# Social Accounting Matrix:

# A user manual for village economies

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**Abstract**

The application of Social Accounting Matrices (SAM) is well established at the national level and provides a comprehensive economic framework. The procedure for developing national SAMs is extensively documented in literature. However, it can also be constructed for smaller economies, such as a village. Studies dealing with village SAMs are rare. In addition, there are hardly any guidelines for design. This gap will be addressed in this paper, which provides a manual for the construction of a village SAM. Theoretical principles and data requirements are discussed. A hypothetical village SAM is constructed by using numerical examples. Subsequently, the SAM of a real-world village case study from Zambia is analyzed. It is demonstrated how macroeconomic indicators can be calculated and microeconomic information obtained. Furthermore, a village SAM provides the database for scientific modelling approaches which are presented. Village SAMs are thus a useful management tool and support policy planning at local and regional level.

**Keywords:** Social accounting matrix, user manual, village economies, management tool, policy planning

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## 1. Introduction

A Social Accounting Matrix (SAM) is a comprehensive data framework, typically representing the economy of a nation. It displays the total transactions undertaken within an economy on a specific date. More technically, a SAM is a square matrix in which each row and column is called an "account". Each cell shows the payment from a column account to a row account. Hence, the incomes of an account appear along its row and its expenditures along its column. The underlying principle of double-entry accounting requires that, for each account in the SAM, total revenue (row total) equals total expenditure (column total) (Breisinger et al., 2009; Lofgren et al., 2002). From an accounting perspective, the SAM is a two-entry square table which presents a series of double-entry accounts whose receipts and payments are recorded in rows and columns respectively (Bellù, 2012).

According to Bellù (2012) a SAM has three main objectives:

1) Organize the information on the social and economic structure of a country for a given period.
2) Provide a synoptic view of the flows of receipts and payments in an economic system.
3) Form a numerical basis for building models of the economic system, with a view to use this to simulate the socio-economic impact of policies.

The framework may be used by policy analysts, academics, trainers (capacity building) and other users like NGOs, political parties, professional organizations or consultancy firms. A SAM offers users extensive social, economic and ecological insights into a study region. In addition, the comprehensive database serves as a basis for various modelling applications and can support local and regional policy planning.

The literature on SAM focuses predominantly on the national level, with few applications at regional or village level (Rickman, 2010). For instance, SAMs are applied to the country of Namibia to analyze the impact of hunting tourism (Samuelsson and Stage, 2007) and angling tourism (Kirchner and Stage, 2005). The framework is further used to assess the value of Namibia's protected areas and the marine fishing industry (Turpie et al., 2010) as well as forest resources (Barnes et al., 2010). However, standards to construct a national SAM, such as the System of National Accounts (European Commission et al., 2009), can only partly be transferred to regional or village levels because detailed data of local economic transactions is rarely available (Partridge and Rickman, 2010).

Studies show that village SAMs may be used to analyze migration and remittances (Adelman et al., 1988), technology adaption (Parikh and Thorbecke, 1996; Subramanian and Sadoulet, 1990; Subramanian and Qaim, 2009) and urban-rural growth linkages (Das et al., 2013) in rural communities of developing countries. The importance of natural resources to the economic development of the rural poor is increasingly acknowledged (Dasgupta et al., 2005), which encourages the need to integrate natural resources into village SAMs for development policy modelling (Angelsen et al., 2014; Shiferaw et al., 2005). However, there are only a few village level SAMs extended by environmental accounts: Studies using environmentally extended SAMs cover topics such as soil degradation (Shiferaw and Holden, 2000), deforestation (Faße et al., 2014; San Martin and Holden, 2004), energy consumption (Hartono and Resosudarmo, 2008) and natural resource management (Morton et al., 2016).

