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## A 2019 Social Accounting Matrix for Kenya including malaria epidemiological and agroecological zones

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**Faculty of Life Sciences**

**Department of Agricultural Economics**



**No. 103/2022**

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**WORKING PAPER**

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# A 2019 Social Accounting Matrix for Kenya Including Malaria Epidemiological and Agroecological Zones<sup>1</sup>

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## Abstract

This paper documents the development of a 2019 Social Accounting Matrix (SAM) for Kenya. A special feature of this SAM is its spatial disaggregation according to malaria epidemiological and agroecological zones. It is built using data from the Kenya National Bureau of Statistics (e.g., the economic survey 2021 and the 2019 Kenya Population and Housing Census), the Central Bank of Kenya (i.e., the Diaspora Remittances Survey), the Kenya Ministry of Health (i.e., the Kenya Malaria Strategy 2019–2023), the 2019 SAM for Kenya, constructed by Thurlow (2021), and the 2017 Kenyan SAM, developed by Ferrari et al. (2020). Compared to the existing Kenyan SAMs, this SAM has two vital features. First, it includes 30 labour categories, disaggregated by skill levels and malaria epidemiological and agroecological zones. Second, households are classified into 40 representative groups according to residence place, income quantiles, and malaria epidemiological and agroecological zones. Consequently, this SAM is a valuable database for conducting economy-wide analysis of health policies, e.g., assessing the implications of implementing malaria control and elimination strategies or changes in labour availability due to malaria effects on morbidity and mortality.

**Keywords:** social accounting matrix, malaria, economic structure, household welfare, human health, public health strategy, policy analysis, Kenya

**JEL:** E16, Q53

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## Abbreviations

CBoK	Central Bank of Kenya
CE	Cross Entropy
CGE	Computable General Equilibrium Model
GDP	Gross Domestic Product
KIHBS	Kenya Integrated Household Budget Survey
KMoF	Kenya Ministry of Health
KNBS	Kenya National Bureau of Statistics
SAM	Social Accounting Matrix
SSA	Sub-Saharan Africa
ROW	Rest of the World

# 1 Introduction

A SAM is a consistent data framework that depicts all transaction values between different economic actors in a country over a particular period, usually one year (Pyatt, 1988). It is a comprehensive and complete snapshot of the circular flow of income in an economy (Pyatt and Round, 1977), providing an economy-wide database for multiplier analysis and economy-wide simulation models (Mainar Causapé et al., 2018).

This paper describes the construction process of a 2019 SAM for Kenya and provides a detailed representation of the economy. The SAM disaggregates labour and households according to malaria epidemiological and agroecological zones, making it unique compared to the existing Kenyan SAMs. It is constructed as part of a project that assesses the economy-wide impacts of climate-change-induced human health in Sub-Saharan Africa (SSA), specifically Kenya and Burkina Faso<sup>2</sup>. The main objective of this project is to evaluate the economy-wide climate change impacts mediated through human health via two channels: (a) effects on agricultural yields, which significantly affect agricultural markets and undernutrition, and (b) effects on labour availability and productivity caused by malaria prevalence and heat stress. Accordingly, this SAM provides an essential database for conducting the targeted analysis.

The selection of 2019 as a base year relates to the availability of the most recent national economic data and the fact that it was the last year before the global economic crisis caused by COVID-19.

The SAM captures 51 accounts for activities and products (i.e., goods and services), of which 22 are agricultural products. There are two capital factors (agricultural and non-agricultural), two land factors (irrigated and non-irrigated) and 30 labour categories. Skill levels and malaria epidemiological and agroecological zones are standards for disaggregating labour. Households are classified into 40 representative groups according to location, income quantiles, and malaria epidemiological and agroecological zone. The remaining accounts of the SAM are enterprises, trade and transport margins, government, four tax accounts (sales, import, production, and income taxes), a saving/investment account, and an account reporting Kenya's transactions with the rest of the world (ROW).

This SAM benefited from the 2021 economic survey, the 2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County, the 2019 Kenya Population and Housing Census Volume IV: Distribution of Population by Socio-Economic Characteristics, the 2015/16 Kenya Integrated Household Budget Survey (KIHBS), and the Labour Force Basic Report of the 2015/2016 Kenya integrated household budget survey, the Quarterly Labour Force Report (October – December 2019), published by the KNBS,

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<sup>2</sup> The project "*Economy-Wide Effects of Climate Change Induced Health Impacts Based on General Equilibrium Models*" is a sub-project of the "Climate Change and Health in Sub-Saharan Africa" Research Unit funded by Deutsche Forschungsgemeinschaft (DFG). For more information see <https://cch-africa.de/>.



Diaspora Remittances Survey, introduced by the CBoK, the Kenya Malaria Strategy (2019–2023) developed by the KMoH, the 2019 SAM for Kenya constructed by Thurlow (2021), and the 2017 Kenyan SAM, designed by Ferrari et al. (2020).

The remainder of this paper is organised as follows. Section 2 describes the general structure of the SAM. Section 3 reviews the existing SAMs for Kenya. Section 4 shows different stages for developing the 2019 Kenyan SAM at the macro and micro levels, describing data sources used to develop the SAM, explaining the balancing procedure of the estimated SAM, and discussing the Kenyan economy as depicted by the developed SAM. Section 5 summarises and concludes.

## 2 Structure of the SAM

The SAM is a square matrix that applies the double-entry bookkeeping system, in which each account has a column and a row, where totals must be equal (Pyatt and Round, 1985). For each account, the row entries record incomes, while expenditures are recorded in the column. Consequently, the SAM incorporates all transfer values between sectors and institutions within an economy (Breisinger et al., 2009). It contains information about production structure, government budget, consumption patterns, the balance of payments, and investment and savings.

Table 1 shows the standard structure of a SAM, which is used for developing the 2019 Kenyan SAM in this paper. The table displays the economy in a 9×9 matrix representing aggregated accounts, including commodities, activities, production factors, households, enterprises, government, saving-investment, and the rest of the world (ROW). The rest of this section explains the components of each account's row and column.

Commodities represent products (i.e., goods and services) available in the economy during the accounting period. The commodity row (row 1) records the domestic payments at the purchaser price, including value-added and sales taxes. In contrast, the commodity column (column A) records the origin of commodities (domestic and foreign), transport margins, and sales taxes.

Activities in the SAM produce commodities and services. The activity column (column B) records production costs, including value-added, intermediate input costs and net tax payments (tax minus subsidies on production). The activity income, recorded in the activity row (row 2), accrues from selling the gross domestically produced supply.

The account of production factors reports the income from domestic and foreign producers (row 3) and the allocation of factor payments across different institutions based on their factor ownerships (column C). Generally, production factors comprise capital, land/natural resources, and labour.

**Table 1. A descriptive 2018 Macro-SAM for Germany**

			Expenditure columns								
			A	B	C	D	E	F	G	H	I
			Commodities	Activities	Factors	Households	Enterprises	Government	Investment	ROW	Total
Income rows	1	Commodities	Marketing Margins	Intermediate demand		Consumption expenditure		Recurrent expenditure	Investment demand	Export earnings	Total demand
	2	Activities	Domestic supply								Total activity income
	3	Factors		Value-added						Factor income from ROW	Total factor income
	4	Households			Factor payments to households		Capital transfers to households	Social transfers		Foreign remittances	Total household income
	5	Enterprises			Factor payments to enterprises			Transfers to enterprises			Total enterprise income
	6	Government	Sale taxes and import tariffs	Production taxes		Household transfers and income taxes	Capital transfers and income taxes			Foreign loans and grants	Government income
	7	Savings				Household savings	Enterprise savings	Fiscal surplus		Current account balance	Total saving
	8	ROW	Import payments		Factor payments to ROW			Current transfers to ROW			Foreign exchange out-flow
	9	Total	Total supply	Total activity expenditure	Total factor expenditure	Total household expenditure	Total enterprise expenditure	Government expenditure	Total investment expenditure	Foreign exchange in-flow	

Source: Author's compilation based on Breisinger et al. (2009).

Household income (row 4) consists of factor income and transfers from other institutions (enterprises, government, and ROW). This income is spent (column D) on purchasing goods and services, taxes, transfers to other institutions (ROW and other households), and savings.

Enterprises receive income from production factors and transfers from the government (row 5). Their income accrues to other domestic institutions (government and households), while the rest is saved (column E).

Government receives income (reported in row 6) from taxes (i.e., direct and indirect) and transfers from other institutions (enterprises and ROW). These government revenues are spent on recurrent consumption, social transfers, capital transfers to enterprises, and foreign transfers to ROW (column F). Government saving/surplus is the difference between total revenues and expenditures (or dissaving/deficit if expenditures exceed revenues).

Savings (row 7) are generated by domestic institutions (households, enterprises, and government) and foreign capital transfers from ROW, which can be negative or positive. These payments are spent on purchasing investment products (column G) to generate new physical capital, gross fixed capital formation (GFCF), and changes in inventories.

Foreign income (row 8) consists of the value of imported products, factor payments to abroad, and current transfers from the government. In contrast, foreign expenditures (column H) are exports (goods and services) and national production factors employed abroad.

