio-economic issues such as employment, poverty, income growth and distribution, trade, etc, allowing to evaluate the impact of different policies.

([1]) Represents the basics of the circular flow. The circular flow is more complicated, existing multiple transactions between institutions (savings, direct taxes, transfers, etc.) other flows as taxes on commodities or activities (Mainar-Causapé et al., 2018b).

([2]) Some problems of I-O frameworks are still present in the SAM framework (i.e. the use of coefficients and fixed prices for inputs and finished products and no substitution elasticities) (Mainar-Causapé et al., 2018a).

The SAM is a database represented by a square matrix, which shows all the transactions that take place between agents in an economy, determining how income is generated and how it is expended. For this purpose, each account is represented by a row and a column, which shows the origin of the income of the different accounts (by the row) and the expenses or payments made (by column), both in monetary values. Thus, each cell (i, j) shows the transaction between account i and j, in which account i receives income from j.

2.1 Structure of a SAM

Typically, a Social Accounting Matrix has six basic groups of accounts:

- Activities or Commodities (or both, separated)
- Factors of production
- Private Institutions (Households and Corporations/Enterprises)
- Public Institution (Government)
- (Combined) Capital accounts
- Accounts for the Rest of the World.

Figure 2 shows the basic structure of a standard SAM ([3]); however the structure of the matrix will be determined by the accounts included in these six basic groups and the disaggregation of these accounts. The structure of a SAM, the disaggregation of its accounts and the geographical scope it represents (national, regional, multi-regional, etc.) may be flexible according to the analysis to be carried out.

([3]) The general characteristic of this structure, as well as specific issues of its definition and composition can be found in Miller & Blair (2009), Eurostat (2008) or Mainar-Causapé et al. (2018b).

Figure 2. A Social Accounting Matrix (SAM) standard structure

	Commodities	**Margins**	**Activities**	**Factors**	**Households**	**Enterprises / Corporations**	**Government**	**Savings-Investment**	**Rest of the World**	***Total***
Commodities		Transaction costs (trade / transport)	Intermediate (inputs) consumption		Household consumption		Government expenditure	Investment and stock changes	Exports	*Demand*
Margins	Transaction costs (trade / transport)									*Margins*
Activities	Domestic production									*Gross output / Production (activity income)*
Factors			Remuneration of factors / Factor income						Factor income from RoW	*Factor income*
Households				Factor income distribution to households	*(Inter Households transfers)*	Distribution of enterprise income to households	Government transfers to households		Transfers to Households from RoW	*Household income*
Enterprises / Corporations				Factor income distribution to enterprises			Government transfers to enterprises		Transfers to Enterprises from RoW	*Enterprise income*
Government	Net taxes on products		Net taxes on production	Factor income to Government / Factor taxes	Direct Household taxes / Transfers to Government	Direct Enterprise taxes / Transfers to Government			Transfers to Government from RoW	*Government income*
Savings-Investment				*(Depreciation)*	Household savings	Enterprise savings	Government savings	*(Capital accounts transfers)*	Capital transfers from RoW (Balance of Payments)	*Savings*
Rest of the World	Imports			Factor income distribution to RoW	Household transfers to RoW	Enterprise income to Row	Government transfers to RoW			*Payments to RoW*
Total	*Supply*	*Margins*	*Costs of production activities*	*Expenditure on factors*	*Household expenditure*	*Enterprise expenditure*	*Government expenditure*	*Investment*	*Incomes from RoW*	

Source: Aragie et al. (2017), Kiringai et al. (2007), Mainar-Causapé et al. (2018b) and Round (2003).

2.2 Economic agents and accounts

2.2.1 Activities and Commodities

The standard SAM structure (Figure 2) distinguishes between Activities (that carry out the production of commodities) and Commodities (market goods and non-factor services). SAM flows are valued at production costs in the accounts of Activities and at market prices in the Commodities accounts (including indirect taxes on raw materials and transactions cost or margins). The domestic production is the sum of the values of Activities (at production prices). To obtain the supply of Commodities (at purchaser's prices), net taxes on products, margins and imports must be added. The supply of Commodities is sold domestically (activities, households, government) or exported.

By analysing the cells by columns, Activity accounts represent the intermediate consumption of commodities as inputs and the use of factors of production (such as labour, capital, land, etc.). The sum of the remuneration of factors plus taxes less subsidies on production is the value added by Activities. By rows, Activities cells show the value of commodities produced by each activity (in basic prices).

In the Commodity columns, payments are made to Activities for the domestic production, the rest of the world (imports) and to the government (payment of taxes - including VAT ([4])- or receipt of subsidies on products, domestic and imported) (Mainar-Causapé et al., 2018a). The column total of each Commodity is the supply value at domestic purchaser prices. Next, it is possible to read across the Commodities rows to determine commodities demand. Each Commodity row is composed of intermediate consumption (by Activities) and the final demand consumption by institutional sectors (Household and Government), investment and exports.

In a SAM, trade flows (moving goods between producers, markets, and national borders, either for domestic, import or export) are associated with the transaction cost (trade and transport) which are part of the costs of supplying commodities. Therefore, for each product the SAM records costs associated with cost of marketing and transportation (margins) (Mainar-Causapé et al., 2018b).

2.2.2 Factors

The factors of production relate to the primary factors used in the production process. Traditionally, they include capital and labour, as well as other types of factors, such as land or other natural resources. The production factors can be disaggregated according to the objective of the analysis. For example, labour account can be disaggregated by occupation groups or educational attainment and capital factor can be disaggregated in accordance with their use i.e. agricultural/non-agricultural capital.

The production factors collects, by row, the income received (wages, rent, etc.) by the activities and the rest of the world. These incomes are distributed to the owners of the factors of production (Household, Enterprises and Government) and the Rest of the World (shown by columns).

2.2.3 Households

The classification and disaggregation of the Household accounts in a SAM traditionally adopts the concept of Representative Household Group (RHG) which means that different household groups are represented by an aggregated account, assuming that all individual household in an RHG are, on average, affected in the same manner by a policy shock. This type of information is crucial for the analysis of socio-economic problems (unemployment, income distribution etc.)

The rows for Households represent the incomes received, which includes income from factors supplied (as owners of labour, capital, land, or natural resources), transfers from Enterprises (distributed profits and direct transfers), from the Government (direct transfers), from the Rest of the World (usually for labour services and remittances) and from other households (Mainar-Causapé et al., 2018b).

Household expenditure is represented by the household column, showing the use of household income for consumption of commodities, payment of direct taxes to the government, transfers to other households (domestic and foreign); the difference between income and expenditure represents households' savings (or financing need if negative).

([4]) Valued Added Tax (VAT) is tax on (final demand) commodities and NOT on tax on value added (Mainar-Causapé et al., 2018a).

2.2.4 Enterprises

Enterprises receive incomes related to the asset ownership (capital, land, or natural resources) and income by transfers form other institutions. Those revenues are then transferred to other institutions, for example households in the form of dividends, and are also used to pay direct taxes (corporation tax) or converted into savings. Enterprises represent the institutional part of the productive sector, so generally they do not consume inputs such as activities.

2.2.5 Government and Public Sector

The Government participates as a "productive activity" through the public sector and the marketed goods and services resulting from their activities are recorded in the respective Activity and Commodities accounts (Mainar-Causapé et al., 2018a). Generally, the Public Administration institutional sector is represented by the Government account for the sector itself, while tax collection is captured through other accounts specific for each tax category (VAT, income, tariffs, etc.).

By row, Government income comes from taxes, transfers received (domestic and foreign) and the remuneration of factors of production (including any government-owned assets). By column, Government expenditure is broken down into the consumption demand of goods and services, transfers to other institutions in form of subsidies or benefits (household and enterprises) or to other countries (e.g. debt services payments). Government savings (government surplus) or government deficit (if negative), which enters the saving-investment cell, is calculated as the difference between income and expenditure.

2.2.6 Saving-Investment

The row of this account records the savings generated by all domestic institutions (households, enterprises, and government) as well as the balance of foreign trade on capital account with the rest of the world. The column shows capital investment, the Gross Fixed Capital Formation (GFCF) and changes in stocks.

2.2.7 Rest of the World

The foreign sector account shows the economic interaction within the country (or region) analysed and the rest of the world. The foreign sector represents two trade accounts (imports and exports) and can be disaggregated depending on the specific interest of the analysis (e.g., ECOWAS, African Union and Rest of the world).

The income received by the rest of the world account include imports of goods and services (commodities), transfers to abroad from institutions (households, businesses and government), and the remuneration of factors of production abroad. The Rest of the World expenditures are divided into the purchase of goods and services (exports), the payments to domestic factors of production used abroad and transfers recorded from other economies (factor payments, foreign loans and aid, remittances, etc.). The balance, which enters the saving-investment cell, reflects the surplus or deficit with the Rest of the World and consequently the capital inflow (in case of negative trade balance) or outflow (positive trade balance) between the Rest of the World and the country at stake.

3 Ghana SAM 2015

3.1 Home Production for Home Consumption (HPHC) approach

In developing countries, the dual role of households as producers and consumers is often a typical characteristic of economies with a large share of subsistence agriculture; therefore, there is a need to define and estimate the home production for home consumption (HPHC) within a SAM.

The classic Representative Household Group (RHG) includes the household behaviour as consumer of goods and services and as providers of factors of production (and receptor-contributors of transfers). The Home Production for Home Consumption (HPHC) concept is introduced in the SAM by assuming that households act as units of production of commodities consuming part or all of their output. Thus, it is necessary to expand the structure of the SAM including extra sets of column and rows as sub-columns and sub-rows of the commodity and activity accounts.

In the case of the Commodities accounts, this requires additional rows and columns to separate the commodities produced by these households for own consumption (HPHC as input or final product) and other marketed commodities (produced both by conventional productive activities and by households). The rows of these commodity accounts show the HPHCs use as intermediate inputs in the productive activities of households and their consumption in final demand of household (RHG). The column summarizes the contribution of the activities of households to each of these goods. HPHC commodities can only be produced by the RHGs that consume those commodities, so each RHG must be a household and an activity. The columns of the household's activities show how they use inputs (HPHC and marketed), and the rows show the destination of their production as inputs (own-consumption goods or marketed commodities). All the tax and trade and transport costs incurred should be allocated solely to the marketed component of the commodity (Mainar-Causapé et al., 2018a).

The inclusion of HPHC in a SAM requires more data from surveys and censuses and some additional estimations. Data for HPHC requires segmenting consumption demand between marketed and HPHC commodities and identifying the costs structures used in production. Typically, this will require reconciling data from different sources, especially household income and expenditure, labour force and agricultural (production) surveys.

3.2 Structure and estimation of the 2015 Ghana SAM

For this study, a new SAM for Ghana (base year 2015) was estimated based on the standard structure outlined above with some peculiarities. The new SAM includes specific accounts for the treatment of HPHC and includes a high regionalisation based on social characteristics differentiated across administrative regions. Consequently, this new framework would allow addressing specific issues related for example to production and productive factors for each region, in order to reduce inequality within and between regions.

The Ghana SAM is based on the standard structure that distinguishes between activities and commodities. The structure and a short version of the SAM is summarised in Table 1.

The regional breakdown in the SAM for Ghana 2015 correspond to 10 regions (reflective of the sub-national boundaries prior to the 2018 referendum). Each regional household is disaggregated into rural and urban and further separated into per capita expenditure quintiles. Finally, 100 different Representative Household Group (RHG) are detailed in the SAM – for each region, households are separated into the rural and urban groups and across income quintiles. Furthermore, each region has a specific agricultural activity producing 14 "subsistence commodities" destined for home consumption, and 20 marketed commodities. The remaining 35 marketed commodities are produced specific activities aggregated at a national level. The Ghana SAM further contains 74 accounts of production factors. There are 3 types of labour, 1 for land factor and 4 types of capital. Labour and land factors are disaggregated across the 10 regions, with labour factors are also separated between rural and urban.

In summary, the 2015 Ghana SAM contains 299 accounts; 45 activities (10 household agricultural activities and 35 activities), 69 commodities (14 home commodities and 55 marketed commodities), 74 factors of production (60 labour accounts, 10 land factors and 4 capital factors), 100 households (disaggregated by rural/urban, region and quantiles) and 4 taxes accounts. Finally, there is a single account for margins, one corresponding to enterprises, one for the government, one for the rest of the world, one for investing and saving and other for change in stocks. **In Annex 1**, Table A1 shows all accounts considered in the Ghana SAM 2015. **In Annex 2** can be found the on-line resources to download the complete 2015 Ghana SAM.

This base SAM database for Ghana was also disaggregated for a specific analysis on the cocoa sector where cocoa output is detailed across the 10 administrative regions separate from the other agricultural production. This version of the Ghana SAM is available upon request.