Yet, these studies show the same gap: Namely, there is no standard for village level SAMs in contrast to the national level. The literature shows a lack of guidelines for the construction of a village SAM. Furthermore, the construction of a village SAM often involves qualitative decisions based on different reference points (e.g. market prices, value of natural resources, household private savings, inter-household transfers), which are included more implicitly than explicitly. Becoming aware of these aspects is essential for this framework. Nevertheless, the general structure of a SAM is clear. Table 1 shows an aggregated SAM with verbal explanations in the cells instead of numbers. Each cell in the matrix defines a flow of funds. For example, the payment flow from the commodity column to the activity row represents the marketed production of the economy, and the entry in the factor column transferred to the institution row calculates households' factor income. Hence, a SAM is a valuable structure for analyzing "who does what with whom, in exchange for what, by what means, for what purpose, with what change in the stock" (European Commission et al., 2009, p.16).

| SAM framework | Activities | Commodities | Factors | Institutions | Capital | Rest of World | Sum of receipts |
|---|---|---|---|---|---|---|---|
| Activities | | Marketed production | | Home consumption | | | Activitiy income (gross output) |
| Commodities | Intermediate demand | | | Consumption expenditure | Investment demand (stock change) | Exports | Total demand |
| Factors | Value added | | | | | Payments from labor outside | Total factor income |
| Institutions | | | Factor income (payments to households) | Inter-household and social transfers | | Remittances received from outside | Total institutions income |
| Capital | | | | Savings | | Current account balance | Total savings |
| Rest of World | | Imports | Payments to labor outside | Remittances transferred to outside | Current account balance | | Foreign exchange outflow |
| Sum of payments | Gross output | Total supply | Total factor expenditure | Total institutions expenditure | Total investment expenditure | Foreign exchange inflow | |

Table 1: The basic SAM structure. Source: Own table based on Bellù (2012), Breisinger et al. (2009) and Lofgren et al. (2002).

The objective of this paper is to provide a guideline for the construction of a theoretically and scientifically grounded village SAM. This manual is primarily based on the work by Bellù (2012), Breisinger et al. (2009), Lofgren et al. (2002) and European Commission et al. (2009). The remainder of the paper is structured as follows: Section 2 describes the data needed for the construction of a SAM. A comprehensive manual for constructing a hypothetical village SAM is illustrated in Section 3. In this context simple numerical examples are used. A case study region is applied to describe the construction of a village SAM in Section 4. Values are interpreted on macro- and microeconomic level. Modelling applications are shown in Section 5 followed by additional remarks in Section 6. Finally, Section 7 concludes.

## 2. Data

SAMs can be constructed based on both primary and secondary data. Regarding the primary data collection, household surveys are a common data source for a village level SAM.[1] The

[1] The information needed to construct a national SAM is usually found in a country's national accounts, input-output table and/or supply-use table. All of these data are usually published by a country's statistical bureau

sample size may vary from less than 50 households (Adelman et al., 1988), to a village census (Subramanian and Qaim, 2009). A census ensures that all economic agents are included, but it may be costly in many circumstances. This can make sampling preferable. The sample should be large enough to be representative for the entire village economy. In a small village (less than 50 households) a census would be appropriate. In contrast, in larger villages (e.g. 600 households) a sample close to 130 households (20%) may be sufficient, and a census could be unnecessarily costly (Groves et al., 2011). However, the sample size may also depend on the degree of diversification within the village. If households' activities are very homogenous, a relative small sample might be appropriate. Generally, there are no rules regarding the sampling for a village SAM. It can be both random and selective to represent and capture all agents and economic activities. Random sampling in a village may result in missing out important economic sectors, such as niche businesses, manufacturers and other activities that may be undertaken only by a few households. For instance, a village may have a single mill, accommodation facility, tree nursery or fish hatchery. If one of the aforementioned institutions belongs to a large village, the probability of the household being selected can be very low. A complementary selective sampling approach may be preferable, where relevant economic agents are targeted as part of a household survey (Lewis and Thorbecke, 1992). Depending on the property rights, information concerning natural resources, such as trees planted on private farms and soil quality of different plots, can also be identified by household surveys (Faße et al., 2014).

Secondary data is a suitable source of information when primary data has gaps. A strength of the SAM is that it can be constructed by using different data sources (Round, 2003a). However, before primary data collection, a comprehensive search for potential secondary data can also be conducted in order to construct the raw structure of a village SAM and then, if necessary, use selective primary data to close the gaps and specify more specific transactions of interest. With regard to the integration of ecological information, secondary data can be particularly valuable, for instance forest intensities, species growth rates or fish biomass estimates in a water body. Secondary data (e.g. regional statistics) can also be used to check the consistency and reliability of the obtained primary data. Commonalities or differences can be analyzed. It should be noted that prices in village economies are often not

(Breisinger et al., 2009). For the description of the System of National Accounts see European Commission et al. (2009).

comparable with urban market prices. If prices are not generated from primary data and only urban market prices are available from secondary literature, it is appropriate to use a "spatial price deflator" (Brandt and Holz, 2006; De Janvry and Sadoulet, 2010; Ravallion and Chen, 2007).