### 3 Overview of existing SAMs for Kenya

Table 2 shows the SAMs developed for Kenya over the last fifteen years. Most of these SAMs are well documented, allowing users to understand and trace the underlying assumptions and data sources.

With the exception of the 2009 SAM, developed by Omolo (2014), the Kenyan SAMs contain detailed agricultural accounts, with the SAMs (Causapé et al., 2015; Ferrari et al., 2020; Kiringai et al., 2006; Randriamamonjy and Thurlow, 2017; Thurlow, 2021) including more than 40 activity accounts, of which 22 are agricultural activities.

Labour in most of these SAMs is classified according to skill levels and households according to location and income. The SAMs, developed by the European Commission (Causapé et al., 2015; Ferrari et al., 2020), further disaggregate households and labour based on the agroecological zones (arid north; arid south; coast; high rainfall; semi-arid north; and semi-south).

Moreover, the European Commission's SAMs include home production for home consumption (HPHC) (Causapé et al., 2015; Ferrari et al., 2020). Besides being consumers, this concept introduces households as producers of agricultural and livestock products for home consumption and the market.

**Table 2. Existing SAMs for Kenya**

No	Title	Authors, publication year	Institution
1.	A 2003 SAM for Kenya	Kiringai et al. (2006)	Kenya Institute for Public Policy Research and Analysis (KIPPRA) and the International Food Policy Research Institute (IFPRI)
2.	A 2009 SAM for Kenya	Omolo (2014)	African Growth and Development Policy Modelling Consortium (AGRODEP)
3.	A 2013 Nexus Project SAM for Kenya	Randriamamonjy and Thurlow (2017)	IFPRI
4.	A 2014 SAM for Kenya	Causapé et al. (2015)	European Commission, Joint Research Centre (JRC)
5.	A 2017 Trade SAM for Kenya	Ferrari et al. (2020)	
6.	A 2019 Nexus Project SAM for Kenya	Thurlow (2021)	IFPRI

Source: Author's compilation.

Accounts for household commodities for their own consumption (HPHC as input or as a final product) are separated from other marketed commodities (produced by households and by conventional productive activities). Columns of these commodity accounts summarise the contributions of household activities to each of these goods. In contrast, the row of these accounts reflects HPHCs use as intermediate inputs in productive household activities and their final demand (Causapé et al., 2015).

This paper documents the development of the 2019 SAM for Kenya on the basis of the 2017 and 2019 Kenyan SAMs, developed by Ferrari et al. (2020) and Thurlow (2021) and the country's statistical data that reflects the structure of the Kenyan economy in 2019, obtained from domestic sources such as the Kenya National Bureau of Statistics (KNBS), the Central Bank of Kenya (CBOK) and the Kenya Ministry of Health (KMoH).

The developed 2019 SAM has two unique and essential disaggregations not included in the 2019 and 2017 SAMs for Kenya (Ferrari et al., 2020; Thurlow, 2021). Firstly, the activity and commodity accounts are more detailed, specifically in the agricultural sector, which includes fourteen crop accounts, six livestock accounts, one fishing account, and one forest account<sup>3</sup>.

Secondly, the labour and households are broken down by malaria epidemiological and agroecological zones. The breakdown of labour and households based on agroecological zones

<sup>3</sup> The 2017 SAM has 11 agricultural activities producing 22 agricultural commodities for the market. HPHC is not included in the SAM developed in this paper because it is not a part of the research focus of the SAM. In contrast, 18 agricultural activities are included in the 2019 SAM, producing 18 agricultural commodities.

has been adapted from the 2017 SAM for Kenya (Ferrari et al., 2020). Data from the KMoH (2020) and KNBS (2019) are used to classify households and labour based on malaria epidemiological zones. Skill levels and income qualities are used to further disaggregate labour and households, following the 2019 Kenyan SAM (Thurlow, 2021). Consequently, this SAM provides a benchmark for health policy simulation, e.g., the effects of changing government expenditure on malaria control and elimination programmes on household welfare.

## 4 Construction process of the 2019 SAM for Kenya

This section provides the data sources, illustrates the construction process of the macro and micro-SAMs and the estimation of balanced SAMs, and presents the Kenyan economy's structure based on the developed micro-SAM.

### 4.1 Data sources

The SAM is developed using a top-down approach in which the macro-SAM is firstly constructed using data from the KNBS, the CBoK, and the 2019 Kenyan SAM of Thurlow (2021). Subsequently, the micro-SAM is developed by disaggregating the Macro SAM. The disaggregation is conducted based on the 2017 and 2019 Kenyan SAMs (Ferrari et al., 2020; Thurlow, 2021) and data from the KNBS (2021) and the KMoH (2020). Table 3 reports the different datasets used to develop the current Kenyan SAM for the year 2019.

**Table 3. Data sources for SAM construction**

No	Author, year	Title
1	CBoK (2021)	Diaspora Remittances Survey
2	Ferrari et al. (2020)	2017 Trade SAM for Kenya
3	KNBS (2022a)	Crop production by crop and county between 2015-2020
4	KNBS (2022b)	Livestock production (animal type & products) by county between 2015-2021
5	KNBS (2021)	Economic Survey 2021
6	KNBS (2020b)	Quarterly Labour Force Report (October - December 2019)
7	KNBS (2019a)	2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County
8	KNBS (2019b)	2019 Kenya Population and Housing Census Volume IV: Distribution of Population by Socio-Economic Characteristics
9	KNBS (2018a)	2015/16 Kenya Integrated Household Budget Survey
10	KNBS (2018b)	Labour Force Basic Report based on 2015/2016 Kenya integrated household budget survey
11	Thurlow (2021)	2019 Nexus Project SAM for Kenya

Source: Author's compilation.

## 4.2 Construction of the macro-SAM

The 2019 macro-SAM for Kenya is compiled based on macro aggregates (e.g., gross domestic product (GDP) components, government budget, and balance of payments) obtained from the Economic Survey 2021 (KNBS, 2020a), the Diaspora Remittances Survey (CBoK, 2021), and the 2019 SAM for Kenya (Thurlow, 2021).

Table 4 presents the developed macro-SAM for Kenya, which is explained verbally in Table 1. All SAM transactions are valued in billions of Kenyan shillings (Ksh). The average (official) annual Ksh-US dollar exchange rate for 2019 is 101.99 Ksh (CBoK, 2022).

Each row in the macro-SAM is discussed separately to explain how each macro-SAM entry is derived. The macro-SAM cells in Table 2 are identified by their row number (1 to 9) and column letter (A-I). For instance, the cell carrying value of social transfers to households is referred to in Table 4 by cell SAM4:F.

### Commodity expenditure (column)

Values of gross output of the total domestic economy at basic prices (cell SAM2:A), indirect taxes on commodities and services (cell SAM6:A), and imports of commodities and services (cell SAM8:A) are taken from the Economic Survey 2021 (KNBS, 2021).

### Activity expenditure (column)

Values for domestic production costs, including intermediate consumption at purchaser prices (cell SAM1:B), gross value added at basic prices (SAM3:B), and net production taxes (cell SAM6:B), are obtained from the Economic Survey 2021 (KNBS, 2021).

### Factor expenditure (column)

Values of factor incomes distributed to households (cell SAM4:C), enterprises (cell SAM5:C), and the rest of the world (cell SAM8:C) are determined using data from KNBS (2021) and the 2019 Kenya SAM of Thurlow (2021). These figures are calculated as a product of the institutional share in total factor income distributed to institutions in the 2019 SAM of Thurlow (2021) multiplied by the total factor payment from domestic and foreign activities (KNBS, 2021).

### Household expenditure (column)

Values of household consumption (cell SAM4:D) and direct taxes on household income (cell SAM6:D) are taken from the Economic Survey 2021 (KNBS, 2021), while household savings are derived as residuals.

**Enterprise expenditure (column)**

Values on capital transfers from enterprises to households (cell SAM4:E) are obtained from Thurlow (2021). Capital transfers to the government are obtained from the Economic Survey 2021 (KNBS, 2021). Like households, enterprise savings are estimated residually.

**Government expenditure (column)**

Values of recurrent government expenditure (cell SAM1:F), social transfers (cell SAM4:F), government transfers to enterprises (cell SAM5:F), government savings (cell SAM7:F), and government transfers to the rest of the world (cell SAM8:F) are obtained from the Economic Survey 2021 (KNBS, 2021).

**Total investment expenditure (expenditure of capital account, column)**

The value of gross fixed capital formation (cell SAM1:G) is obtained from the Economic Survey 2021 (KNBS, 2021).

**Expenditure of the rest of the world (column)**

Data on exported commodities and services (cell SAM1:H), foreign transfers to enterprises (SAM4:H), foreign transfers to government (cell SAM6:H), and balance of payments (cell SAM7:H) are obtained from the Economic Survey 2021 (KNBS, 2021). Foreign remittances (SAM4:H) are taken from the Diaspora Remittances Survey (CBoK, 2021). Factor payments from foreign producers (cell SAM3:H) are estimated by multiplying their GDP shares (Thurlow, 2021) and the 2019 GDP from Economic Survey 2021 (KNBS, 2020a).