3.2.1 Accounts and data sources

3.2.1.1 Activities and Commodities

For the initial values of rows and columns for commodities and activities the Ghana SAM 2015 developed by the GSS, ISSER and IFPRI was considered (GSS, 2017).

The HPHC approach mentioned before is introduced in the SAM by assuming that each household also acts as a producing unit. Therefore, estimates are required for the additional commodity and activity accounts. Considering this approach, household can be divided between the classic Representative Household Group (RHG) as consumer of good and services, providers of factors of production (and receptor-contributors of transfers) and the household presented as units of production of commodities. The latter accounts represent the economic behaviour of households as producers of food commodities (agricultural and livestock products) and have been broken down regionally. In view of this approach, it is also necessary to separate accounts for commodities produced by these households for own consumption and other marketed commodities (produced both by households and by conventional productive activities).

The SAM for Ghana is characterized by a high disaggregation of agricultural and food activities and commodities. There is one agricultural households' activity for each region that produce 14 "subsistence commodities" and 20 marketed commodities and there are 35 Activities that produce 35 marketed commodities.

In summary, the 2015 Ghana SAM includes 45 activities (10 of them are households as producers), producing 14 HPHC commodities and 55 marketed commodities. Table 2 summarised the breakdown of commodities and activities, and they are also show in detail in Appendix I Table A1 (Accounts of the Ghana Social Accounting Matrix 2015).

3.2.1.2 Households

In the case of the Ghana SAM 2015, the breakdown distinguishes between rural and urban households using the country official definition of these areas and disaggregated each one by regions. Moreover, households are further disaggregated into per capita expenditure quintiles using information from the 2016/17 GLSS7 (Ghana Living Standards Survey Round 7) (GSS, 2019). Quintiles are defined at the national level, meaning that the combined population of each quintile (rural and urban quintiles) is a fifth of the national population (GSS, 2017).

As a result, the Ghana SAM 2015 contains 100 representative household groups (RHG). Such classification will allow for a good analysis of redistributive aspects and the specific impact of different policies. The description is summarized in Table 3.

3.2.1.3 Factors of production

The disaggregation of production factors is very important depending on the objective of the analysis. In the Ghana SAM 2015, factors are separated into three broad categories: labour, land and capital (see table 2). The SAM developed in this report classified the labour factors into three types of labour: skilled, semi- skilled and unskilled labour. Each labour factor is also regionalized given the 10 regions and further separated into rural and urban. This information is disaggregated using the data derived from the 2016/17 GLSS7 (GSS, 2019) and the Labour Force Survey 2015 (GSS, 2016). Also, four types of capital are considered: crops, livestock, mining and other, and one account for land factor (agricultural crops) for each region.

3.2.1.4 Other accounts

For the Public sector, the Ghana SAM disaggregated into the government account for the sector itself and other accounts representing different types of taxes and subsidies: direct, sales, import and exports, show on Annex 1, Table A1.

Direct taxes on enterprise and households (dirtax), includes corporate and other direct taxes paied by enterprises to the government and direct income or personal taxes paid by households (taxes on income, profits and capital gains that are "payable by individuals") taken from the Government Financial Statistics (GFS). Lastly, net taxes

on products includes all indirect taxes imposed on goods and services: sales (saltax), export (exptax) and import tariffs (imptax) (GSS, 2017).

Transaction cost includes trade and transport cost from moving goods between producers, markets and/or national borders, either for domestic, import or export trade.

Saving and investment account includes by row the domestic private saving by enterprises and households and the fiscal surplus (or deficit) for the government. By columns, includes the combination of gross fixed capital formation (investment on commodities as machinery, vehicles, and equipment) and change in stocks (dstk).

Table 1. Ghana SAM 2015 with aggregated values. Millions of Ghanaian Cedis.

	ch	c	trcost	ah	a	flab	fland	fcap	hh	enterp	govert	dirtax	exptax	imptax	saltax	i-s	dstk	row	Total
HPHC Commodities (ch)				16					4,547										4,562
Marketed Commodities (c)			22,439	4,213	123,349				84,099		22,341					35,964	2,540	52,257	347,203
Margins (trcost)		22,439																	22,439
Households as activities (ah)	4,562	21,662																	26,225
Activities (a)		223,194																	223,194
Labour factors (flab)				8,235	34,960														43,196
Land factors (fland)				8,387	0														8,387
Capital factor (fcap)				5,373	64,885													781	71,038
Households (hh)						43,196	8,387	4,177		59,290	1,571							4,991	121,612
Enterprises (enterp)								63,966			9,020								72,986
Government (govert)									290	6,088		7,392	361	5,014	9,688			2,775	31,607
Taxes - direct (dirtax)									3,572	3,819									7,392
Taxes - export (exptax)		361																	361
Taxes - import (imptax)		5,014																	5,014
Taxes - sales (saltax)		9,688																	9,688
Savings-investment (i-s)									29,104	3,789	-3,053							8,665	38,504
Change in stocks (dstk)																2,540			2,540
Rest of world (row)		64,844						2,895			1,729								69,468
Total	4,562	347,203	22,439	26,225	223,194	43,196	8,387	71,038	121,612	72,986	31,607	7,392	361	5,014	9,688	38,504	2,540	69,468	

Source: Own elaboration

Table 2. Activities and commodities disaggregated in Ghana SAM 2015

HPHC commodities	***Marketed commodities***	***Representative Households Groups as activities***	***Activities***
Maize	Maize	Western	Forestry
Sorghum and millet	Sorghum and millet	Central	Crude Oil
Rice	Rice	Greater Accra	Other mining
Pulses	Pulses	Volta	Meat, fish and dairy
Groundnuts	Groundnuts	Eastern	Fruit and vegetable processing
Other oilseeds	Other oilseeds	Ashanti	Fats and oils
Cassava	Cassava	Brong Ahafo	Grain milling
Other roots	Other roots	Northern	Sugar refining
Vegetables	Vegetables	Upper East	Other foods
Fruits and nuts	Sugar cane	Upper West	Beverages
Cattle	Tobacco	Upper West	Tobacco (processed)
Poultry	Cotton and fibers		Textiles
Other livestock	Fruits and nuts		Clothing
Fishing	Cocoa		Leather and footwear
	Coffee and tea		Wood and paper
	Other crops		Petroleum
	Cattle		Chemicals
	Poultry		Non-metal minerals
	Other livestock		Metals and metal
	Forestry		Machinery and equipment
	Fishing		Other manufacturing
	Crude oil		Electricity, gas and steam
	Other mining		Water supply and sewage
	Meat, fish and dairy		Construction
	Fruit and vegetable processing		Wholesale and retail trade
	Fats and oils		Transportation and storage
	Grain milling		Accommodation and food services
	Sugar refining		Information and communication
	Other foods		Finance and insurance
	Beverages		Real estate activities
	Tobacco processing		Business services
	Textiles		Public administration
	Clothing		Education
	Leather and footwear		Health and social work
	Wood and paper		Other services
	Petroleum		
	Chemicals		
	Non-metal minerals		
	Metals and metal products		
	Machinery and equipment		
	Other manufacturing		
	Electricity, gas and steam		
	Water supply and sewage		
	Construction		
	Wholesale and retail trade		
	Transportation and storage		
	Accommodation and food services		
	Information and communication		
	Finance and insurance		
	Real estate activities		
	Business services		
	Public administration		
	Education		
	Health and social work		
	Other services		

Source: Own elaboration based on GSS (2017).

Table 3. Description of factors and households in Ghana SAM 2015

Description	***Notes***
Factors	
Unskilled labour	0-6 years of formal schooling
Semi-skilled labour	Primary and secondary (7-12+ years of formal schooling and/or incomplete tertiary education)
Skilled labour	Complete tertiary education (e.g., degree, certificate, diploma).
Land-agricultural crops	Harvested crop land
Capital – crops	For agricultural crops (e.g., tractors, irrigation infrastructures)
Capital - livestock	For livestock (e.g., live animals, paddocks, beehives).
Capital - mining	For mining (e.g., mineral resources, mining equipment)
Capital - other	Capital - other
Households	
Rural -quintiles 1 to 5	Rural households with or without crop and /or livestock incomes separated into national per capita expenditure quintiles.
Urban -quintiles 1 to 5	Urban households with or without crop and /or livestock incomes separated into national per capita expenditure quintiles.

Source: Own elaboration based on GSS (2017).

3.2.2 SAM final adjustment and balancing

For the construction of the SAM presented in this report, the 2015 Ghana SAM, developed as part of a collaboration between the Ghana Statistical Services (GSS), the Institute for Statistical, Social and Economic Research (ISSER) and the International Food Policy Research Institute (IFPRI), was used. Furthermore, two sources were used to carry out the aforementioned disaggregation: the 2016/2017 Ghana Living Standard Survey 7 (GSS, 2019) and the 2015 Labour Force Survey (GSS, 2016).

The 7th Ghana Living Standards Survey (GLSS) it is a household-based survey focusing on key socio-economic characteristics and well-being of households in Ghana. The data was collected between 22nd October 2016 and 17th October 2017 and provides information for understanding and monitoring living conditions in Ghana (GSS, 2019). The survey has a sample size of 15,000 households with a response rate of 93.3%, and the data collected includes detailed information on demographic characteristics, education, health, employment, migration and tourism, housing, household agriculture, expenditure and income, financial services, among others (GSS, 2019). The Household Questionnaire consisted of four modules, namely A, B, C and D. Data from the modules (A, B and C) was used to estimate the SAM in this report. The Module A includes 7 sections with information regarding: demographic characteristics of respondents; education and skills training; health; employment; migration, tourism and ICT and housing. The Module B covers household agriculture; household expenditure; income transfers; migration and remittances; credit, assets, savings and use of financial services. Lastly, the Module C comprises Section 10 that covers non-farm household enterprises focusing on: employment, wage earnings, quantity and cost of materials purchased, value of production and sale of products, revenue, expenditure, assets of enterprises and consumption, payments and savings (GSS, 2019).

The 2015 Labour Force Survey collects basic statistics on the labour force situation in Ghana, including for example indicators on employment and unemployment. It was performed from November 2015 to December 2015 in each region of Ghana and covered 6,030 households (GSS, 2016).

Using the microdata provided by the aforementioned surveys, it is possible to obtain the necessary information for the disaggregation of Household account in the sub-accounts of the structure of this SAM.

Regarding the regions, it is necessary to distinguish between the southern and northern regions of Ghana as there are disparities in employment and welfare. As the government is interested in promoting policies to improve equality among the regions, the 2015 national SAM for Ghana is disaggregated into 10 regions that are distinguished into northern and southern regions. The regional breakdown in the 2015 Ghana SAM includes in the northern region the Northern, Upper East and Upper West. The southern region is defined by the Brong-Ahafo, Volta, Ashanti, Western, Central, Eastern and Greater Accra regions (GSS, 2017) (table 4). The regional disaggregation has been applied to both households, as productive units (activities), and as institutional units, and for labour and land factors.

Table 4. Regional description in Ghana SAM 2015

Northern	Southern
Upper West	Central
Upper East	Western
Northern	Greater Accra
	Volta
	Eastern
	Ashanti
	Brong Ahafo

Source: Own elaboration based on GSS (2017).

The main problem in estimating a disaggregated SAM is to find a way to incorporated and reconcile the information from many sources. In order to address this issue and obtain an estimated and balanced matrix, the RAS and Cross Entropy methods were used. The RAS procedure, also knows as a "biproportional" matrix balancing technique, is used to reconcile the data in a matrix with certain previously defined row and column values. This methodology is based on a process of iterations up to finding the balance between rows and columns (Bacharach, 1970). The cross-entropy approach represents an extension of the standard RAS method and provides a flexible and powerful method for estimating a social accounting matrix (SAM) when dealing with scattered and inconsistent data (Robinson, et al., 1998). These methods are useful when there is not enough information but macroeconomic targets or targets for specific accounts and cells or sub-matrices are available (McDougall, 1999; Robinson et al., 2001).

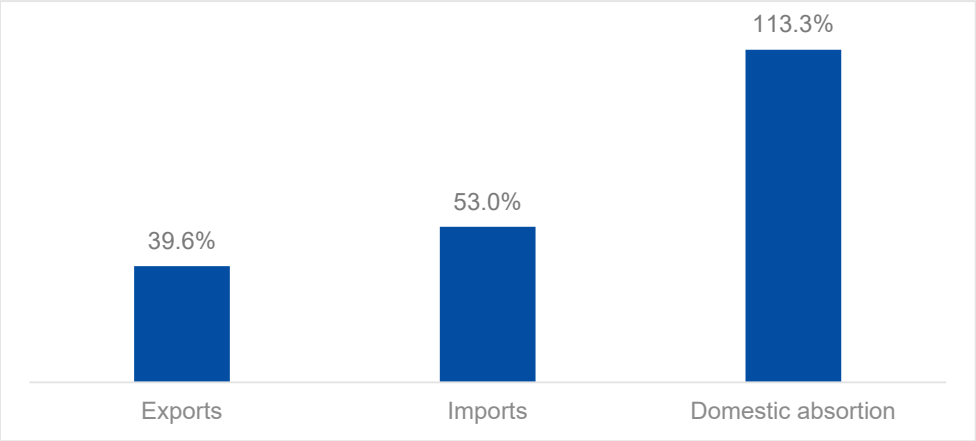
4 Ghana 2015 analysis with SAM data

4.1 Economy structure analysis

A SAM facilitates the description of the economic reality of a country. The data analysis of the Ghana SAM for the year 2015 provided a snapshot of the characteristics of the Ghana economy. Starting with the supply of commodities (351,765 Millions of Ghanaian Cedis), 1.3 % belongs to the HPHC commodities.