Overall, trade-offs should be taken into account with respect to the costs of primary and secondary data collection: Secondary data may save time in the field, but need more time during the construction by matching of different data sets and data sources. This may be avoided by using primary data which are more expensive, both in monetary terms and in terms of the organization and stakeholder involvement. Morton et al. (2016) provide an example in which primary and secondary data have been merged to create a village SAM in the Zambezi region of Namibia.

## 3. Constructing a village SAM

### 3.1 Overview

The SAM represents the whole economic system and highlights the interlinkages and circular flow of payments and receipts among the different components of the system. It is a monetary assessment. Values refer to activities, commodities, factors, institutions, capital accounts and a rest of the world account.

*a) Activities*

Activities are the processes undertaken to produce commodities (goods and services) within the village economy (Breisinger et al., 2009). They generally refer to a defined sector such as agriculture, mining or services (Bellù, 2012). When selecting activities for the construction of a village SAM, the data can be collected at any disaggregated level. For instance, instead of “maize production”, the activity may be separated into “growing raw maize” and “processing maize”. The maize production activity can also be distinguished for different mechanization techniques (hoe, oxen or tractor). In the first case, the two activities produce separate and distinguishable commodities (raw maize and processed maize), in the second case different activities produce one commodity, here maize.

*b) Commodities*

Commodities are the outputs of the activities and can take the form of goods and services. Activities and commodities are separated because it permits an activity to produce multiple commodities (for instance, a dairy activity may produce the commodities milk and cheese or intercropping may produce maize and beans). Similarly, a commodity can be produced by more than one kind of activity (for example, activities for small-scale and large-scale maize production may both produce the same maize commodity) (Breisinger et al., 2009; Lofgren et al., 2002).

*c) Factors*

Factors are assigned to production accounts and depict receipts from activities. They are usually covered by labor and capital, but can also relate to natural resources such as land and water (Bellù, 2012). Single factors may be further differentiated, for instance labor according to gender or quality.

*d) Institutions*

A SAM also contains complete information about different institutional accounts (Breisinger et al., 2009). Institutions in the SAM context mean economic agents and normally comprise households, companies (small and large businesses), NGOs and the government. Institutional income is recorded along the row and expenditure along the column of the SAM (Bellù, 2012). Institutions are the economic agents who undertake production and consumption activities within the economy and reflect either human or legal entities. However, households are the main actors in a village SAM (Suriya, 2011).

*e) Capital account*

The capital account (saving-investment or accumulation account) records the allocation of resources for capital formation. It describes the use of resources for purchasing investment products and building up stocks of goods (Bellù, 2012).

*f) Rest of the world (ROW) account*

The ROW account describes transactions that go beyond the border of the village economy. The row records payments by the ROW from the economic system (e.g. imports) and the column records the payments to the ROW towards the economic system (e.g. exports) (Bellù, 2012).

SAMs have an inherent structural flexibility based on the data and accounts needed and used. Each category is normally split into more detailed accounts. This enables a comprehensive disaggregation of the SAM, for example by subdividing commodities (raw maize and processed maize) or household groups (male and female headed households). Once the research objective or focus of work is defined, different accounts can be aggregated or further disaggregated. For example, if the focus is on off-farm activities, crops can be put into aggregated categories such as “cereals”, or a village SAM may distinguish between rich and poor (Adelman et al., 1988) or rural and urban households (Lewis and Thorbecke, 1992). Hence, the objective of a SAM may guide the decision regarding its structure: A livestock-oriented SAM (Gelan et al., 2012) may have a different structure compared to one focusing on natural resource or landscape management (Morton et al., 2016).

In the following, the individual accounts from Table 1 are calculated with numerical examples for illustration. A hypothetical village economy is considered which includes:

a) *Five activities:* Maize farming, cassava farming, cassava processing, firewood collection and fishing.
b) *Five commodities:* Maize, cassava, cassava processed, firewood and fish.
c) *Four factors:* Labor, land, forest and fish resources.
d) *Three institutions (types of agents):* Male headed households, female headed households and the government.
e) *Two capital accounts:* Cash savings and storage.
f) *A ROW account.*

### 3.2 Marketed production

The village marketed production refers to all commodities and services produced by economic activities. It is sold within the village economy (domestic sales)[2], used as inputs for other production processes (intermediate demand) and traded outside the village (exports). It may also be stored, which leads to an increase in physical capital (stock change) (Taylor and Adelman, 1996).