**Table 4. A 2019 macro-SAM for Kenya (billions of Ksh)**

		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>	<b>I</b>
		<b>Commodities</b>	<b>Activities</b>	<b>Factors</b>	<b>Households</b>	<b>Enterprises</b>	<b>Government</b>	<b>Investment</b>	<b>Rest of world</b>	<b>Total</b>
<b>1</b>	<b>Commodities</b>		6,365		7,947		1,262	1,960	1,170	<b>18,703</b>
<b>2</b>	<b>Activities</b>	15,754								<b>15,754</b>
<b>3</b>	<b>Factors</b>		9,130						30	<b>9,159</b>
<b>4</b>	<b>Households</b>			5,601		1,925	97		1,585	<b>9,209</b>
<b>5</b>	<b>Enterprises</b>			3,470			1,621			<b>5,091</b>
<b>6</b>	<b>Government</b>	867	260		399	852			50	<b>2,429</b>
<b>7</b>	<b>Savings</b>				862	2,314	-677		-539	<b>1,960</b>
<b>8</b>	<b>Rest of world</b>	2,081		88			126			<b>2,296</b>
<b>9</b>	<b>Total</b>	<b>18,703</b>	<b>15,754</b>	<b>9,159</b>	<b>9,209</b>	<b>5,091</b>	<b>2,429</b>	<b>1,960</b>	<b>2,296</b>	

Source: Author's compilation.



### 4.3 Construction of the micro-SAM

Compared to the existing 2019 Micro-SAM (Thurlow, 2021), this SAM has several unique features as follows:

1. It includes 51 accounts for commodities and productive activities compared to 42 commodities and activities in the 2019 Kenyan SAM (Thurlow, 2021).
2. It contains two capital factors (agricultural and non-agricultural), two land types (irrigated and non-irrigated), and 30 labour categories. Labour is classified according to skill levels and malaria epidemiological and agroecological zones.
3. It contains 40 representative household groups, classified according to residence place, income quantiles and malaria epidemiological and agroecological zone, and
4. It exhibits both two types of direct taxes (income tax) and three types of indirect taxes (import, sales, and production taxes).

The Micro-SAM is constructed by disaggregating the macro-SAM presented in Table 4. The following sub-sections explain the disaggregation of activity, commodity, factors of production, and household accounts.

#### Activities and commodities

Domestic gross output value, the total factor and intermediate inputs used, and production taxes for each industry are available from the Economic Survey 2021 report (KNBS, 2021). The disaggregation by industry and commodity is carried out based on the use matrix of the 2017 Kenyan SAM (Ferrari et al., 2020) and data from the KNBS.

The SAM identifies 51 productive activities producing single commodities, including 22 agricultural, 19 industrial, 10 services accounts.

#### Production factors

Value-added payments are obtained from the Economic Survey 2021 report (KNBS, 2021). The SAM has 34 production factors: two types of capital (agricultural or non-agricultural), two types of land (irrigated or non-irrigated) and 30 labour categories. Capital and land disaggregation is based on a factor use matrix adapted from the 2017 SAM (Ferrari et al., 2020).

Labour is disaggregated into two stages. The first stage disaggregates based on malaria epidemiological and agroecological zones, as shown in Figure 1. These zones include: (a) arid and seasonal transmission; (b) coastal endemic; (c) high rainfall and highland epidemic; (d) high rainfall and lake endemic; (e) high rainfall and low epidemic; (f) high rainfall and seasonal transmission; (g) semi-arid and coastal; (h) semi-arid and seasonal transmission; (i) semi-arid and highland epidemic; and (j) semi-arid and low epidemic. The second stage classifies each regional labour category according to the skill classification into three labour categories. These categories are: (a) skilled (finished post-primary schooling); (b) semi-skilled (finished primary but not finished secondary schooling); and (c) unskilled (not finished primary schooling) labour.

The disaggregation according to malaria epidemiological and agroecological zones is conducted using data from the 2019 Kenya Population and Housing Census Volume I: Population by County and Sub-County (KNBS, 2018a), the Kenya Malaria Strategy (2019–2023) (KMoH 2020), and a labour use matrix from the 2017 Kenyan SAM (Ferrari et al., 2020). Skill disaggregation is conducted using data from the basic labour force report based on the 2015/2016 Kenya integrated household budget survey (KNBS, 2018b), Quarterly Labour Force Report (October - December 2019) (KNBS, 2020b), and the labour use the matrix of the 2019 Kenyan SAM (Thurlow, 2021).

## Households

The SAM has 40 representative household groups, classified according to malaria epidemiological and agroecological zones, location (rural and urban), and income level (poor and non-poor).

Households are disaggregated in three stages. First, households are disaggregated according to malaria epidemiological and agroecological zones (Figure 1). This procedure uses the 2019 Kenya Population and Housing Census Volume I and the 2019 Kenya Population (KNBS, 2019a), the 2019 Kenya Population and Housing Census Volume IV: Distribution of Population by Socio-Economic Characteristics (KNBS, 2019b), the Kenya Malaria Strategy (2019–2023) (KMoH 2020), and household matrices of the 2017 Kenyan SAM (Ferrari et al., 2020). Second, the disaggregation of regional households according to location is conducted using a sub-matrix of the 2019 Kenyan SAM (Thurlow, 2021). Finally, the disaggregation according to income level is conducted using sub-matrix of the 2019 Kenyan SAM (Thurlow, 2021) and the Kenya Integrated Household Budget Survey for 2015/2016 (KNBS, 2018a).

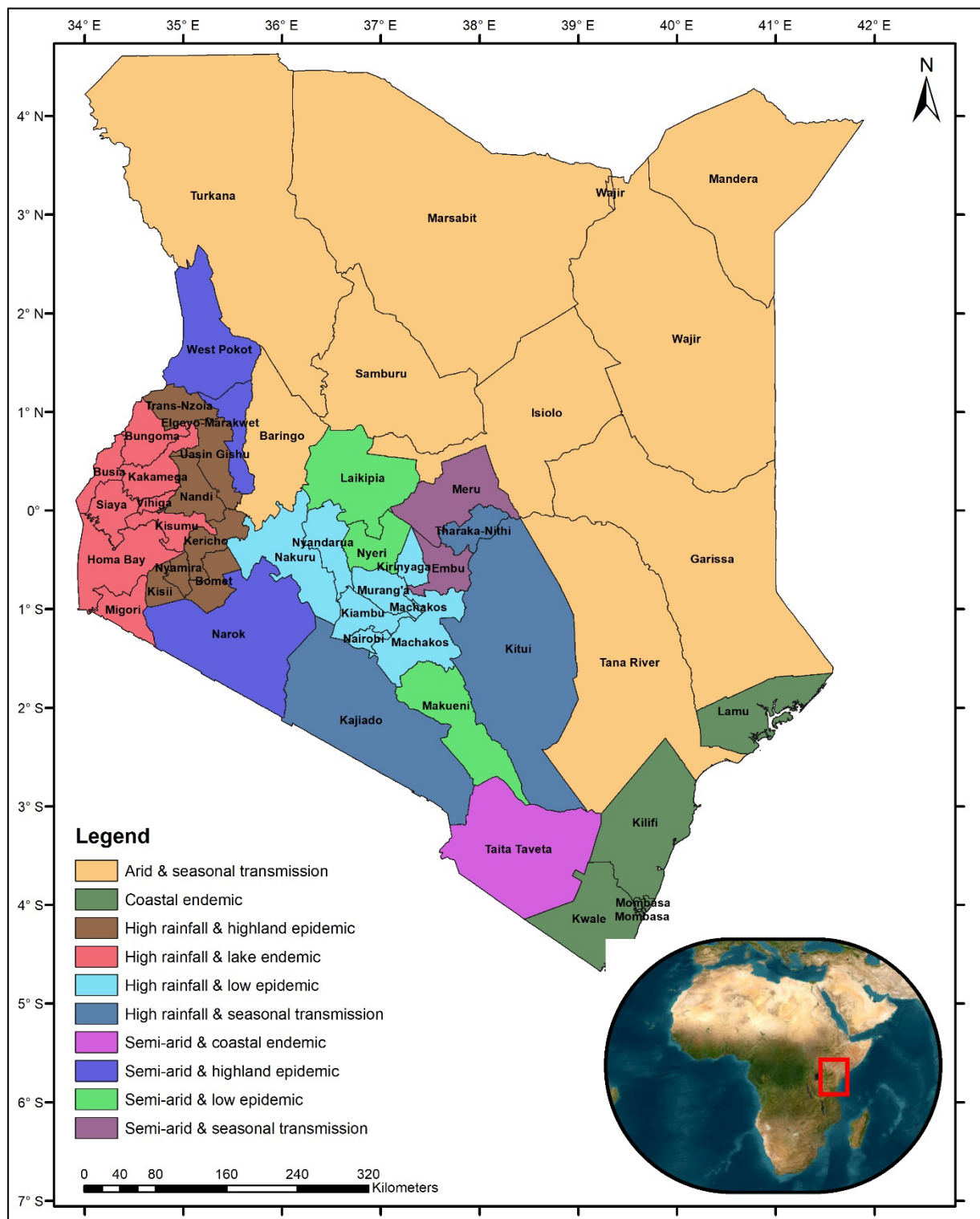
## 4.4 Balancing estimated SAMs

The 2019 micro-SAM for Kenya is developed using data from different sources. These sources use numerous statistical methods and approaches. As a result, the estimated SAM is unbalanced and inconsistent, i. e. the row and column totals do not equate.