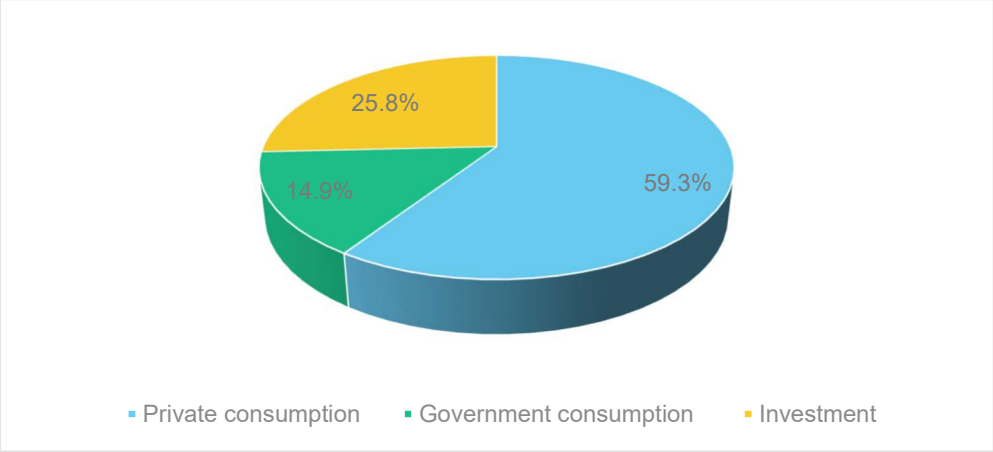
The macroeconomic analysis shows that domestic absorption represents 113.3% of the GDP and the foreign sector dependency shows that exports represent 39.6% and imports 53% of the GDP (figure 3). Regarding the composition of domestic absorption, private household consumption represents 59.3%, followed by investment representing 25.8% and government expenditure 14.9% (Figure 4).

Figure 3. Domestic absorption, imports, and exports as % of the GDP. Ghana 2015.



Source: Own elaboration with Ghana SAM 2015.

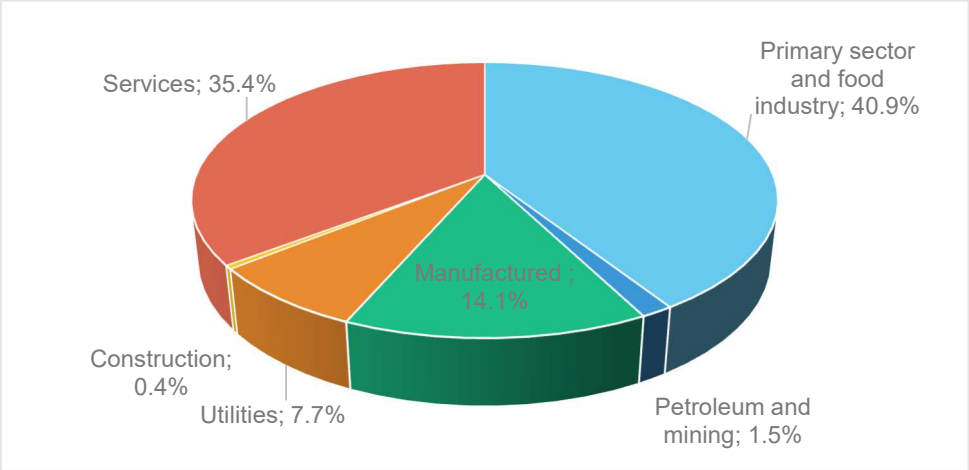
Figure 4. Domestic absorption composition. Ghana 2015.



Source: Own elaboration with Ghana SAM 2015.

By analysing the pattern of household consumption, the primary sector and food industry stand out with 40.9% of expenditure and the second most important one are services with 35.4% of the household consumption (Figure 5). Within agriculture, vegetables, fruits and nuts, other roots, and cassava and within the food industry sector grain milling, meat, fish and dairy, and beverages are the most demanded products by households. Of the expenditure on services, 28.3% is spent on accommodation and food services, 20.8% on other services and 13.6% on information and communication. Regarding the expenditure in the manufacturing sector, it represents 14.1% destined mainly for textiles (3.9%) and machinery and equipment (3.4%).

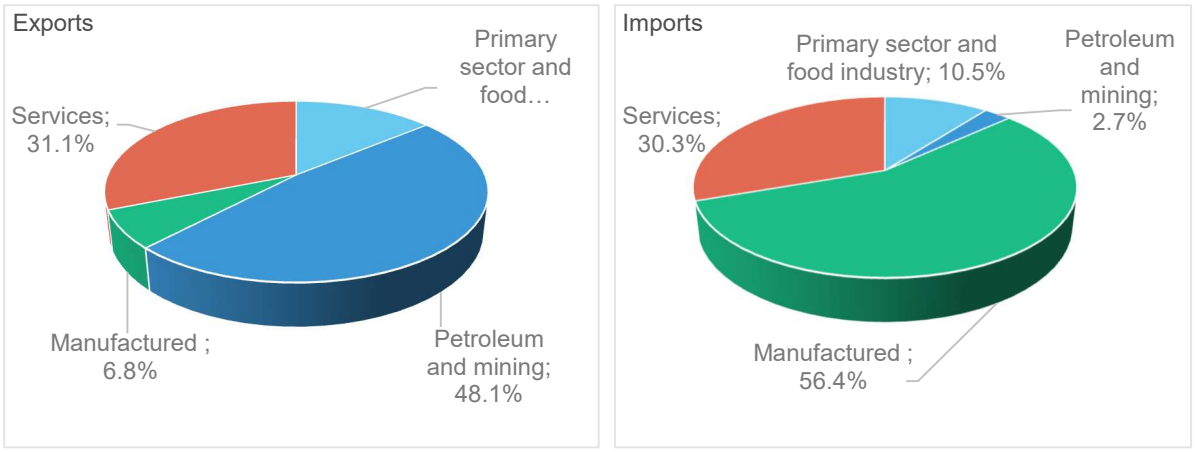
Figure 5. Household consumption pattern. Ghana 2015.



Source: Own elaboration with Ghana SAM 2015.

In the case of exports, the petroleum and mining activities represent the 48.1% (40.4% other mining) and the primary and food sector 14% (of which 8% refers to cocoa exports). For imports, the manufacturing sectors stand out with 56.4%, due to imports of machinery and equipment (27.3%) (figure 6).

Figure 6. Exports and imports composition. Ghana 2015.



Source: Own elaboration with Ghana SAM 2015.

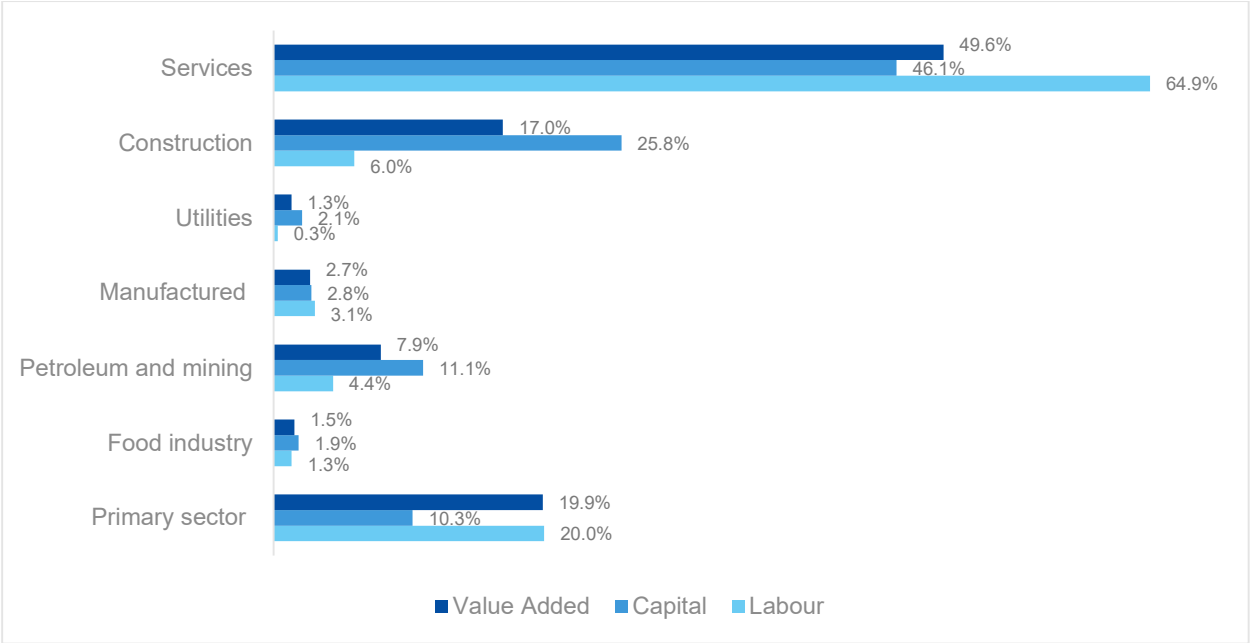
Focusing on productive factors, labour, land, and capital represent 35.5 %, 6.9 % and 57.9 % of the value added, respectively (Table 5). Analysing the distribution of value added by activities (Table 5 and Figure 7), services stand out representing 49.6%, followed by primary sector with 19.9%. In the case of services, labour factor is particularly important with 64.9% (is highly concentrated the use of Semi-skilled labour) and 46.1% of the value added is related to other capital factors. The land factor is exclusive to the primary sector and, to a lesser extent, labour factor in primary sector represents 20% (with 11.6% unskilled labour). In the case of capital, in addition to services, the construction sector stands out (25.8%).

Table 5. Distribution of factors by aggregate activities. Ghana 2015.

	Labour			Capital				Land
	Unskilled	Semi-skilled	Skilled	Crops	Livestock	Mining	Other	
Primary sector	11.6%	8.3%	0.1%	4.0%	1.9%	-	4.3%	100%
Food industry	0.4%	0.9%	0.0%	-	-	-	1.9%	-
Petroleum and mining	0.6%	3.4%	0.4%	-	-	8.96%	2.1%	-
Manufactured	0.3%	2.7%	0.01%	-	-	-	2.8%	-
Utilities	0.02%	0.1%	0.2%	-	-	-	2.1%	-
Construction	0.5%	4.5%	0.9%	-	-	-	25.8%	-
Services	8.0%	42.0%	14.8%	-	-	-	46.1%	-
% of the Value added		*35.5%*				*57.9%*		*6.9%*

Source: Own elaboration with Ghana SAM 2015.

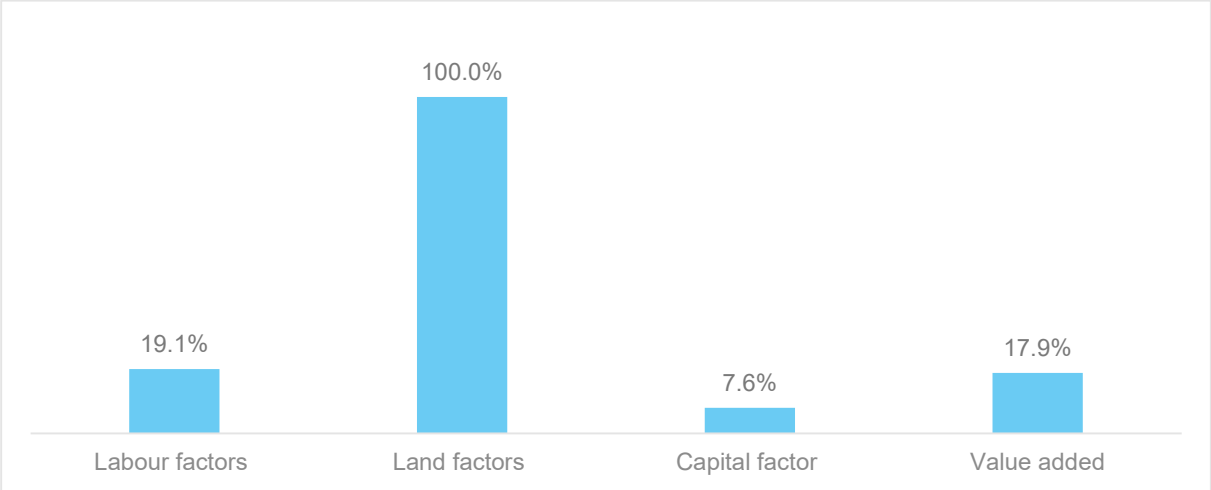
Figure 7. Distribution of factors and Value Added by aggregate activities. Ghana 2015.