<u>Calculation:</u>

*Marketed production (in monetary units) = Market price * quantity produced*

<u>Example:</u>

[2] Domestic sales refer to the share of goods and services intended for the domestic market (Bellù, 2012). The value of domestic sales is marketed production minus exports, but also total demand minus imports (Lofgren et al., 2002).

A village economy produces 5,000 kg maize and the market price for maize is 1.5 $ per kg.

Marketed production = 1.5 $/kg * 5,000 kg = 7,500 $.

The marketed production of maize is entered in the commodity maize column and activity maize farming row, which is marked with bold letters. The remaining lightly printed entries are listed for the completeness.

| | Commodities | | | | | |
|---|---|---|---|---|---|---|
| | Marketed production: | Maize | Cassava | Cassava processed | Firewood | Fish |
| Activities | Maize farming | **7,500** | | | | |
| | Cassava farming | | 5,000 | | | |
| | Cassava processing | | | 3,000 | | |
| | Firewood collection | | | | 4,200 | |
| | Fishing | | | | | 1,800 |

Table 2: Marketed production.

### 3.3 Home consumption

Home consumption refers to activities that produce outputs that are consumed directly by the households. In a developing country village SAM a household's subsistence consumption forms an important part (Lofgren et al., 2002; Taylor and Adelman, 1996) and represents an essential difference from a national SAM where home consumption is rather marginal.

<u>Calculation:</u>

*Home consumption = Producer or market price * quantity used for home consumption*

<u>Example:</u>

Female headed households consume 3,200 kg cassava from their own production and the market price for cassava is 1 $ per kg.

Home consumption = 1 $/kg * 3,200 kg= 3,200 $.

The entry of home consumption is in the female headed household column and the activity cassava farming row.

| | Households | | |
|---|---|---|---|
| | Home consumption: | Male | Female |
| Activities | Maize farming | 5,100 | 4,600 |
| | Cassava farming | 4,000 | **3,200** |
| | Cassava processing | 800 | 1,600 |
| | Firewood collection | 6,500 | 7,800 |
| | Fishing | 4,400 | 2,600 |

Table 3: Home consumption.

### 3.4 Intermediate demand

The intermediate demand is a payment from activities to commodities. It captures the value of all commodities and services used as inputs in production processes within the village. Intermediate demand includes imported and domestically produced commodities.

Calculation:

*Intermediate demand = Market price * quantity used for production*

Example:

In the village economy 1,500 kg cassava are processed and the market price for unprocessed cassava is 1 $ per kg.

Intermediate demand = 1 $/kg * 1,500 kg= 1,500 $.

The entry of intermediate demand is in the activity cassava processing column and the commodity cassava row.

| | | Activities | | | | |
|---|---|---|---|---|---|---|
| Commodities | Intermediate demand: | Maize farming | Cassava farming | Cassava processing | Firewood collection | Fishing |
| | Maize | | | | | |
| | Cassava | | | **1,500** | | |
| | Cassava processed | | | | | |
| | Firewood | | | | | |
| | Fish | | | | | |

Table 4: Intermediate demand.

### 3.5 Value added

Activities produce commodities and services by combining the factors of production with intermediate inputs. The value-added block refers to a payment from production activity accounts in columns to the factors accounts in rows. Hence, value added describes the earnings received by the factors of production. This payment generally comprises salaries, rents, profits and capital payments (machines, buildings and other equipment) (Bellù, 2012; Breisinger et al., 2009).

In a village SAM, the value-added matrix may consist of factor income from labor, agricultural components (e.g. land and livestock) and natural resources (e.g. fish and forest). The primary decision when determining factor prices is what information is available and what information needs to be calculated. Salaries should be determined for each activity.

For this reason, the time that a household allocates to each activity should be estimated. The recording of time use means that an estimated hourly/daily wage for labor is assigned to the activity to calculate the factor income. Labor factor values are calculated via reported time use from different activities, captured by household surveys, and multiplied by the average hourly/daily rate for skilled or unskilled labor. Secondary data are possibly needed, for instance on minimum wage rates. This highlights the need to obtain both time use and income information when generating primary data. Specific factors may also be obtained from data like the value of renting livestock to plough land (livestock factor), as well as cost of employing labor to work on the land (farmland factor).