The Cross-Entropy (CE) programme is one of the econometric optimisation techniques often used to estimate a balanced SAM. Using an information metric, it estimates the best-fitting SAM numerically, given the prior data and any constraints. It incorporates errors in variables, inequality constraints, and prior knowledge about any part of the SAM (not just row and column sums) (Robinson et al., 1998). The estimation philosophy of this method is Bayesian and interactive (Robinson and McDonald, 2006). Each cell in the SAM is treated as being specified with an error support set with determined weights (Agbahey et al., 2016). Macro totals such as GDP at market prices and factor costs are fixed with zero error, representing fixed constraints for the estimation process.

The 2019 prior unbalanced micro-SAM for Kenya is balanced using the CE method developed by Robinson and McDonald (2006). The macro totals from the balanced macro-SAM (Table 4) are used to estimate the balanced micro-SAM.

**Figure 1. Kenyan malaria epidemiological and agroecological zones included in the 2019 SAM**



Source: Author's compilation based on KMoH (2020) and Ferrari et al. (2020).

## 4.5 Kenyan economy as depicted by the 2019 SAM

Kenya is an eastern African and lower-middle-income country. According to the KNBS (2021), real GDP grew by 5.4% in 2019, and real GDP per capita averaged Ksh 106,244<sup>4</sup>. The real GDP growth is driven by the growth in service-oriented sectors, specifically financial and insurance and real estate activities.

The total population was 48 million in 2019 (KIPPRA, 2020), of which 72% are rural (World Bank, 2022). Agriculture is the primary food production and employment source, particularly for the rural population. Despite the importance of the agricultural sector in Kenya, the most significant contribution to GDP at factor cost comes from the services sector, accounting for 60%. In contrast, the agricultural and industrial sectors contribute 23% and 17% to GDP, respectively.

The SAM reflects the GDP at current market prices of Ksh 10,257 billion, of which households consume 77%. Investment demand contributes 19%, and government consumption 12% to the current Kenyan GDP. Kenya is a net importer of commodities and services. Imports account for about 20% of GDP, and exports for about 11% of GDP.

This section describes the Kenyan economy based on the SAM developed in this paper. It discusses the structure of domestic production and the distribution of production factors across sectors. In addition, household and government income and expenditure are presented. The section ends by discussing international transactions (imports and exports).

### Domestic production

Services (i.e., private and government services) contribute 57% of the total market output value, representing the most dominant sector in the Kenyan economy. In contrast, the industrial and agricultural sectors contribute 26% and 17% to the total market output value.

For agricultural sectors, crop production contributes 67% of the total agricultural market output value, which is followed by animal production (23%), forest production (7%), and fishing production (4%).

Cash crop production represents 39% of the total crop market output value, of which 32% is tea production. In contrast, food crop production accounts for 34% of the total crop market output value, followed by other crop production (27%)<sup>5</sup>.

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<sup>4</sup> Average (official) exchange rate for 2019 is US \$ 1 = 101.99 Ksh.

<sup>5</sup> In this study, cash crops include tea, coffee, and sugarcane. In contrast, food crops consist of cereals, root and tubers, pulses and oil seeds, fruits, and vegetables. Other crops comprise cotton, tobacco, fresh flowers, and other crops not included in the previous two terms.

**Production factors**

Table 5 illustrates the shares of factor cost by sector. Capital represents 62% of total value-added, followed by labour (33%) and land (5%).

Crops, government services and construction are the most labour-intensive sectors in the country. Other sectors (i.e., livestock, fishing, forests, mining, manufacturing, water and electricity and private services) are relatively capital-intensive.

A closer look at the allocation of labour income concerning skill levels illustrates that skilled labour earns 48% of total labour income, while income to semi-skilled labour represents 44%. Only 8% of these incomes go to unskilled labour.

Table 6 shows the distribution of labour income per skill category by sector. About 44% of total skilled labour income stems from government services. Private services provide 36% and 41% of total semi-skilled and unskilled labour incomes. In contrast, the agricultural sector accounts for 22% of total labour income, of which 69% is paid to semi-skilled labour, and 24% goes to skilled labour.

**Table 5. Distribution of factor income by sector (% column)**

	Crops	Livestock	Fishing	Forests	Mining	Manufac- turing	Water and electricity	Construc- tion	Private services	Govern- ment ser- vices	Total
<b>Labour</b>	48.3	6.7	4.1	5.7	19.3	24.9	16.6	57.9	21.9	66.6	32.6
<b>Irrigated land</b>	1.8										0.3
<b>Non-irrigated land</b>	34.9										5.2
<b>Agricultural capital</b>	15.0	93.3	95.9	94.3							9.4
<b>Non-agricultural capital</b>					80.7	75.1	83.4	42.1	78.1	33.4	52.6
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Total (Ksh billion)</b>	<b>1,355.0</b>	<b>467.7</b>	<b>74.8</b>	<b>155.3</b>	<b>71.1</b>	<b>712.9</b>	<b>212.3</b>	<b>563.0</b>	<b>4,358.9</b>	<b>1,158.6</b>	<b>9,129.5</b>

Source: Author's calculation based on the developed 2019 SAM for Kenya.

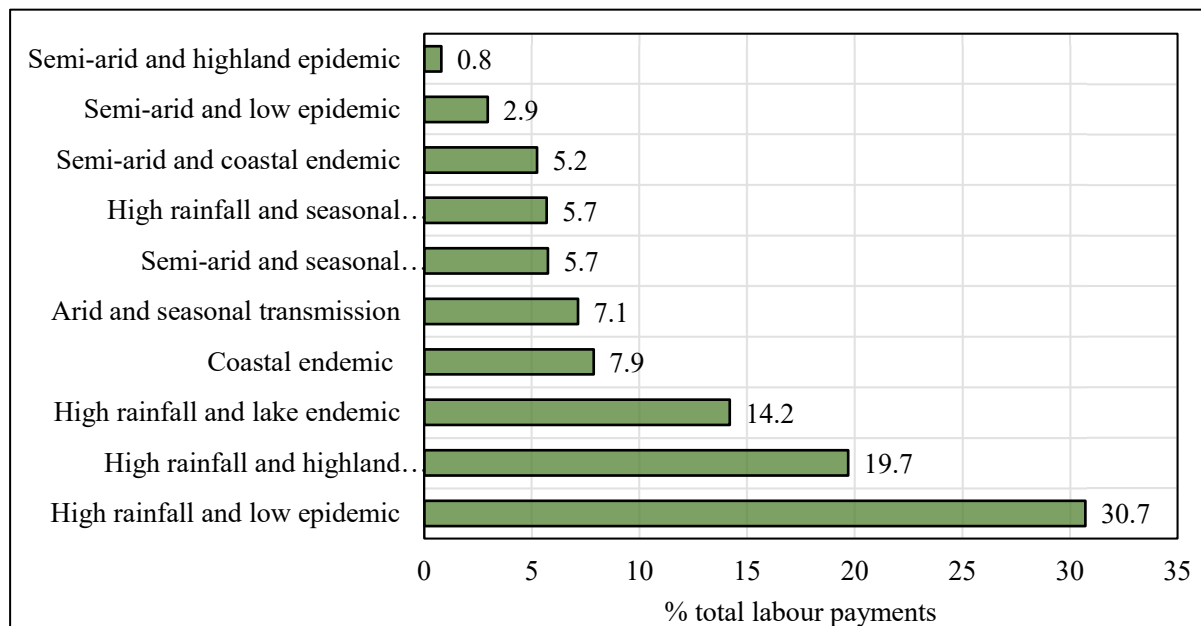
**Table 6. Distribution of labour income by skill level and sectors (% row)**

	Crops	Livestock	Fishing	Forests	Mining	Manufac- turing	Water and electricity	Construc- tion	Private ser- vices	Govern- ment ser- vices	Total	Total (Ksh billion)
<b>Skilled labour</b>	11.1			0.1	0.4	3.8	2.4	11.4	26.8	44.0	<b>100.0</b>	<b>1,424.7</b>
<b>Semi-skilled labour</b>	34.6	1.9	0.2	0.5	0.5	8.0	0.1	7.5	36.2	10.5	<b>100.0</b>	<b>1,305.2</b>
<b>Unskilled labour</b>	18.3	2.5	0.1	0.4	0.7	7.3	0.1	26.3	41.2	3.3	<b>100.0</b>	<b>245.7</b>
<b>Total</b>	<b>22.0</b>	<b>1.1</b>	<b>0.1</b>	<b>0.3</b>	<b>0.5</b>	<b>6.0</b>	<b>1.2</b>	<b>11.0</b>	<b>32.1</b>	<b>25.9</b>	<b>100.0</b>	<b>2,975.6</b>

Source: Author's calculation based on the developed 2019 SAM for Kenya.