Source: Own elaboration with Ghana SAM 2015.

Continuing with the analysis of the factors of production, the weight of households as activities in the generation of value added is analysed. Households as activities (focus on agricultural activities) represent 17.9% of the value added, which includes all the land factor, 19.1% of labour factors and 7.6% of capital factors (figure 8).

Figure 8. Share of agricultural activities in production factors. Ghana 2015.



Source: Own elaboration with Ghana SAM 2015.

Finally, referring to factors of productions and households, the distribution of households' income by factors of production and by transfers from enterprises, the government, and the rest of the world, is represented in the Table 6. Almost 35.5% of households' incomes come from compensation to labour and 48.8% correspond to transfers of enterprises.

Table 6. Distribution of households' income. Ghana 2015.

		Factors income			Transfers		
		Labour	**Land**	**Capital**	**Enterprise**	**Government**	**Rest of the World**
	Ghana	**35.5%**	**6.9%**	**3.4%**	**48.8%**	**1.3%**	**4.1%**
	Rural	42.6%	17.5%	8.4%	26.3%	1.1%	4.1%
	Urban	32.8%	2.8%	1.5%	57.5%	1.4%	4.1%
South	Western	37.1%	6.2%	5.5%	43.3%	1.8%	6.0%
South	Central	29.2%	6.4%	3.0%	53.2%	1.9%	6.3%
South	Greater Accra	32.5%	0.8%	0.3%	63.4%	0.8%	2.2%
South	Volta	37.6%	9.5%	10.0%	33.3%	2.2%	7.4%
South	Eastern	32.5%	15.1%	6.8%	39.9%	1.4%	4.3%
South	Ashanti	34.8%	3.9%	2.3%	55.1%	0.9%	2.9%
South	Brong Ahafo	41.4%	16.7%	3.5%	32.0%	1.5%	4.8%
North	Northern	53.0%	17.3%	4.8%	18.7%	1.5%	4.7%
North	Upper East	63.1%	20.0%	4.4%	6.0%	1.3%	5.1%
North	Upper West	37.9%	9.9%	19.4%	11.4%	4.9%	16.5%

Source: Own elaboration with Ghana SAM 2015.

Labour is equally distributed among the urban and rural environments; however, business transfers are more concentrated for the urban area. According to the information provided in the SAM, 83% of the income received by enterprises corresponds to the capital factor (mining 5% and 83% other) and the remaining 12% to government transfers. Those revenues are mainly transferred to households (representing 81%).

Focusing the analysis on each region, business transfers are concentrated in the southern regions and government and rest of the world transfers are mainly distributed in the Upper West region (which belongs to the northern region). The labour factor distribution also stands out for the northern regions, with more than 50% for Northern and Upper East. Both capital and land are key factors in income in the rural zones, representing 8.4% and 17.5% respectively.

4.2 Linear multiplier analysis

The linear SAM models are a simple way to analyse the information provided by a SAM regarding the structure of an economy. They show the separate effects being generated in the economic activity of different agents due to the relationships of the circular flow of income. In this section the output, value added, and employment multipliers are calculated. A brief explanation of the calculation of the three multipliers is included in Annex 3.

4.2.1 Multipliers

The analysis of the multiplier effect shows those commodities with capacity to generate output, employment and value added above average, and therefore, identifies which ones are suitable to be promoted through policies. Although the exact results obtained for each multiplier must be taken with some caution, multiplier analysis is a useful tool for ex-ante policy evaluation (Mainar-Causapé et al., 2018a).

The values of the multipliers calculated for the Ghana economy 2015 are presented in Tables 7 and 8. The cells are shaded to compare those below or above the average. Each vale of the output multiplier shows the increase in gross output in sectors, due to one-unit exogenous injection into the final demand of a commodity (i.e. an exogenous increase in exports demand). As for example, the output multiplier of Maize indicates that a one-unit increase in exogenous demand in Maize leads to 2.63 of output increase in the economy. Likewise, the value added multiplier indicate the new value added created by the additional production in responses to an exogenous shock in demand. Finally, the values of the employment multipliers measure the increment in the number of jobs generated by the exogenous increase in demand. Taking the multipliers of Table 7 into account, the primary sector group showed a higher backward income generation capacity than the economy average. Within agriculture, the calculation of the output multiplier highlights the importance of several products, with major values for sorghum and millet (2.68), sugar cane (2.70), tobacco (2.69), cotton and fibers (2.75) and cattle (2.70). On the other hand, other crops and rice have a weaker impact on the economy, both in production, value added and employment. Livestock commodities shows values clearly greater than the average for both output and value added multipliers, but less relevant in employment (although higher than average).

The employment multiplier has value clearly above average for most primary sector products, with highest impact for sugar cane, groundnuts, maize and oilseeds. Analysing this sector, the distribution of employment generated are concentrated with over 50% in "*unskilled workers*" (see Table 3). Only for cocoa, the number of additional jobs per million of additional output has a similar distribution towards the group of workers classified as "*semi-skilled*" (47%) and "*unskilled*" (51%). Considering agricultural products, the jobs generated as detailed by the employment multiplier are concentrated in the southern regions of Ghana. However, for sorghum and millet, pulses, tobacco and cotton and fibers the impact of the jobs generated in the northern region is slightly higher.

The analysis shows that many of the commodities classified within food industry sector, such as meat, fish and dairy, fruit and vegetable processing and sugar refining have very low multiplier values both in production and value added. Within this group, only fats and oils and grain milling have an output and value added multipliers above average. For the food industry sector, the employment multiplier has very low values and the jobs generated by an exogenous impact of demand are distributed more than 50% among "*semi-skilled*" workers. Within this group, only the employment multiplier of fats and oils and grain milling stand out, with slightly above average values and whose jobs generated impact predominates for "*unskilled workers*" as in the primary sector.

Table 7. Linear multipliers of primary sector and food industry commodities for Ghana 2015.

	Description	Multipliers		
		Output	Value added	Employment
Primary sector	Maize	2.63	1.70	209.36
	Sorghum and millet	2.68	1.65	187.58
	Rice	1.55	0.95	109.73
	Pulses	2.64	1.64	189.43
	Groundnuts	2.63	1.70	205.53
	Other oilseeds	2.57	1.68	208.60
	Cassava	2.61	1.62	185.07
	Other roots	2.64	1.66	196.63
	Vegetables	2.59	1.61	189.69
	Sugar cane	2.70	1.75	244.40
	Tobacco	2.69	1.68	189.44
	Cotton and fibers	2.75	1.61	195.49
	Fruits and nuts	2.54	1.55	170.91
	Cocoa	2.37	1.46	161.83
	Coffee and tea	2.57	1.50	160.72
	Other crops	1.20	0.74	83.69
	Cattle	2.70	1.64	186.07
	Poultry	2.50	1.49	167.99
	Other livestock	2.63	1.64	189.07
	Forestry	2.59	1.39	82.62
	Fishing	2.60	1.63	183.35
Food industry	Meat, fish and dairy	0.82	0.40	35.71
	Fruit and vegetable processing	0.89	0.44	46.12
	Fats and oils	2.60	1.32	139.63
	Grain milling	2.49	1.14	133.56
	Sugar refining	0.64	0.31	33.00
	Other foods	1.57	0.76	72.22
	Beverages	1.56	0.75	74.84
	Tobacco processing	1.56	0.69	59.59

Source: Own elaboration with Ghana SAM 2015. Shaded cells: value greater than the average

Focusing on table 8, the results indicate that for the manufactured and utilities sectors, none stand out in terms of job creation. Even though some products have an above average output multiplier, they do not automatically generate high value added multiplier, accordingly (for example wood and paper, electricity and water). Something similar is for the petroleum and mining sector, with only other mining having an above-average output multiplier. The Construction is slightly above the average in output and value added, but significantly below the average for employment.

The service sectors show above-average values in terms of output and value added for trade, information and communication, finance and insurance, public administration, health and education, but significantly lower in terms of employment. Only accommodation and food services and education have employment linkages above the global average.

Table 8. Linear multipliers of manufactures, utilities, services and other commodities for Ghana 2015.

	Description	Multipliers		
		Output	Value added	Employment
Petroleum and mining	Crude oil	1.86	1.03	83.25
	Other mining	2.28	0.68	48.41
	Petroleum	2.07	0.87	61.33
Manufactured	Textiles	1.49	0.71	75.55
	Clothing	1.60	0.77	64.03
	Leather and footwear	0.78	0.38	32.14
	Wood and paper	2.37	1.00	71.03
	Chemicals	0.81	0.37	28.60
	Non-metal minerals	0.91	0.43	54.30
	Metals and metal	0.65	0.30	22.43
	Machinery and equipment	0.23	0.11	9.45
	Other manufacturing	0.77	0.37	35.90
Utilities	Electricity, gas and steam	2.61	0.89	62.39
	Water supply and sewage	2.28	0.77	47.90
Construction	Construction	2.21	1.34	67.09
Services	Wholesale and retail trade	2.73	1.28	116.20
	Transportation and storage	2.15	1.19	90.94
	Accommodation and food services	2.16	1.24	140.10
	Information and communication	2.72	1.22	75.00
	Finance and insurance	2.56	1.41	86.77
	Real estate activities	2.37	1.09	52.56
	Business services	1.40	0.56	40.13
	Public administration	2.49	1.20	90.67
	Education	2.80	1.47	155.62
	Health and social work	2.56	1.18	120.96
	Other services	2.20	1.43	121.55

Source: Own elaboration with Ghana SAM 2015. Shaded cells: value greater than the average

5 Conclusions

This report presents the construction of Ghana's SAM for 2015, with the main purpose of providing a suitable database for implementing and evaluating the country's own developmental social and economic policies and initiatives.

In summary, the new Ghana SAM 2015 presented in this report contains 299 accounts: 45 activities (10 for household as producers), producing 55 marketed commodities and 14 HPHC. It considers 3 type of labour (skilled, unskilled and semi-skilled) in 10 regions and disaggregated in rural and urban (60 labour accounts), 1 type of land for each region (10 land factor accounts) and 4 type of capitals: crops, livestock, mining and other (4 capital factors accounts). Regarding households, each of the 10 regions is divided in urban and rural and also disaggregated in quantiles (100 households' accounts). Finally, there is a single account for margins, one corresponding to enterprises, other for the government, the rest of the world, one for investing and saving and other for change in stocks. Disaggregation between the northern and southern regions of the country is very important to promote policies focused on equality and development in the northern regions. In Annex 1, Table A1 shows all accounts considered in the Ghana SAM 2015. The Ghana 2015 SAM can be freely downloaded from DataM portal, as explained in the Annex 2.