Factors may also be computed as residual values. If there is no data available for the calculation of a factor's income or cost, the residual value can provide useful information. The value added for each production activity is then generated by taking the difference between the value of total production shown in the total activity row minus the value of intermediate input (and other factors) used. Accordingly, value added is an adjusting variable and used as a balancing item in the production account (Bellù, 2012). For instance, in the case where one activity uses two factors for production and the labor factor is calculated first, the other one can be calculated as the residual value. Consequently, it is possible to calculate each factor separately or to use it as an adjusting variable. However, the residual value can lead to a particular bias towards one factor. Practitioners should apply their own judgement about the quality of data. However, if values are available for all factors it might be preferred to directly calculate the respective costs and incomes.

The prices for natural resources used in the production of goods, such as trees used for the production of firewood, need to include a separation of labor costs and the end price of the product produced. In this regard, the factor payments for labor may appear much smaller when the value of environmental inputs is included. This may reflect the nature of scarce (unsustainable) resources used within a rural community where labor capacity is high and opportunity costs are low.

<u>Calculation:</u>

*a. Value added (of a factor) = Sum of activity row – intermediate input – other factors*

*b. Labor factor = Daily wage rate * days worked for production activity*

c. *Fish/Forest/Livestock factor = Price per kg * total production (harvest)*

d. *Land factor = Value of a hectare land * hectare used*

<u>Example:</u>

a. The value of total production of processed cassava is 5,400 $, and 1,500 $ is needed as intermediate input. The activity needs labor as factor input.

   Value added (labor factor) = 5,400 $ – 1,500 $ = 3,900 $.

b. The daily wage rate for maize production (minimum wage agricultural worker) is 5 $ per day, and the community spends 2,000 days on the production activity. Land is the adjusting variable. The production value of the activity maize of 17,000 $:

   Labor factor maize = 5 $/day * 2,000 days = 10,000 $.

   Land factor maize = 17,200 $ – 10,000 $ = 7,200 $.

   For instance, the labor value required for the activity maize farming is inserted in the labor factor row, and the land value is inserted in the land factor row.

c. The market price for firewood is 2 $ per kg. In the village economy 9,250 kg of firewood have been extracted from the natural resource base. Labor costs are known. The wage rate is 5 $ per day and 1,600 days are spend on firewood collection. The forest factor is derived as the residual value. These calculated costs do not represent the total value of the forest, but serve as adjustment items. The column/row total is the total economic value of the firewood collection:

   Labor factor = 5 $/day * 1,600 days = 8,000 $.

   Forest factor = 18,500 $ – 8,000 $ = 10,500 $.

d. Land used for cassava production has a value of 120 $ per hectare, and 70 hectare are used by the community. Labor is the adjusting variable.

   Land factor = 120 $/ha * 70 ha = 8,400 $.

   Labor factor cassava = 12,200 $ – 8,400 $ = 3,800 $.

| | | Activities | | | | |
|---|---|---|---|---|---|---|
| | Value added: | Maize farming | Cassava farming | Cassava processing | Firewood collection | Fishing |
| Factors | Labor | **10,000** | **3,800** | **3,900** | **8,000** | 3,800 |
| | Land | **7,200** | **8,400** | | | |
| | Forest | | | | **10,500** | |
| | Fish | | | | | 5,000 |

Table 5: Value added.

### 3.6 Consumption expenditure

The amount that institutions spend on commodities and services (food and non-food products) is captured by the consumption expenditure block. In a village economy, it mainly covers households' purchases. For government consumption, it is common to consist largely of the costs of government services (goods and services purchased to maintain government functions), such as education and health.

Calculation:

*Consumption expenditure = Market price * quantity used for consumption*

Example:

Male households purchase 500 kg of fish at a market price of 3 $ per kg.

Consumption expenditure = 3 $/kg * 500 kg = 1,500 $.

The consumption expenditure entry is made in the male headed household column and commodity fish row.

| | Households | | |
|---|---|---|---|
| Commodities | Consumption expenditure: | Male | Female |
| | Maize | 2,100 | 3,800 |
| | Cassava | 2,500 | 1,100 |
| | Cassava processed | 1,200 | 500 |
| | Firewood | | 3,000 |
| | Fish | **1,500** | |

Table 6: Consumption expenditure.