Labour income by malaria epidemiological zone is presented in Figure 2. Labour in the high rainfall and low epidemic zone accounts for the highest share (31%) of total labour income, followed by the high rainfall and highland epidemic zones (20%) and labour in the high rainfall and lake endemic (14%). In contrast, labour in the coastal endemic, semi-arid and coastal endemic, high rainfall and seasonal transmission, arid and seasonal transmission, semi-arid and seasonal transmission, semi-arid and low epidemic, semi-arid and highland epidemic zones earn between 8% and 1% of total labour income.

**Figure 2. Labour income shares by malaria epidemiological and agroecological zones (% of total labour income)**



Source: Author's calculation based on the developed 2019 SAM for Kenya.

Table 7 illustrates the distribution of labour income by zone and sector. Services (i.e., private and government) account for the largest share of total labour income for all labour categories except in the arid and seasonal transmission and the semi-arid and low epidemic zones. The latter labour categories receive 53 % and 29% of their total revenue from the crop sector.

**Table 7. Distribution of labour payment by zone and productive sectors (% row)**

	<b>Crops</b>	<b>Livestock</b>	<b>Fishing</b>	<b>Forests</b>	<b>Mining</b>	<b>Manufactur- ing</b>	<b>Water and electricity</b>	<b>Construc- tion</b>	<b>Private ser- vices</b>	<b>Government services</b>	<b>Total</b>	<b>Total (Ksh billion)</b>
Arid and seasonal transmission	52.8	0.5	0.0	0.4	1.6	0.9	1.4	4.3	19.9	18.1	<b>100.0</b>	<b>212.4</b>
Coastal endemic	24.9	0.2	0.7	1.4	0.4	3.7	0.7	12.1	30.5	25.5	<b>100.0</b>	<b>234.1</b>
High rainfall and lake endemic	13.7	1.0	0.1	0.2	0.4	7.2	0.8	11.2	38.4	27.0	<b>100.0</b>	<b>422.2</b>
High rainfall and highland epidemic	19.8	1.1	0.1	0.2	0.3	7.8	0.8	11.6	35.7	22.7	<b>100.0</b>	<b>586.1</b>
High rainfall and low epidemic	18.0	0.7	0.1	0.2	0.5	7.0	0.7	9.9	32.3	30.8	<b>100.0</b>	<b>914.0</b>
High rainfall and seasonal transmission	21.1	1.1	0.1	0.2	0.4	7.2	1.1	10.9	35.2	22.8	<b>100.0</b>	<b>169.0</b>
Semi-arid and highland epidemic	25.5	2.6	0.0	0.3	0.2	3.4	3.9	14.0	25.7	24.6	<b>100.0</b>	<b>23.4</b>
Semi-arid and low epidemic	29.0	2.8	0.0	0.4	0.3	4.1	2.4	13.7	28.3	19.0	<b>100.0</b>	<b>87.6</b>
Semi-arid and coastal	22.1	2.2	0.0	0.3	0.2	2.8	3.5	15.0	26.7	27.2	<b>100.0</b>	<b>155.7</b>
Semi-arid and seasonal transmission	26.3	2.6	0.0	0.3	0.2	3.2	3.1	15.1	24.9	24.2	<b>100.0</b>	<b>171.1</b>
<b>Total</b>	<b>22.0</b>	<b>1.1</b>	<b>0.1</b>	<b>0.3</b>	<b>0.5</b>	<b>6.0</b>	<b>1.2</b>	<b>11.0</b>	<b>32.1</b>	<b>25.9</b>	<b>100.0</b>	<b>2,978.6</b>

Source: Author's calculation based on the developed 2019 SAM for Kenya.

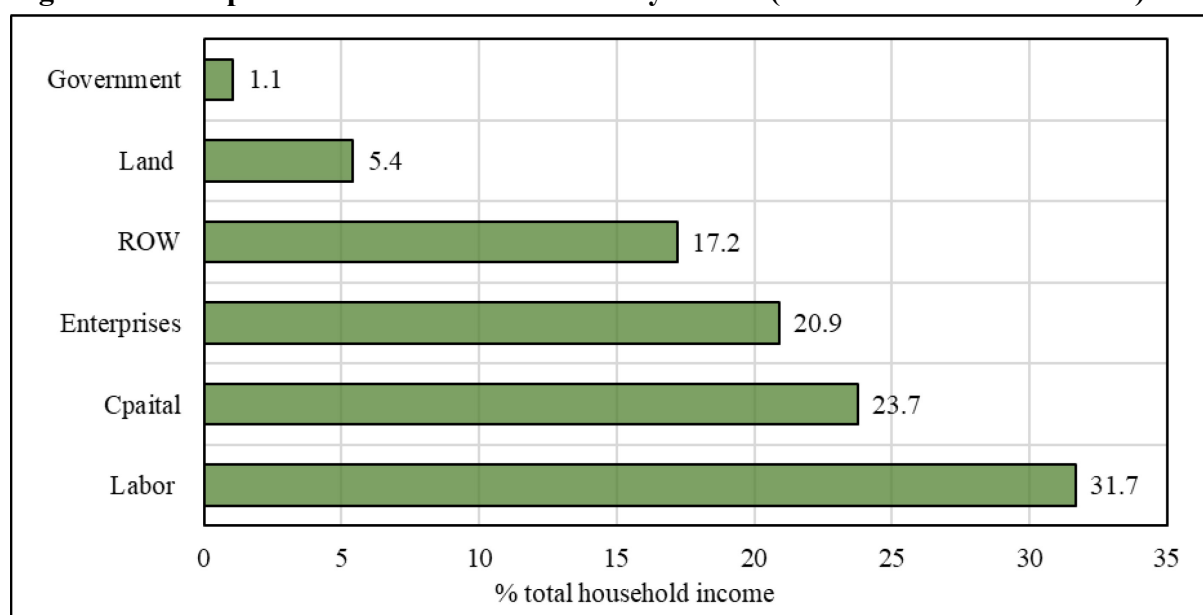


## Household income and expenditure

### Household income

Figure 3 shows the different income sources of household groups included in the SAM. 32% of total household income is derived from labour income. In contrast, capital income contributes 24% to total household income. Incorporated enterprises are the third primary household income source, accounting for 21% of total household income. Other sources of income include foreign remittances (17%), land income (5%), and social transfers from the government (1%).

**Figure 3. Composition of household income by source (% total household income)**



Source: Author's calculation based on the 2019 SAM for Kenya

Table 8 shows income composition across different household groups and income sources. Capital income represents more than 35% of rural (poor and non-poor) household income. Labour income accounts for more than 60% of urban poor household income. In contrast, about 36% of urban non-poor household income comes from incorporated enterprises.

The distribution of factor income and enterprise transfers to households across different household groups is presented in Table 9. The distribution of labour income across categories and households indicates that 84% of total skilled labour income accrues to non-poor households, of which 65% goes to urban households. Rural households earn more than 50% of total semi-skilled labour income. In contrast, rural poor households earn more than 50% of total unskilled labour income. More than 90% of land and capital income goes to rural (poor and non-poor) households.

Most of the factor incomes accrue to rural households (59%), while more than 50% of these incomes accrue to poor households. Besides, urban non-poor households earn more than 70% of enterprise transfers.

**Table 8. Composition of household income by source and household group (% row)**

	Labour	Land	Capital	Enterprises	Government	Rest of the world	Total	Total (Ksh billion)
<b>Rural poor</b>	31.4	11.5	48.1	5.7	1.1	2.2	100.0	2,267.3
<b>Rural non-poor</b>	23.8	8.0	38.1	11.3	0.6	18.2	100.0	2,383.3
<b>Urban poor</b>	63.2	2.2	6.9	20.6	4.1	2.9	100.0	659.1
<b>Urban non-poor</b>	31.3	0.8	3.7	35.7	0.8	27.8	100.0	3,898.9
<b>Total</b>	<b>31.7</b>	<b>5.4</b>	<b>23.8</b>	<b>20.9</b>	<b>1.1</b>	<b>17.2</b>	<b>100.0</b>	<b>9,208.5</b>

Source: Author's calculation based on the SAM.

**Table 9. Distribution of factor income across household groups by factor (% column)**

	Skilled	Semi-skilled	Unskilled	Land	Capital	Enterprises	Total
<b>Rural poor</b>	8.0	36.4	58.0	52.4	49.8	6.7	29.1
<b>Rural non-poor</b>	18.6	19.2	26.9	38.4	41.5	14.0	25.7
<b>Urban poor</b>	8.2	21.8	8.4	3.0	2.1	7.1	8.1
<b>Urban non-poor</b>	65.2	22.7	6.7	6.2	6.6	72.3	37.0
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Total (Ksh billion)</b>	<b>1,397.3</b>	<b>1,302.9</b>	<b>216.9</b>	<b>2,917.2</b>	<b>497.2</b>	<b>1,924.8</b>	<b>7,526.0</b>

Source: Author's calculation based on the SAM.

Table 10 presents income shares by malaria epidemiological and agroecological zones. The majority of total income is derived from semi-skilled labour (40%) for households residing within the semi-arid and coastal zone. In contrast, skilled labour income comprises the highest proportion of total income for households residing in coastal (23%), high rainfall and low epidemic (25%) zones. Conversely, capital income is the primary source of income for households in high rainfall & highland epidemic, high rainfall & lake endemic, high rainfall & low epidemic, high rainfall & seasonal transmission, semi-arid & highland epidemic, semi-arid & low epidemic, and semi-arid & seasonal transmission zones. For households in the arid and seasonal transmission zone, enterprise transfers represent the largest share of total income, accounting for 30% of the total income.