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List of abbreviations and definitions

A	Activities accounts
AH	Representative households' groups as activities
C	Commodities accounts
CH	HPHC Commodities
CEM	Cross Entropy Method
CGE	Computable General Equilibrium
DataM	JRC data portal of agro-economic modelling
DIRTAX	Direct taxes
DSTK	Change in stocks
ENTERP	Enterprise
EXPTAX	Export taxes
FCAP	Capital factors
FLAB	Labour factors
FLAND	Land factors
GOVERT	Government
GSS	Ghana Statistical Services
GLSS	Ghana Living Standard Survey
HPHC	Home Production for Home Consumption
HH	Households accounts
IFPRI	International Food Policy Research Institute
ISSER	Institute of Statistical, Social and Economic Research
I-S	Investment- Saving
IMPTAX	Import taxes
PANAP	Pan-Africa Network for Economic Analysis of Policies
RoW	Rest of the World accounts
RHG	Representative Household Group
SAM	Social Accounting Matrix
SALTAX	Sales taxes
TRCOST	Margins

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Figure A2. QR Code – direct bulk data download:
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Annexes

Annex 1. Accounts of the Ghana Social Accounting Matrix 2015

Table A.1. Accounts of the Ghana Social Accounting Matrix 2015

Code	Description	Code	Description
ah_f_Wes	Western (HH as producers)	flab_urb_SSK_Ash	Urban- Semi-skilled labour Ashanti
ah_f_Cen	Central (HH as producers)	flab_urb_SKL_Ash	Urban- Skilled labour Ashanti
ah_f_Acc	Greater Accra (HH as producers)	flab_rur_USK_BrA	Rural- Unskilled labour Brong Ahafo
ah_f_Vol	Volta (HH as producers)	flab_rur_SSK_BrA	Rural- Semi-skilled labour Brong Ahafo
ah_f_Eas	Eastern (HH as producers)	flab_rur_SKL_BrA	Rural- Skilled labour Brong Ahafo
ah_f_Ash	Ashanti (HH as producers)	flab_urb_USK_BrA	Urban- Unskilled labour Brong Ahafo
ah_f_BrA	Brong Ahafo (HH as producers)	flab_urb_SSK_BrA	Urban- Semi-skilled labour Brong Ahafo
ah_f_Nor	Northern (HH as producers)	flab_urb_SKL_BrA	Urban- Skilled labour Brong Ahafo
ah_f_UpE	Upper East (HH as producers)	flab_rur_USK_Nor	Rural- Unskilled labour Northern
ah_f_UpW	Upper West (HH as producers)	flab_rur_SSK_Nor	Rural- Semi-skilled labour Northern
a_fore	Forestry	flab_rur_SKL_Nor	Rural- Skilled labour Northern
a_coil	Crude Oil	flab_urb_USK_Nor	Urban- Unskilled labour Northern
a_omin	Other mining	flab_urb_SSK_Nor	Urban- Semi-skilled labour Northern
a_meat	Meat, fish and dairy	flab_urb_SKL_Nor	Urban- Skilled labour Northern
a_fveg	Fruit and vegetable processing	flab_rur_USK_UpE	Rural- Unskilled labour Upper East
a_foil	Fats and oils	flab_rur_SSK_UpE	Rural- Semi-skilled labour Upper East
a_gmll	Grain milling	flab_rur_SKL_UpE	Rural- Skilled labour Upper East
a_sref	Sugar refining	flab_urb_USK_UpE	Urban- Unskilled labour Upper East
a_food	Other foods	flab_urb_SSK_UpE	Urban- Semi-skilled labour Upper East
a_beve	Beverages	flab_urb_SKL_UpE	Urban- Skilled labour Upper East
a_ptob	Tobacco (processed)	flab_rur_USK_UpW	Rural- Unskilled labour Upper West
a_text	Textiles	flab_rur_SSK_UpW	Rural- Semi-skilled labour Upper West
a_clth	Clothing	flab_rur_SKL_UpW	Rural- Skilled labour Upper West
a_leat	Leather and footwear	flab_urb_USK_UpW	Urban- Unskilled labour Upper West
a_wood	Wood and paper	flab_urb_SSK_UpW	Urban- Semi-skilled labour Upper West
a_petr	Petroleum	flab_urb_SKL_UpW	Urban- Skilled labour Upper West
a_chem	Chemicals	fland_Wes	Land - agricultural crops Western
a_nmet	Non-metal minerals	fland_Cen	Land - agricultural crops Central
a_metl	Metals and metal	fland_Acc	Land - agricultural crops Greater Accra
a_mach	Machinery and equipment	fland_Vol	Land - agricultural crops Volta
a_oman	Other manufacturing	fland_Eas	Land - agricultural crops Eastern
a_elec	Electricity, gas and steam	fland_Ash	Land - agricultural crops Ashanti
a_watr	Water supply and sewage	fland_BrA	Land - agricultural crops Brong Ahafo
a_cons	Construction	fland_Nor	Land - agricultural crops Northern
a_trad	Wholesale and retail trade	fland_UpE	Land - agricultural crops Upper East
a_tran	Transportation and storage	fland_UpW	Land - agricultural crops Upper West
a_hotl	Accommodation and food services	fcap_c	Capital - crops
a_comm	Information and communication	fcap_l	Capital - livestock
a_fsrv	Finance and insurance	fcap_m	Capital - mining
a_real	Real estate activities	fcap_n	Capital - other
a_bsrv	Business services	enterp	Enterprises
a_padm	Public administration	hh_rur_Wes_Q1	Rural farm - quintile 1 Western
a_educ	Education	hh_rur_Wes_Q2	Rural farm - quintile 2 Western
a_heal	Health and social work	hh_rur_Wes_Q3	Rural farm - quintile 3 Western
a_osrv	Other services	hh_rur_Wes_Q4	Rural farm - quintile 4 Western
ch_maiz	Maize (HPHC commodities)	hh_rur_Wes_Q5	Rural farm - quintile 5 Western
ch_sorg	Sorghum and millet (HPHC commodities)	hh_rur_Cen_Q1	Rural farm - quintile 1 Central
ch_rice	Rice (HPHC commodities)	hh_rur_Cen_Q2	Rural farm - quintile 2 Central

ch_puls	Pulses (HPHC commodities)	hh_rur_Cen_Q3	Rural farm - quintile 3 Central
ch_gnut	Groundnuts (HPHC commodities)	hh_rur_Cen_Q4	Rural farm - quintile 4 Central
ch_oils	Other oilseeds (HPHC commodities)	hh_rur_Cen_Q5	Rural farm - quintile 5 Central
ch_cass	Cassava (HPHC commodities)	hh_rur_Acc_Q1	Rural farm - quintile 1 Greater Accra
ch_root	Other roots (HPHC commodities)	hh_rur_Acc_Q2	Rural farm - quintile 2 Greater Accra
ch_vege	Vegetables (HPHC commodities)	hh_rur_Acc_Q3	Rural farm - quintile 3 Greater Accra
ch_frui	Fruits and nuts (HPHC commodities)	hh_rur_Acc_Q4	Rural farm - quintile 4 Greater Accra
ch_catt	Cattle (HPHC commodities)	hh_rur_Acc_Q5	Rural farm - quintile 5 Greater Accra
ch_poul	Poultry (HPHC commodities)	hh_rur_Vol_Q1	Rural farm - quintile 1 Volta
ch_oliv	Other livestock (HPHC commodities)	hh_rur_Vol_Q2	Rural farm - quintile 2 Volta
ch_fish	Fishing (HPHC commodities)	hh_rur_Vol_Q3	Rural farm - quintile 3 Volta
c_maiz	Maize	hh_rur_Vol_Q4	Rural farm - quintile 4 Volta
c_sorg	Sorghum and millet	hh_rur_Vol_Q5	Rural farm - quintile 5 Volta
c_rice	Rice	hh_rur_Eas_Q1	Rural farm - quintile 1 Eastern
c_puls	Pulses	hh_rur_Eas_Q2	Rural farm - quintile 2 Eastern
c_gnut	Groundnuts	hh_rur_Eas_Q3	Rural farm - quintile 3 Eastern
c_oils	Other oilseeds	hh_rur_Eas_Q4	Rural farm - quintile 4 Eastern
c_cass	Cassava	hh_rur_Eas_Q5	Rural farm - quintile 5 Eastern
c_root	Other roots	hh_rur_Ash_Q1	Rural farm - quintile 1 Ashanti
c_vege	Vegetables	hh_rur_Ash_Q2	Rural farm - quintile 2 Ashanti
c_sugr	Sugar cane	hh_rur_Ash_Q3	Rural farm - quintile 3 Ashanti
c_toba	Tobacco	hh_rur_Ash_Q4	Rural farm - quintile 4 Ashanti
c_cott	Cotton and fibers	hh_rur_Ash_Q5	Rural farm - quintile 5 Ashanti
c_frui	Fruits and nuts	hh_rur_BrA_Q1	Rural farm - quintile 1 Brong Ahafo
c_coco	Cocoa	hh_rur_BrA_Q2	Rural farm - quintile 2 Brong Ahafo
c_coff	Coffee and tea	hh_rur_BrA_Q3	Rural farm - quintile 3 Brong Ahafo
c_ocrp	Other crops	hh_rur_BrA_Q4	Rural farm - quintile 4 Brong Ahafo
c_catt	Cattle	hh_rur_BrA_Q5	Rural farm - quintile 5 Brong Ahafo
c_poul	Poultry	hh_rur_Nor_Q1	Rural farm - quintile 1 Northern
c_oliv	Other livestock	hh_rur_Nor_Q2	Rural farm - quintile 2 Northern
c_fore	Forestry	hh_rur_Nor_Q3	Rural farm - quintile 3 Northern
c_fish	Fishing	hh_rur_Nor_Q4	Rural farm - quintile 4 Northern
c_coil	Crude oil	hh_rur_Nor_Q5	Rural farm - quintile 5 Northern
c_omin	Other mining	hh_rur_UpE_Q1	Rural farm - quintile 1 Upper East
c_meat	Meat, fish and dairy	hh_rur_UpE_Q2	Rural farm - quintile 2 Upper East
c_fveg	Fruit and vegetable processing	hh_rur_UpE_Q3	Rural farm - quintile 3 Upper East
c_foil	Fats and oils	hh_rur_UpE_Q4	Rural farm - quintile 4 Upper East
c_gmll	Grain milling	hh_rur_UpE_Q5	Rural farm - quintile 5 Upper East
c_sref	Sugar refining	hh_rur_UpW_Q1	Rural farm - quintile 1 Upper West
c_food	Other foods	hh_rur_UpW_Q2	Rural farm - quintile 2 Upper West
c_beve	Beverages	hh_rur_UpW_Q3	Rural farm - quintile 3 Upper West
c_ptob	Tobacco processing	hh_rur_UpW_Q4	Rural farm - quintile 4 Upper West
c_text	Textiles	hh_rur_UpW_Q5	Rural farm - quintile 5 Upper West
c_clth	Clothing	hh_urb_Wes_Q1	Urban - quintile 1 Western
c_leat	Leather and footwear	hh_urb_Wes_Q2	Urban - quintile 2 Western
c_wood	Wood and paper	hh_urb_Wes_Q3	Urban - quintile 3 Western
c_petr	Petroleum	hh_urb_Wes_Q4	Urban - quintile 4 Western
c_chem	Chemicals	hh_urb_Wes_Q5	Urban - quintile 5 Western
c_nmet	Non-metal minerals	hh_urb_Cen_Q1	Urban - quintile 1 Central
c_metl	Metals and metal products	hh_urb_Cen_Q2	Urban - quintile 2 Central
c_mach	Machinery and equipment	hh_urb_Cen_Q3	Urban - quintile 3 Central
c_oman	Other manufacturing	hh_urb_Cen_Q4	Urban - quintile 4 Central
c_elec	Electricity, gas and steam	hh_urb_Cen_Q5	Urban - quintile 5 Central
c_watr	Water supply and sewage	hh_urb_Acc_Q1	Urban - quintile 1 Greater Accra
c_cons	Construction	hh_urb_Acc_Q2	Urban - quintile 2 Greater Accra
c_trad	Wholesale and retail trade	hh_urb_Acc_Q3	Urban - quintile 3 Greater Accra