**Table 10. Composition of household income by household group and Malaria epidemiological zone (% column)**

	Skilled	Semi-skilled	Unskilled	Land	Capital	Enterprises	Government	Rest of the world	Total	Total (Ksh billion)
<b>Arid &amp; seasonal transmission</b>	6.9	8.5	1.5	10.5	24.2	30.6	1.7	16.1	<b>100.0</b>	<b>1,250.7</b>
<b>Coastal endemic</b>	22.9	14.5	3.4	4.7	21.3	12.3	0.7	20.1	<b>100.0</b>	<b>565.4</b>
<b>High rainfall &amp; highland epidemic</b>	15.8	18.4	3.7	4.3	20.8	19.6	1.0	16.5	<b>100.0</b>	<b>1,532.5</b>
<b>High rainfall &amp; lake endemic</b>	10.9	10.8	1.8	5.7	27.5	26.6	1.3	15.3	<b>100.0</b>	<b>1,738.8</b>
<b>High rainfall &amp; low epidemic</b>	24.6	15.6	2.2	2.6	22.5	14.8	0.7	17.1	<b>100.0</b>	<b>2,115.1</b>
<b>High rainfall &amp; seasonal transmission zone</b>	12.6	17.7	1.9	5.9	24.8	18.5	0.9	17.8	<b>100.0</b>	<b>501.4</b>
<b>Semi-arid &amp; coastal</b>	36.3	40.2	4.7	2.2	4.8	6.1	0.2	5.5	<b>100.0</b>	<b>187.5</b>
<b>Semi-arid &amp; highland epidemic</b>	2.6	3.7	0.4	8.3	34.1	28.1	1.3	21.5	<b>100.0</b>	<b>342.3</b>
<b>Semi-arid &amp; low epidemic</b>	5.5	11.5	2.5	6.0	27.4	21.0	1.0	25.1	<b>100.0</b>	<b>437.0</b>
<b>Semi-arid &amp; seasonal transmission</b>	12.3	16.4	2.5	6.0	22.9	19.4	0.8	19.7	<b>100.0</b>	<b>537.7</b>
<b>Total</b>	<b>15.2</b>	<b>14.1</b>	<b>2.4</b>	<b>5.4</b>	<b>23.7</b>	<b>20.9</b>	<b>1.1</b>	<b>17.2</b>	<b>100.0</b>	<b>9,208.5</b>

Source: Author's calculation based on the SAM.

## Household expenditure

Table 11 illustrates expenditure shares by household groups. It shows that purchasing goods and services spending represents 86% of total household expenditure. While about 9% of total household expenditure is saved, and 4% is paid as income tax to the government.

Poor households (rural and urban combined) spend most of their income on purchasing goods and services (Table 11). In contrast, non-poor households (rural and urban) spending on goods and services represents between 86% and 79% of their total income.

Non-poor households save between 11% and 13% of their income, while poor households save less than 4% (Table 11).

Non-poor (rural and urban) households pay between 3% and 8% of their income as taxes, while poor households (rural and urban) pay less than 1% of their income as taxes to the government.

**Table 11. Structure of household expenditure by household group (column % shares)**

	Rural poor household	Rural non-poor households	Urban poor household	Urban non-poor households	Total
Expenditure on purchasing goods and services	95.5	86.1	95.8	79.5	86.3
Direct taxes	0.7	2.9	0.5	8.0	4.3
Savings	3.8	11.0	3.7	12.5	9.4
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
<b>Total (Ksh billion)</b>	<b>2,267.3</b>	<b>2,383.3</b>	<b>659.1</b>	<b>3,898.9</b>	<b>9,208.5</b>

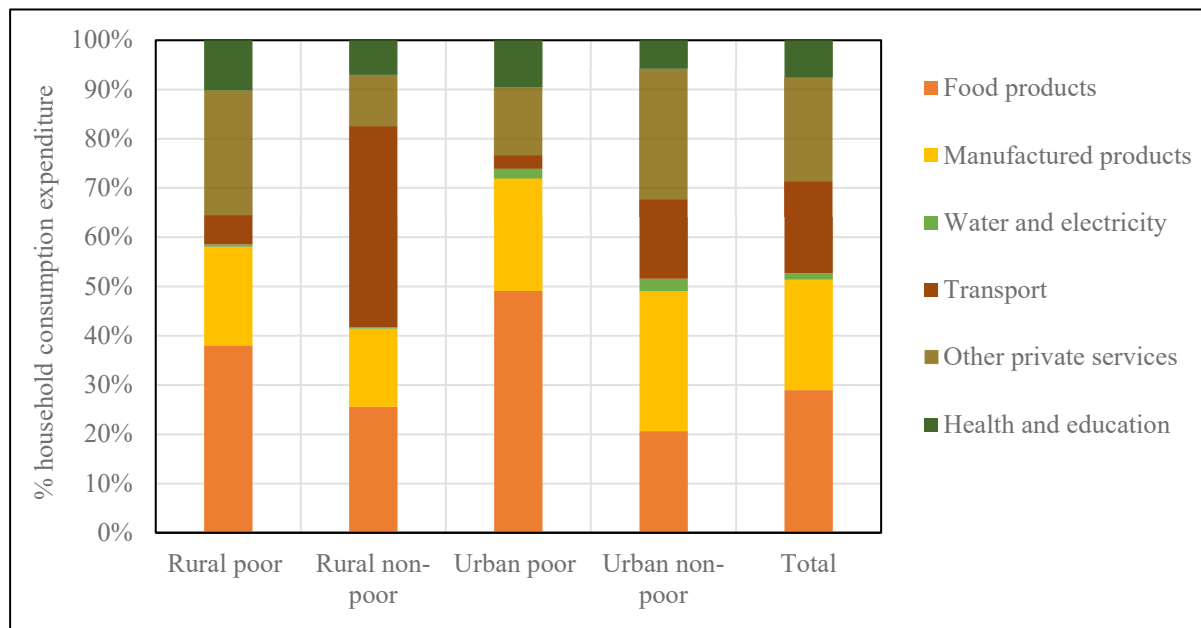
Source: Author's calculation based on the developed 2019 SAM for Kenya.

Figure 4 shows household consumption expenditures on different products across household groups. Overall, one-third of household consumption expenditure is on food products, including agricultural and processed products. Poor households (rural and urban) spend higher shares of their consumption budget on food products than non-poor households.

Expenditures on manufactured products account for more than 20% of consumption expenditure for urban households, while it represents less than 16% for rural households.

Urban households spend more of their consumption budget on water and electricity services than rural households.

**Figure 4. Distribution of household consumption expenditure by product and household group (% household consumption expenditure)**



Source: Author's calculation based on the SAM.

### Government revenue and expenditure

Government revenue is composed of tax income (76%), income from enterprises (22%), and foreign development aid and grants (2%)<sup>6</sup>.

Sales and direct taxes account for 39% of total tax revenue, followed by production taxes (14%) and import taxes (8%).

Import and sales taxes are collected on manufactured products, with petroleum accounting for 34% and 44% of import and sales tax revenue, respectively (Table 12).

Production taxes on services represent 53% of total production tax revenue, of which 23% are taxes on trade (Figure 5).

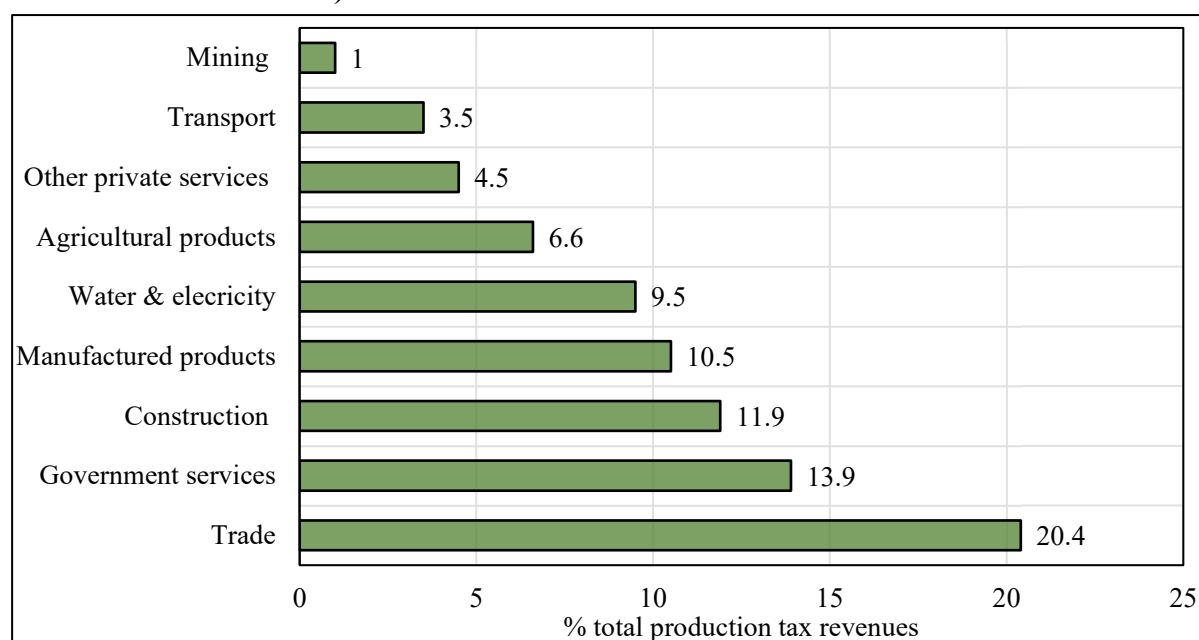
Government savings are negative (a budget deficit), representing 28% of total government expenditure (Ksh -677 billion) and accounting for 16% of the current GDP in 2019.

<sup>6</sup> According to KNBS (2020a), total government revenue is Ksh 2,429 billion in 2019, while total government expenditure is Ksh 3,106 billion.

**Table 12. Distribution of indirect taxes by commodities (% row)**

	Agricultural products	Manufactured products	Trade	Other private services	Total	Total (Ksh billion)
<b>Import taxes</b>	5.0	95.0			100.0	151.3
<b>Sale taxes</b>	5.7	87.0	6.4	1.0	100.0	715.5
<b>Total</b>	<b>5.5</b>	<b>88.4</b>	<b>5.3</b>	<b>0.8</b>	<b>100.0</b>	<b>866.8</b>

Source: Author's calculation based on the 2019 SAM for Kenya.

**Figure 5. Distribution of production taxes by productive sector (% of total production tax revenues)**

Source: Author's calculation based on the 2019 SAM for Kenya.

Capital transfers to enterprises account for 52% of government expenditure, while 41% of total government expenditure is spent on purchasing products, followed by transfers to the ROW (4%) and social transfers (3%). The main product consumed by the government is public administration services, accounting for 49% of total recurrent expenditure.

## International trade

Agricultural exports represent the primary source of foreign currency earnings, contributing 68% of the total export value. Of this, 45% are tea exports. In contrast, services account for 19% of total export value, followed by manufactured and industrial products (12%).

Imports represent 19% of total domestic final demand. Manufactured products account for more than 80% of the total import value, of which 43% are for petroleum and chemical products.

## 5 Summary

This paper describes the development of a detailed 2019 SAM for Kenya, which is regionally disaggregated according to malaria and agroecological zones. The SAM is especially suited to analyse shocks regarding human health, such as changes in malaria prevalence and shocks on agriculture, which can be treated differently according to agroecological zones.

The SAM is constructed based on official statistics collected from domestic institutions (i.e., the KNBS and the KMoH) and complemented with data from current available SAMs (Ferrari et al., 2020; Thurlow, 2021). A top-down approach is used for developing the 2019 Kenyan SAMs. The Cross-Entropy method is used to balance the prior micro-SAM (with minor imbalances), using values in the macro-SAM as macro-totals (estimation controls for balancing).

The micro-SAM contains 185 accounts: 51 activities (22 agricultural, 19 industrial, and 10 service sectors); 51 commodities; one margin account; 34 production factors (2 types of capital, 2 types of land, and 30 labour categories); 40 household groups; the government as well as four tax accounts; enterprises; a savings/investment account and a foreign account.

The agricultural sector accounts for 22% of GDP at factor costs. It is a relatively capital-intensive sector, with capital accounting for 42% of total agricultural value-added, followed by labour, which accounts for 34%, and land, which accounts for 24% of total agricultural value-added.

Factor income is a significant income source for households, particularly rural households. Rural households receive the highest share of capital and labour income. In contrast, more than 50% of this income accrues to non-poor households. In comparison, urban households receive the highest percentage (56%) of labour income, of which 42% goes to non-poor households.

There is variation in the importance of income sources when it comes to households across malaria epidemiological and agroecological zones. For instance, labour is a significant income source in high rainfall and low epidemic households. In contrast, non-labour factors and institutional transfers, e.g., enterprises and government, are the primary income source of households in high rainfall and lake endemic, high rainfall and highland epidemic, arid and seasonal transmission, and high rainfall and seasonal transmission zones.

Poor households tend to spend a higher proportion of their expenditure, over 90%, on buying commodities and services compared to non-poor households. They also allocate a more significant portion of their consumption expenditure towards purchasing food products, which comprises over 35% of their expenditure. In contrast, non-poor households spend less than 30% of their consumption expenditure on food products.

Tax revenues comprise the majority (76%) of government income, with 39%, coming from sales taxes. The government ran a deficit of Ksh 677 billion in 2019. The most significant part of government spending goes toward capital transfers to enterprises.

Kenya is a net importer of commodities and services from the rest of the world. Imported products account for 20% of current GDP, with manufactured products accounting for over 80% of the total import value.

Tea exports are the country's primary foreign currency source, contributing more than 30% to the total export value.



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## Appendices

### Appendix A: Accounts in the 2019 Micro-SAM for Kenya

No	Micro-SAM account	Description
1	c_maize	Maize
2	c_wheat	Wheat
3	c_rice	Rice
4	c_cereal	Other cereals
5	c_root	Roots & tubers
6	c_seed	Pulses & oil seeds
7	c_fruit	Fruits
8	c_veg	Vegetables
9	c_cotton	Cotton
10	c_sugcane	Sugarcane
11	c_coffee	Coffee
12	c_tea	Tea
13	c_tabac	Tobacco
14	c_othcrop	Others crops
15	c_beef	Beef
16	c_dairy	Dairy
17	c_poltry	Poultry
18	c_sheep	Sheep & goat, and lamb
19	c_live	Other livestock
20	c_fish	Fishing
21	c_forest	Forestry
22	c_mining	Mining
23	c_meat	Meat & dairy
24	c_milling	Grain milling
25	c_bakery	Sugar & bakery & confectionary
26	c_tabaco	Beverages & tobacco
27	c_ofood	Other manufactured food
28	c_textile	Textile & clothing
29	c_leather	Leather & footwear
30	c_wood	Wood & paper
31	c_printing	Printing and publishing
32	c_petro	Petroleum
33	c_chemical	Chemicals
34	c_ferizr	Fertilisers
35	c_nmetallic	Non-metallic products
36	c_metals	Metals and machines
37	c_othmanf	Other manufacturers
38	c_water	Water
39	c_elect	Electricity
40	c_constr	Construction
41	c_trade	Trade

No	Micro-SAM account	Description
42	c_hotel	Hotels
43	c_transp	Transport
44	c_commu	Communication
45	c_finan	Finance
46	c_estate	Real estate
47	c_othserv	Other services
48	c_admin	Administration
49	c_health	Health
50	c_educ	Education
51	m_mtrad	Margins
52	a_food	Food crops
53	a_cotton	Cotton
54	a_sugarcane	Sugarcane
55	a_coffee	Coffee
56	a_tea	Tea
57	a_tabac	Tobacco
58	a_others	Others crops
59	a_livestock	Livestock
60	a_dairy	Dairy
61	a_fishing	Fishing
62	a_forestry	Forestry
63	a_mining	Mining
64	a_meat	Meat & dairy
65	a_grain	Grain milling
66	a_sugar	Sugar & bakery & confectionary
67	a_beverages	Beverages & tobacco
68	a_othfood	Other manufactured food
69	a_textile	Textile & clothing
70	a_leather	Leather & footwear
71	a_wood	Wood & paper
72	a_printing	Printing and publishing
73	a_petrol	Petroleum
74	a_chemical	Chemicals
75	a_fertilz	Fertilisers
76	a_metals	Non-metallic products
77	a_nmetalc	Metals and machines
78	a_othmanuf	Other manufacturers
79	a_water	Water
80	a_elect	Electricity
81	a_constr	Construction
82	a_trade	Trade
83	a_hotel	Hotels
84	a_transp	Transport
85	a_comm	Communication
86	a_finance	Finance