c_tran	Transportation and storage	hh_urb_Acc_Q4	Urban - quintile 4 Greater Accra
c_hotl	Accommodation and food services	hh_urb_Acc_Q5	Urban - quintile 5 Greater Accra
c_comm	Information and communication	hh_urb_Vol_Q1	Urban - quintile 1 Volta
c_fsrv	Finance and insurance	hh_urb_Vol_Q2	Urban - quintile 2 Volta
c_real	Real estate activities	hh_urb_Vol_Q3	Urban - quintile 3 Volta
c_bsrv	Business services	hh_urb_Vol_Q4	Urban - quintile 4 Volta
c_padm	Public administration	hh_urb_Vol_Q5	Urban - quintile 5 Volta
c_educ	Education	hh_urb_Eas_Q1	Urban - quintile 1 Eastern
c_heal	Health and social work	hh_urb_Eas_Q2	Urban - quintile 2 Eastern
c_osrv	Other services	hh_urb_Eas_Q3	Urban - quintile 3 Eastern
trcost	Trade and transport margin	hh_urb_Eas_Q4	Urban - quintile 4 Eastern
trcostexp	Trade and transport margin	hh_urb_Eas_Q5	Urban - quintile 5 Eastern
flab_rur_USK_Wes	Rural- Unskilled labour Western	hh_urb_Ash_Q1	Urban - quintile 1 Ashanti
flab_rur_SSK_Wes	Rural- Semi-skilled labour Western	hh_urb_Ash_Q2	Urban - quintile 2 Ashanti
flab_rur_SKL_Wes	Rural- Skilled labour Western	hh_urb_Ash_Q3	Urban - quintile 3 Ashanti
flab_urb_USK_Wes	Urban- Unskilled labour Western	hh_urb_Ash_Q4	Urban - quintile 4 Ashanti
flab_urb_SSK_Wes	Urban- Semi-skilled labour Western	hh_urb_Ash_Q5	Urban - quintile 5 Ashanti
flab_urb_SKL_Wes	Urban- Skilled labour Western	hh_urb_BrA_Q1	Urban - quintile 1 Brong Ahafo
flab_rur_USK_Cen	Rural- Unskilled labour Central	hh_urb_BrA_Q2	Urban - quintile 2 Brong Ahafo
flab_rur_SSK_Cen	Rural- Semi-skilled labour Central	hh_urb_BrA_Q3	Urban - quintile 3 Brong Ahafo
flab_rur_SKL_Cen	Rural- Skilled labour Central	hh_urb_BrA_Q4	Urban - quintile 4 Brong Ahafo
flab_urb_USK_Cen	Urban- Unskilled labour Central	hh_urb_BrA_Q5	Urban - quintile 5 Brong Ahafo
flab_urb_SSK_Cen	Urban- Semi-skilled labour Central	hh_urb_Nor_Q1	Urban - quintile 1 Northern
flab_urb_SKL_Cen	Urban- Skilled labour Central	hh_urb_Nor_Q2	Urban - quintile 2 Northern
flab_rur_USK_Acc	Rural- Unskilled labour Greater Accra	hh_urb_Nor_Q3	Urban - quintile 3 Northern
flab_rur_SSK_Acc	Rural- Semi-skilled labour Greater Accra	hh_urb_Nor_Q4	Urban - quintile 4 Northern
flab_rur_SKL_Acc	Rural- Skilled labour Greater Accra	hh_urb_Nor_Q5	Urban - quintile 5 Northern
flab_urb_USK_Acc	Urban- Unskilled labour Greater Accra	hh_urb_UpE_Q1	Urban - quintile 1 Upper East
flab_urb_SSK_Acc	Urban- Semi-skilled labour Greater Accra	hh_urb_UpE_Q2	Urban - quintile 2 Upper East
flab_urb_SKL_Acc	Urban- Skilled labour Greater Accra	hh_urb_UpE_Q3	Urban - quintile 3 Upper East
flab_rur_USK_Vol	Rural- Unskilled labour Volta	hh_urb_UpE_Q4	Urban - quintile 4 Upper East
flab_rur_SSK_Vol	Rural- Semi-skilled labour Volta	hh_urb_UpE_Q5	Urban - quintile 5 Upper East
flab_rur_SKL_Vol	Rural- Skilled labour Volta	hh_urb_UpW_Q1	Urban - quintile 1 Upper West
flab_urb_USK_Vol	Urban- Unskilled labour Volta	hh_urb_UpW_Q2	Urban - quintile 2 Upper West
flab_urb_SSK_Vol	Urban- Semi-skilled labour Volta	hh_urb_UpW_Q3	Urban - quintile 3 Upper West
flab_urb_SKL_Vol	Urban- Skilled labour Volta	hh_urb_UpW_Q4	Urban - quintile 4 Upper West
flab_rur_USK_Eas	Rural- Unskilled labour Eastern	hh_urb_UpW_Q5	Urban - quintile 5 Upper West
flab_rur_SSK_Eas	Rural- Semi-skilled labour Eastern	govert	Government
flab_rur_SKL_Eas	Rural- Skilled labour Eastern	dirtax	Taxes - direct
flab_urb_USK_Eas	Urban- Unskilled labour Eastern	exptax	Taxes - sales
flab_urb_SSK_Eas	Urban- Semi-skilled labour Eastern	imptax	Taxes - import
flab_urb_SKL_Eas	Urban- Skilled labour Eastern	saltax	Taxes - export
flab_rur_USK_Ash	Rural- Unskilled labour Ashanti	i-s	Savings-investment
flab_rur_SSK_Ash	Rural- Semi-skilled labour Ashanti	dstk	Change in stocks
flab_rur_SKL_Ash	Rural- Skilled labour Ashanti	row	Rest of world
flab_urb_USK_Ash	Urban- Unskilled labour Ashanti		

Source: Own elaboration.

Annex 2. On-line resources to download the Ghana Social Accounting Matrix 2015

The 2015 Social Accounting Matrix of Ghana is available on the public website "EC Data-Modelling platform of agro-economic research DataM". Links can be also accessed with the QR codes listed in this annex.

Figure A1. QR code – DataM URL: https://datam.jrc.ec.europa.eu

Source: JRC, 2021.

Bulk download

Using DataM, users can make a bulk download of SAM in a ZIP file (Dataset_JRC_-_Social_accounting_matrix_-_Ghana_-_2015.zip) containing a homonymous CSV file. The hyperlink for the direct bulk download is in Figure A2.

Figure A2. QR Code – direct bulk data download: https://datam.jrc.ec.europa.eu/datam/perm/dataset/9e5aa734-2dac-4e08-bf14-d518151e4f53/download/dataset.zip

Source: JRC, 2021.

In the bulk download, the SAM is presented in a standard flat format as CSV file with header row. Conceptually, it contains a column for the spending agent, a column for the receiving agent and a column for the value in Millions of Ghanaian Cedi. See figure A3.

Figure A3. Bulk download of the matrix in flat table format

	A	B	C	D	E	F	G	H
1	Year	Spending Agent	Spending Agent (Macro-	Spending Agent (Code)	Receiving Agent	Receiving Agent (Macro-	Receiving Agent (Code)	Value (Millions of Ghanaian Cedis)
2	2015	Accommodation and food services	Activities	a_hotl	Beverages (marketed commodities)	Commodities	c_beve	64.778632
3	2015	Accommodation and food services	Activities	a_hotl	Business services (marketed commodities)	Commodities	c_bsrv	11.50533054
4	2015	Accommodation and food services	Activities	a_hotl	Capital - other (Factors - Capital)	Factors	fcap_n	4757.337799
5	2015	Accommodation and food services	Activities	a_hotl	Cassava (marketed commodities)	Commodities	c_cass	18.93876593
6	2015	Accommodation and food services	Activities	a_hotl	Cattle (marketed commodities)	Commodities	c_catt	12.21088384
7	2015	Accommodation and food services	Activities	a_hotl	Chemicals (marketed commodities)	Commodities	c_chem	67.36262236
8	2015	Accommodation and food services	Activities	a_hotl	Fats and oils (marketed commodities)	Commodities	c_foil	393.3251347
9	2015	Accommodation and food services	Activities	a_hotl	Finance and insurance (marketed commodities)	Commodities	c_fsrv	17.36850359
10	2015	Accommodation and food services	Activities	a_hotl	Fishing (marketed commodities)	Commodities	c_fish	303.222414
11	2015	Accommodation and food services	Activities	a_hotl	Forestry (marketed commodities)	Commodities	c_fore	36.76005067
12	2015	Accommodation and food services	Activities	a_hotl	Fruit and vegetable processing (marketed comm	Commodities	c_fveg	52.92193936
13	2015	Accommodation and food services	Activities	a_hotl	Fruits and nuts (marketed commodities)	Commodities	c_frui	285.2660942
14	2015	Accommodation and food services	Activities	a_hotl	Grain milling (marketed commodities)	Commodities	c_gmll	748.504166
15	2015	Accommodation and food services	Activities	a_hotl	Groundnuts (marketed commodities)	Commodities	c_gnut	25.88920537
16	2015	Accommodation and food services	Activities	a_hotl	Machinery and equipment (marketed commodit	Commodities	c_mach	11.2250259
17	2015	Accommodation and food services	Activities	a_hotl	Maize (marketed commodities)	Commodities	c_maiz	261.8767231
18	2015	Accommodation and food services	Activities	a_hotl	Meat, fish and dairy (marketed commodities)	Commodities	c_meat	477.5726066
19	2015	Accommodation and food services	Activities	a_hotl	Other foods (marketed commodities)	Commodities	c_food	289.781042
20	2015	Accommodation and food services	Activities	a_hotl	Other livestock (marketed commodities)	Commodities	c_oliv	66.54189247
21	2015	Accommodation and food services	Activities	a_hotl	Other mining (marketed commodities)	Commodities	c_omin	17.10089528
22	2015	Accommodation and food services	Activities	a_hotl	Other oilseeds (marketed commodities)	Commodities	c_oils	98.81232469
23	2015	Accommodation and food services	Activities	a_hotl	Other roots (marketed commodities)	Commodities	c_root	54.48215735
24	2015	Accommodation and food services	Activities	a_hotl	Petroleum (marketed commodities)	Commodities	c_petr	43.45268334

Source: DataM, provided by the European Commission – Joint Research Centre. Dataset: JRC - BioSAMs for the EU Member States - 2015, accessed on 30/04/2021.

In fact, the file contains also columns for the codes internally used in GAMS for the agents and the Year (always 2015). The extra columns help for using the data in modelling tools, and for characterizing this file among other SAM's that are published by JRC.

Interactive download

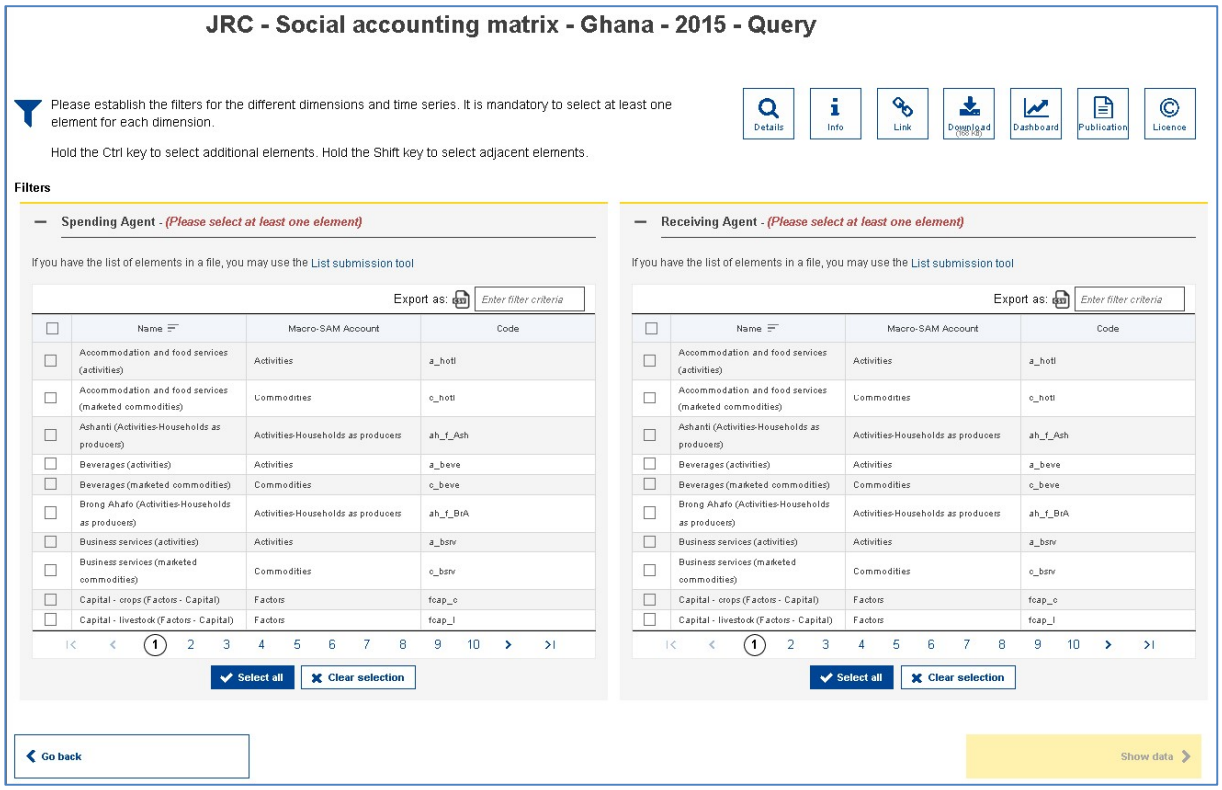
— DataM includes also a function for interactive download, which allows filtering the only part of interest of the datasets and to preview results on the screen. Find the direct link for the SAM in the figure A4.

Figure A4. QR Code – direct link to the data warehouse page of the dataset:
https://datam.jrc.ec.europa.eu/datam/perm/dataset/9e5aa734-2dac-4e08-bf14-d518151e4f53

Source: JRC, 2021.

— The link gives access to the screen in the figure A5.