No	Micro-SAM account	Description
87	a_estate	Real estate
88	a_othserv	Other services
89	a_administration	Administration
90	a_health	Health
91	a_educ	Education
92	f_labskASean	Skilled labour - Arid & seasonal transmission zone
93	f_labsskASean	Semi-skilled labour - Arid & seasonal transmission zone
94	f_labuskASean	Unskilled labour - Arid & seasonal transmission zone
95	f_labskCoast	Skilled labour - Coastal endemic
96	f_labsskCoast	Semi-skilled labour - Coastal endemic
97	f_labuskCoast	Unskilled labour - Coastal endemic
98	f_labskHRLake	Skilled labour - High rainfall & lake endemic zone
99	f_labsskHRLake	Semi-skilled labour - High rainfall & lake endemic zone
100	f_labuskHRLake	Unskilled labour - High rainfall & lake endemic zone
101	f_labskHRHInd	Skilled labour - High rainfall & highland epidemic zone
102	f_labsskHRHInd	Semi-skilled labour - High rainfall & highland epidemic zone
103	f_labuskHRHInd	Unskilled labour - High rainfall & lake endemic zone
104	f_labskHRLow	Skilled labour - High rainfall & low epidemic zone
105	f_labsskHRLow	Semi-skilled labour - High rainfall & low epidemic zone
106	f_labuskHRLow	Unskilled labour - High rainfall & low epidemic zone
107	f_labskHRSean	Skilled labour - High rainfall & seasonal transmission zone
108	f_labsskHRSean	Semi-skilled labour - High rainfall & seasonal transmission zone
109	f_labuskHRSean	Unskilled labour - High rainfall & seasonal transmission zone
110	f_labskSAHInd	Skilled labour - Semi-arid & highland epidemic zone
111	f_labsskSAHInd	Semi-skilled labour - Semi-arid & highland epidemic zone
112	f_labuskSAHInd	Unskilled labour - Semi-arid & highland epidemic zone
113	f_labskSALowA	Skilled labour - Semi-arid & low epidemic zone
114	f_labsskSALowA	Semi-skilled labour - Semi-arid & low epidemic zone
115	f_labuskSALowA	Unskilled labour - Semi-arid & highland epidemic zone
116	f_labskSACoasA	Skilled labour - Semi-arid & coastal zone
117	f_labsskSACoasA	Semi-skilled labour - Semi-arid & coastal zone
118	f_labuskSACoasA	Unskilled labour - Semi-arid & coastal zone
119	f_labskSASeanA	Skilled labour - Semi-arid & seasonal transmission zone
120	f_labsskSASeanA	Semi-skilled labour - Semi-arid & seasonal transmission zone
121	f_labuskSASeanA	Unskilled labour - Semi-arid & seasonal transmission zone
122	f_landirrg	Land - irrigated (land factor)
123	f_landNirrg	Land - non-irrigated (land factor)
124	f_agricap	Capital (agricultural)
125	f_nagricap	Capital (non-agricultural)
126	h_AridSeanRurP	Arid & seasonal transmission zone - Rural - Poor
127	h_AridSeanRurNP	Arid & seasonal transmission zone - Rural - Non-poor
128	h_AridSeanUrbP	Arid & seasonal transmission zone - Urban - Poor
129	h_AridSeanUrbNP	Arid & seasonal transmission zone - Urban - Non-poor
130	h_coastRurP	Coastal endemic - Rural - Poor
131	h_coastRurNP	Coastal endemic - Rural - Non-poor

No	Micro-SAM account	Description
132	h_coastUrbP	Coastal endemic - Urban - Poor
133	h_coastUrbNP	Coastal endemic - Urban - Non-poor
134	h_HRLakeRurP	High rainfall & lake endemic zone - Rural - Poor
135	h_HRLakeRurNP	High rainfall & lake endemic zone - Rural - Non-poor
136	h_HRLakeUrbP	High rainfall & lake endemic zone - Urban - Poor
137	h_HRLakeUrbNP	High rainfall & lake endemic zone - Urban - Non-poor
138	h_HRHIndRurP	High rainfall & highland epidemic zone - Rural - Poor
139	h_HRHIndRurNP	High rainfall & highland epidemic zone - Rural - Non-poor
140	h_HRHIndUrbP	High rainfall & highland epidemic zone - Urban - Poor
141	h_HRHIndUrbNP	High rainfall & highland epidemic zone - Urban - Non-Poor
142	h_HRLowRurP	High rainfall & low epidemic zone -Rural - Poor
143	h_HRLowRurNP	High rainfall & low epidemic zone -Rural - Non-poor
144	h_HRLowUrbP	High rainfall & low epidemic zone -Urban - Poor
145	h_HRLowUrbNP	High rainfall & low epidemic zone -Urban - Non-poor
146	h_HRSeanRurP	High rainfall & seasonal transmission zone - Rural - Poor
147	h_HRSeanRurNP	High rainfall & seasonal transmission zone - Rural - Non-poor
148	h_HRSeanUrbP	High rainfall & seasonal transmission zone - Urban - Poor
149	h_HRSeanUrbNP	High rainfall & seasonal transmission zone - Urban - Non-poor
150	h_SAHIndARurP	Semi-arid & highland epidemic zone - Rural - Poor
151	h_SAHIndARurNP	Semi-arid & highland epidemic zone - Rural - Non-poor
152	h_SAHIndAUrbP	Semi-arid & highland epidemic zone - Urban - Poor
153	h_SAHIndAUrbNP	Semi-arid & highland epidemic zone - Urban - Non-poor
154	h_SALowARurP	Semi-arid & low epidemic zone - Rural - Poor
155	h_SALowARurNP	Semi-arid & low epidemic zone - Rural - Non-poor
156	h_SALowAUrbP	Semi-arid & low epidemic zone - Urban - Poor
157	h_SALowAUrbNP	Semi-arid & low epidemic zone - Urban - Non-poor
158	h_SACoasARurP	Semi-arid & coastal zone - Rural- Poor
159	h_SACoasARurNP	Semi-arid & coastal zone - Rural- Non-poor
160	h_SACoasAUrbP	Semi-arid & coastal zone - Urban- Poor
161	h_SACoasAUrbNP	Semi-arid & coastal zone - Urban- Non-poor
162	h_SASeanARurP	Semi-arid & seasonal transmission zone - Rural - Poor
163	h_SASeanARurNP	Semi-arid & seasonal transmission zone - Rural - Non-poor
164	h_SASeanAUrbP	Semi-arid & seasonal transmission zone - Urban - Poor
165	h_SASeanAUrbNP	Semi-arid & seasonal transmission zone - Urban - Non-poor
166	ENT	Enterprises
167	GOVT	Government
168	imptax	Imports taxes
169	saltax	Sales taxes
170	indtax	Indirect taxes
171	dirtax	Direct taxes
172	i_s	Investment & saving
173	row	Rest of the world

Source: Author's compilation.

## Appendix B: Standards for labour disaggregation in the 2019 SAM for Kenya

No	Standard	Sub-standards
1	Skill level	1.1. Skilled labour
		1.2. Semi-skilled labour
		1.3. Unskilled labour
2	Agroecological zones	2.1. Arid
		2.2. Coast
		2.3. High rainfall
		2.4. Semi-arid
3	Epidemiological zones	3.1. Coast endemic
		3.2. Highland endemic
		3.3. Lake endemic
		3.4. Low risk area
		3.5. Seasonal transmission

Source: Author's compilation.

## Appendix C: List of activity and commodity accounts in the micro-SAM and their correspondence with KNBS data

No	Commodities	No	Activities	KNBS data
1	Maise	1	Food crops	Agriculture, forestry and fishing
2	Wheat			
3	Rice			
4	Other cereals			
5	Roots & tubers			
6	Pulses & oil seeds			
7	Fruits			
8	Vegetables			
9	Cotton	2	Cotton	
10	Sugarcane	3	Sugarcane	
11	Coffee	4	Coffee	
12	Tea	5	Tea	
13	Tobacco	6	Tobacco	
14	Others crops	7	Others crops	
15	Beef	8	Livestock	
16	Poultry			
17	Sheep & goat and lamb			
18	Other livestock			
19	Dairy	9	Dairy	
20	Fishing	10	Fishing	
21	Forestry	11	Forestry	
22	Mining	12	Mining	

No	Commodities	No	Activities	KNBS data
23	Meat & dairy	13	Meat & dairy	Manufacturing
24	Grain milling	14	Grain milling	
25	Sugar & bakery & confectionary	15	Sugar & bakery & confectionary	
26	Beverages & tobacco	16	Beverages & tobacco	
27	Other manufactured food	17	Other manufactured food	
28	Textile & clothing	18	Textile & clothing	
29	Leather & footwear	19	Leather & footwear	
30	Wood & paper	20	Wood & paper	
31	Printing and publishing	21	Printing and publishing	
32	Petroleum	22	Petroleum	
33	Chemicals	23	Chemicals	
34	Fertilisers	24	Fertilisers	
35	Non-metallic products	25	Non-metallic products	
36	Metals and machines	26	Metals and machines	
37	Other manufacturers	27	Other manufacturers	
38	Water	28	Water	Electricity, gas and water supply
39	Electricity	29	Electricity	
40	Construction	30	Construction	Construction
41	Trade	31	Trade	Wholesale and retail trade
42	Hotels	32	Hotels	Accommodation and Food Services
43	Transport	33	Transport	Transportation and storage
44	Communication	34	Communication	Information and communication
45	Finance	35	Finance	Financial and insurance activities
46	Real estate	36	Real estate	Real estate
47	Other services	37	Other services	Other services
48	Administration	38	Administration	Public administration and defence
49	Health	39	Health	Health
50	Education	40	Education	Education

Source: Author's compilation.



**Appendix D: Standards for household disaggregation in the 2019 SAM for Kenya**

No	Standard	Sub-standards
1.	Residence place	1.1. Rural
		1.2. Urban
2.	Income quantile	2.1. Poor
		2.2. Non-poor
3	Agroecological zones	3.1. Arid
		3.2. Coast
		3.3. High rainfall
		3.4. Semi-arid
4	Epidemiological zones	4.1. Coast endemic
		4.2. Highland endemic
		4.3. Lake endemic
		4.4. Low risk area
		4.5. Seasonal transmission

Source: Author's compilation.