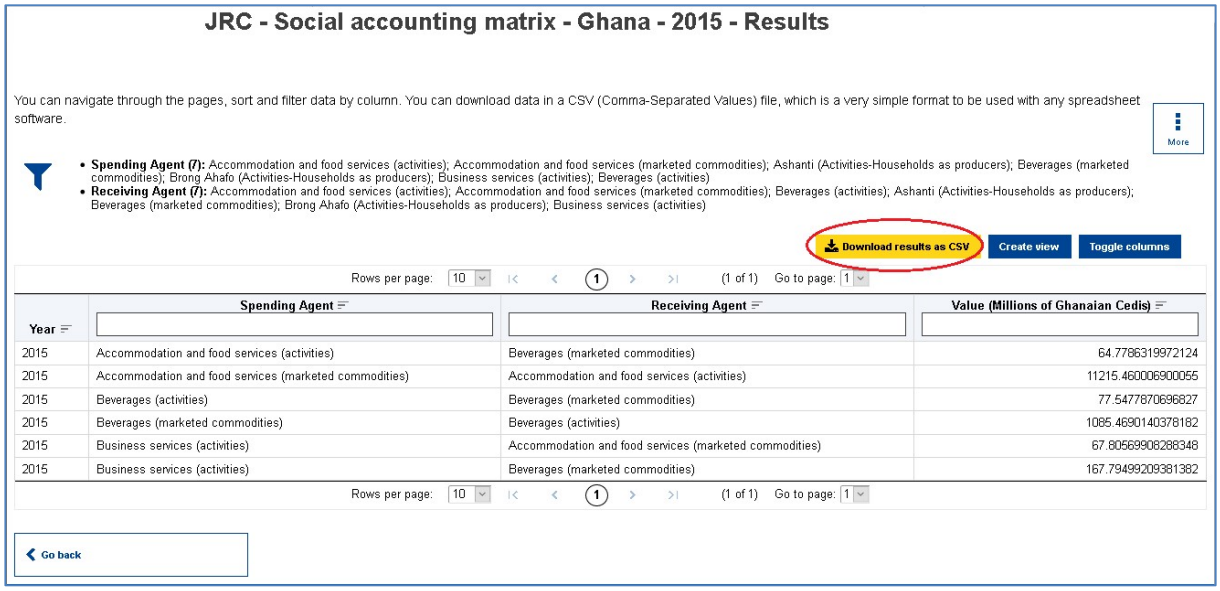
Figure A5. Data warehouse page of the Ghana SAM 2015



Source: DataM, JRC, 2021.

— After specifying some filtering and pushing on the "Next" button, the data is visualised on the screen, see figure A6.

Figure A6. Visualising the SAM on the screen



Source: DataM, JRC, 2021.

— The "Download results as CSV" option would produce a file similar to the one obtained in the bulk download, but only with the records reflecting the selection operated. See figure A7.

Figure A7. Exporting only part of the SAM in flat format

	A	B	C	D
1	Year	Spending Agent	Receiving Agent	Value (Millions of Ghanaian Cedis)
2	2015	Accommodation and food services (activities)	Beverages (marketed commodities)	64.778632
3	2015	Accommodation and food services (marketed commodities)	Accommodation and food services (activities)	11215.46001
4	2015	Beverages (activities)	Beverages (marketed commodities)	77.54778707
5	2015	Beverages (marketed commodities)	Beverages (activities)	1085.469014
6	2015	Business services (activities)	Accommodation and food services (marketed commodities)	67.80569908
7	2015	Business services (activities)	Beverages (marketed commodities)	167.7949921

Source: DataM, provided by the European Commission – Joint Research Centre. Dataset: JRC – SAM Ghana - 2015, accessed on 11/05/2021.

Interactive dashboard

— Finally, users may explore and analyse the data through an interactive dashboard placed in the "PANAP network" section of the website (Figure A8).

Figure A8. QR Code – direct link to the interactive dashboard: https://datam.jrc.ec.europa.eu/datam/mashup/SAM_GH_2015

Source: JRC, 2021.

— The interactive dashboard allows users to undertake their own analysis of the dataset.

— It consists of a number of sheets that allow analysing data from different perspectives.

Figure A9. Navigating within the sheets

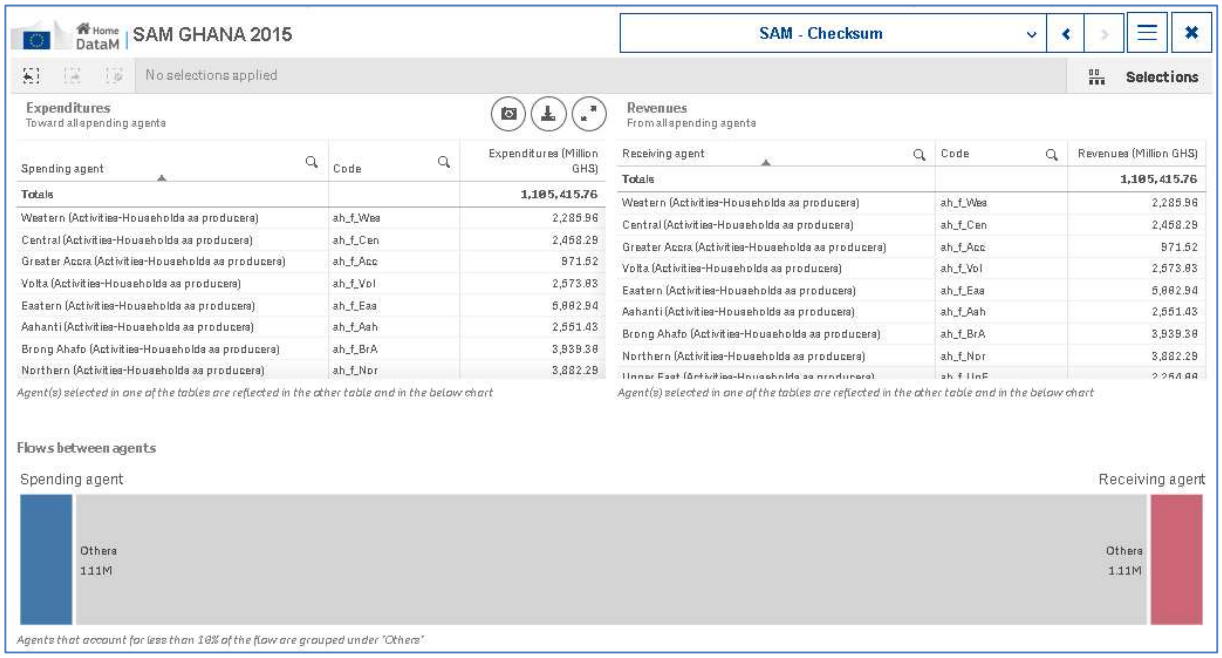
Source: DataM, JRC, 2021.

Each sheet consists of a screen with a number of different visualisations (tables, charts and maps) and some filtering boxes.

The key strength of the tool is that all these visualisations are interactive and interrelated. This allows users to study the data by means of simple mouse gestures.

The DataM visualisation framework is quite intuitive; some basic guidelines to facilitate its use will follow. All DataM dashboards are similar to the example shown in Figure A10.

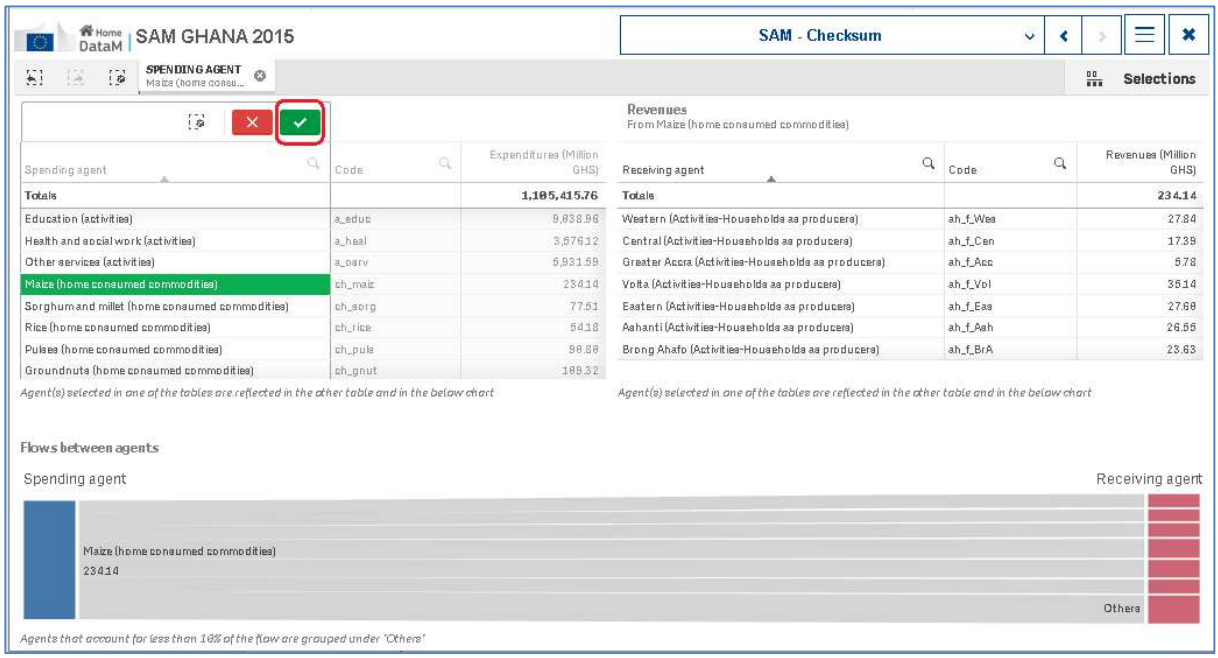
Figure A10. A generic dashboard



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

— By clicking on any visualisation, for example by clicking on "Maize (home consumed commodities)" in the left table by spending agent, all the visualisations are recalculated using data concerning only the expenditures from maize activity.

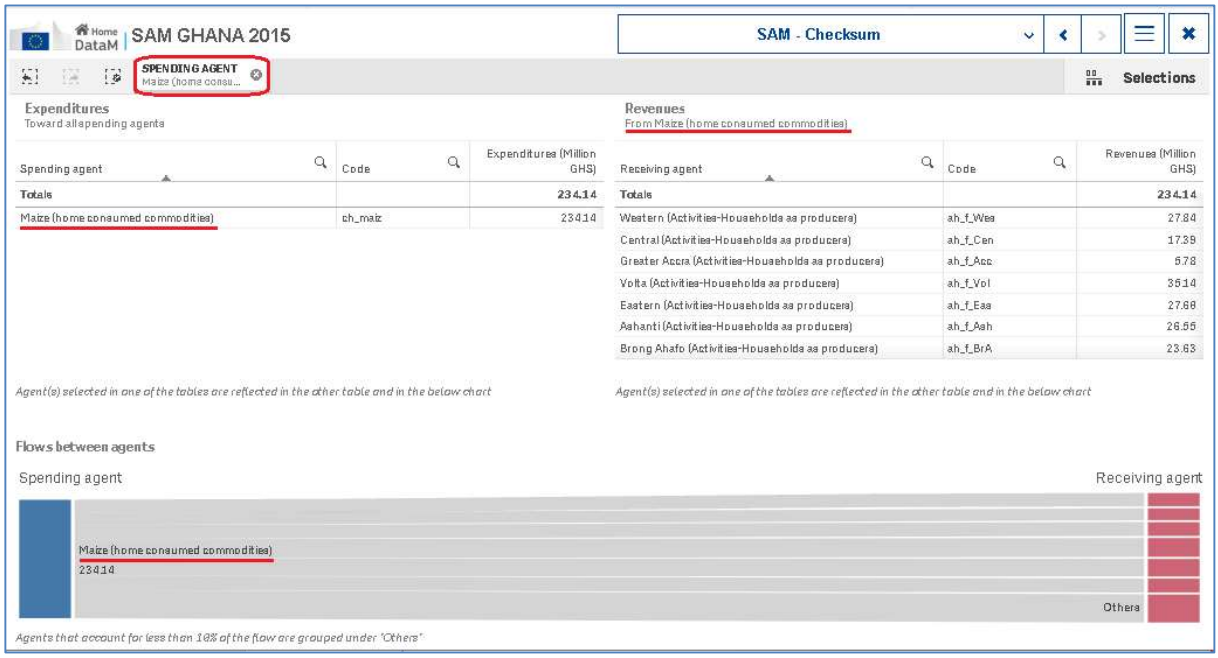
Figure A11. Making an interactive selection



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

— For example, in Figure A12 the right table now shows all the agents that receives from Maize and the below diagram illustrates these flows.

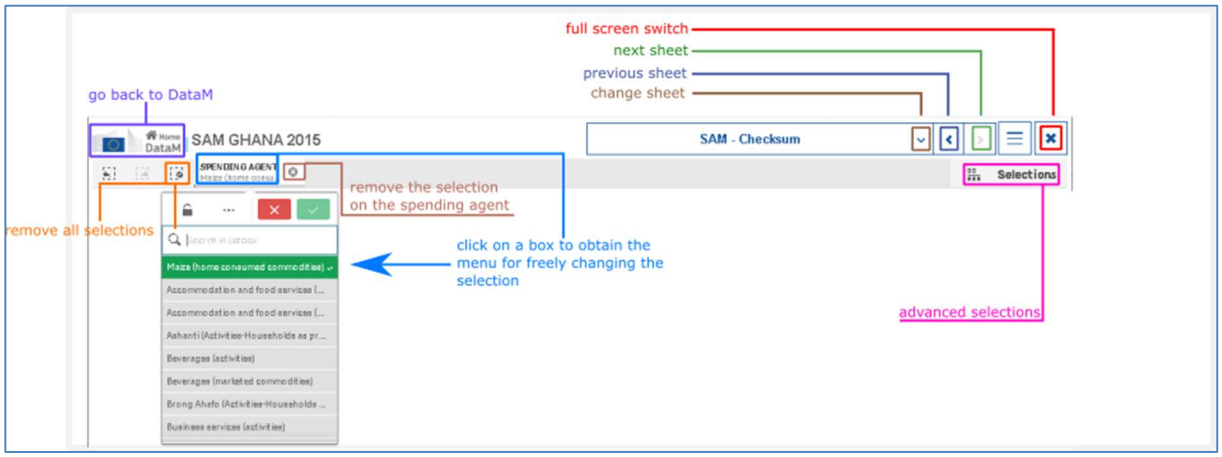
Figure A12. Result of an interactive selection



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

The currently active selections are always shown in the dark-grey bar at the top. Selections can be cancelled or changed as explained in figure A13.

Figure A13. Instructions to change selections

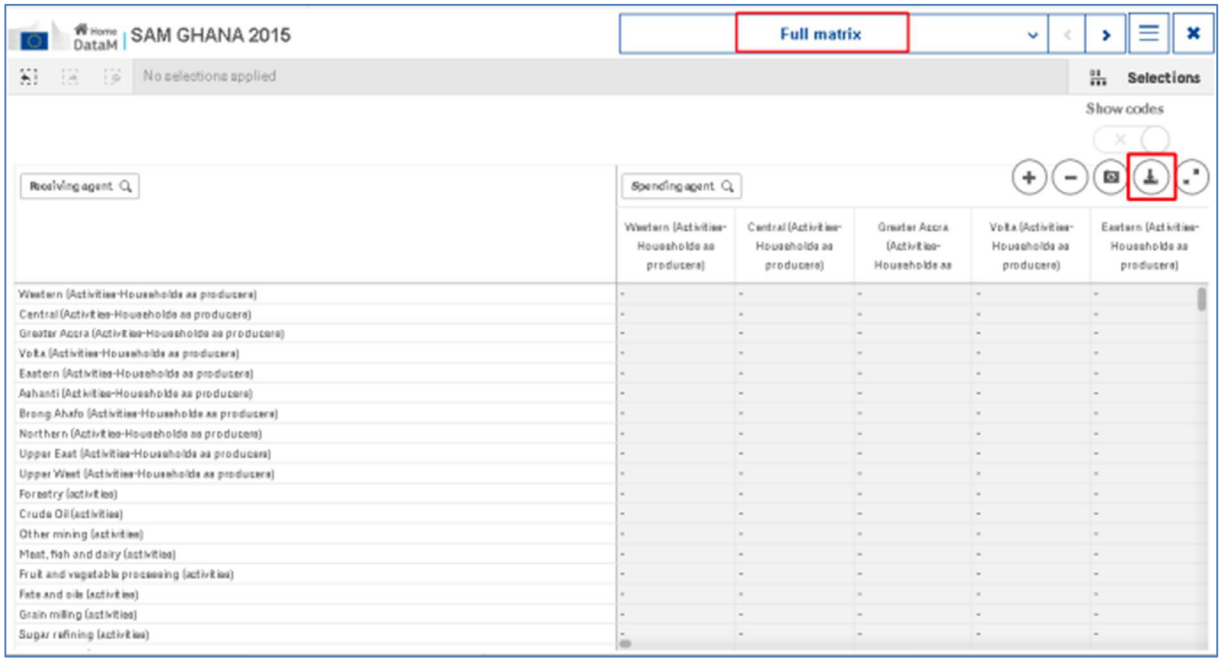


Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

Downloading the traditional matrix

— From the "Full matrix" sheet of the interactive dashboard, users can visualize and make the download in "xlsx" format of the SAM in traditional sparse-matrix aspect.

Figure A14. How to download the SAM in traditional matrix format

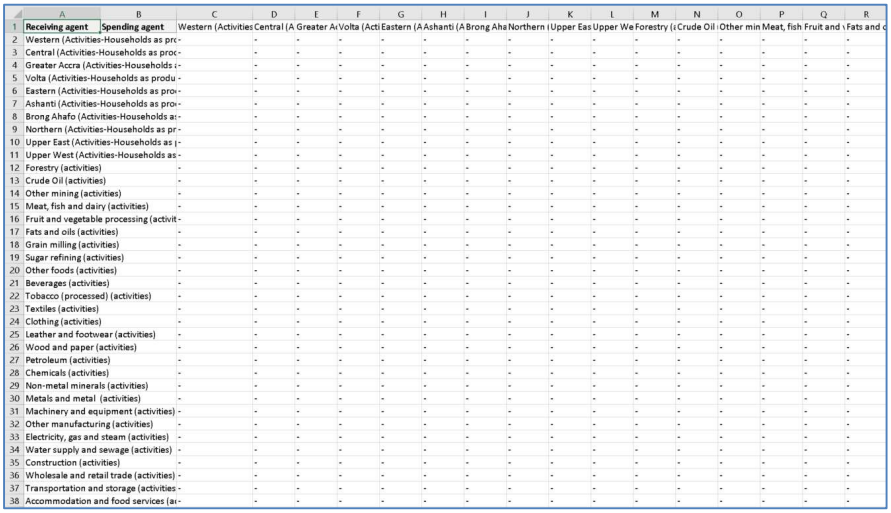


Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

The download icon at the top-right corner of the chart (see figure A14), which is visible when passed over with the mouse; allow the data for the chart to be downloaded. The "+" and "-" icons allow to expand the matrix in case there are nested dimension (for this pivot table, these buttons do not have any effect), whereas the last icon on the right is to show the chart in full-screen mode.

See the aspect of the downloaded file in figure A15.

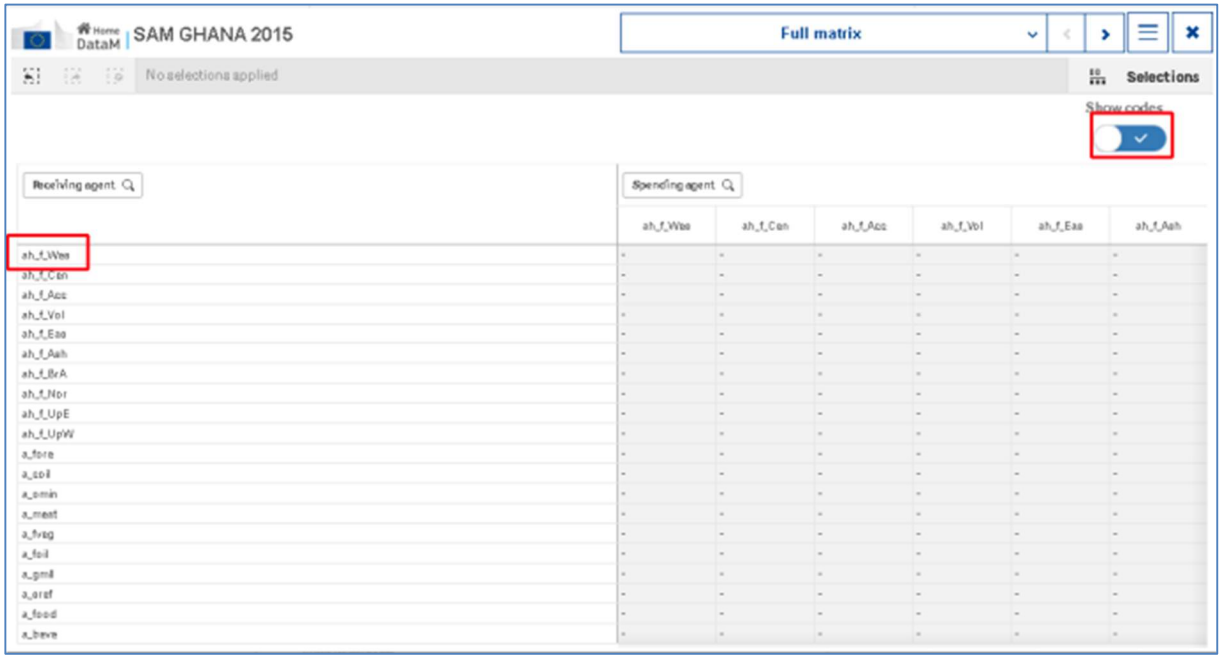
Figure A15. Traditional matrix outcome



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

— JRC, especially in the modelling tools, uses codes for identifying the agents. By toggling the "Show codes" switch, the column and row headings of the SAM are changed from agent names to agent codes. See figure A16.

Figure A16. Downloading a SAM with codes



Source: DataM, provided by the European Commission – Joint Research Centre. Dashboard: SAM Ghana - 2015, accessed on 11/05/2021.

Open data portals

— In the period subsequent to the publication of this report, following pages will[5] be gradually activated on relevant open data portals, enabling to easily find this dataset on the web:

1. On the JRC Data Catalogue: https://data.jrc.ec.europa.eu/dataset/d7423648-90b8-403d-8518-ff2152f59820
2. On the EU Open Data Portal: https://data.europa.eu/euodp/data/dataset/d7423648-90b8-403d-8518-ff2152f59820

List of abbreviations and definitions

CSV	Comma separated value
GAMS	General Algebraic Modelling System
DataM	JRC data-modelling platform of agro-economics research
QR code	Quick response code
SAM	Social Accounting Matrix
XLSX	Microsoft Excel file format

[5] The time necessary for the activations of these services is beyond the control of the authors.

Annex 3. The linear SAM model and multipliers

SAM are used as databases for linear multiplier models, enabling the linkages between sectors to be analysed which is useful for studying the impact of different policies.

The starting point is the Leontief's equilibrium equation ([6]), applied to the case of a SAM obtaining the SAM Leontief inverse (Pyatt & Round, 1985). The standard representation is as follows: $M = (I - \mathrm{A})^{-1}$, where the matrix A is the coefficient matrix (calculating dividing each element of the SAM by the total of their corresponding column), and each element m_{ij} in M shows the output requirements of account i to increase the final demand of account j by one unit (or the input requirements of account i to produce one unit by account j) (Mainar-Causapé et al., 2018a). This matrix is used as a tool to evaluate the capacity of each economic sector to generate output and employment in the rest of the economy through the analysis of multipliers.

Output multiplier

The sum of the multiplier values of the commodities column of $\boldsymbol{M}_a$, shows the output multiplier. This multiplier indicates the increase in output of the economy generated as a result of a unitary exogenous shock in exogenous values for the corresponding commodity. A high value of this multiplier indicates an account with a large backward income expansion influence on the rest of the economy, given that its input requirements to cope with the increase when it receives an exogenous shock are transferred to its upstream input suppliers (Pulido & Fontela, 1993).

Employment multiplier

The employment multiplier provides the number of jobs that would be generated by an exogenous shock in final demand. First, it is necessary to have the employment vector $\boldsymbol{e}$, that contains the ratios between the number of jobs and the output of each activity *(per million of output value)*. The employment matrix $\boldsymbol{E}$ is a diagonal matrix whose elements are the vector *e* and is multiplied by the part of the multiplier matrix ($\boldsymbol{M}_a$) that incorporates the rows corresponding to the productive accounts and the columns corresponding to commodities. The expression of the employment multiplier is given as: $\boldsymbol{M_e} = \boldsymbol{E} \times \boldsymbol{M_a}$. Each element in $\boldsymbol{M_e}$, $\boldsymbol{me_{ij}}$ is the increment in the number of jobs in sector i when there is a unit exogenous injection into the endogenous final demand account of j. The sum of the columns in the matrix shows the global effect on employment produced by the exogenous increase in demand. In summary, the multipliers reveal the number of additional jobs per million of additional output from each activity (Mainar-Causapé et al., 2018a). Notably, the results do not take social variables such as the quality of employment into account. Besides, due to the assumptions of the model mentioned above, the results should not be interpreted as an exact forecast of job creation due to exogenous shocks. Nonetheless, they are useful as an indicator of the economy commodities with a greater potential to generate jobs.

Value added multiplier

The Value added multiplier relates the new value added created in each sector in response to the exogenous shock (Miller & Blair, 2009). Similar to the calculation of the employment multiplier, a value added vector can be used to calculate the Value added multiplier. The vector $\boldsymbol{v}$ contains the ratios between the value added and the output of each activity. The sum of the remuneration of factors plus taxes les subsidies on production is the value added by Activities.

([6]) Assuming Leontief technologies (i.e. with fixed prices and no substitution elasticities), the result should be taken with caution.

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KJ-NA-30720-EN-N

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doi:10.2760/432014
ISBN 978-92-76-38077-1