### 3.7 Investment demand (stock change)

Investment demand covers changes in stock and defines the formation of physical capital stock (Bellù, 2012). In a village SAM, it is also an important variable when considering the net change of livestock.[3] Gross capital formation refers to all payments made by the capital account to the commodities account. Investment demand may consist of both private (crop storage, livestock capital) and public (construction of roads, schools and residential housing) gross capital formation.

Calculation:

*Investment demand = Market price * stock changes (formation of physical capital stock)*

[3] Net change livestock = Birth – death + purchases - sales.

Example:

Maize storage increased by 1,200 kg in the time period under consideration. The market price of maize is 1.5 $ per kg.

Investment demand = 1.5 $/kg * 1,200 kg = 1,800 $.

The entry is in the storage column and the commodity maize row.

| | Capital | | |
|---|---|---|---|
| Commodities | Investment demand: | Cash savings | Storage |
| | Maize | | **1,800** |
| | Cassava | | 200 |
| | Cassava processed | | |
| | Firewood | | 480 |
| | Fish | | |

Table 7: Investment demand.

### 3.8 Exports

Village economies are often connected to other villages, regions or nearby cities. Sales of commodities that go beyond village borders are recorded via village economy export earning accounts. Exports are represented by monetary flows from the ROW account to the commodities accounts.

Calculation:

*Exports = Market price * quantity exported*

Example:

Households of the village export 240 kg of firewood to the nearby regional capital at a market price 3 $ per kg.

Exports = 3 $/kg * 240 kg = 720 $.

The exports are entered in the ROW column and commodity firewood row.

| | Rest of World account | |
|---|---|---|
| Commodities | Exports: | ROW |
| | Maize | |
| | Cassava | |
| | Cassava processed | 1,300 |
| | Firewood | **720** |
| | Fish | |

Table 8: Exports.

### 3.9 Imports

Commodities are supplied via the domestic marketed production account, but can also be imported. Imports are determined by the flow of goods from outside (the village borders) into the village economy. In the village SAM, imports are represented by payments made by commodity accounts to the ROW account.

Calculation:

*Imports = Market price * quantity imported*

Example:

Households of the village import 200 kg of fish from a nearby city at a market price 3 $ per kg.

Imports = 3 $/kg * 200 kg = 600 $.

The entry of the import can be found in the commodity fish column and ROW line.

| | Commodities | | | | | |
|---|---|---|---|---|---|---|
| Rest of World Account | Imports: | Maize | Cassava | Cassava processed | Firewood | Fish |
| | ROW | 200 | | | | **600** |

Table 9: Imports.

### 3.10 Factor income (payments to households)

In the village SAM construction, value added is carried forward to the income account (factor income). Households are usually the owners of the factors of production and hence they receive the incomes earned by factors during the production process (Bellù, 2012; Breisinger et al., 2009). Factor payments to households capture the income that households receive from different activities (factors pay salaries to households). The payments for each activity are aggregated by factor type and disaggregated by institution.

Calculation:

a. *Factor income = Factor payments to households*
b. *Factor income = Total factor value (total value added of factor) * share of factor endowment (use)*

Example:

a. Male households receive 14,750 $ of their income from labor and female households 11,800 $.

   Male headed household factor income (from labor) = 14,750 $.

   Female headed household factor income (from labor) = 11,800 $.

The entry is in the labor factor column and male and female headed household row.

b. Male headed households own and use 70% of the total farmland available. The remaining 30% are used by female headed households. The total factor income of land amounts 15,600 $.

   Male headed households' factor income (from land) = 0.7 * 15,600 $ = 10,920 $.

   Female headed households cover 24% of total fish use (production/extraction) and the total income from fish is 5,000 $. The remaining 76% are used by male headed households.

   Female headed households' factor income (from fish) = 0.24 * 5,000 $= 1,200 $.

| | Factors | | | | |
|---|---|---|---|---|---|
| | Factor income: | Labor | Land | Forest | Fish |
| Institutions | Male households | **14,750** | **10,920** | 3,000 | 3,800 |
| | Female households | **11,800** | 4,680 | 7,500 | **1,200** |
| | Government | | | | |

Table 10: Factor income.

### 3.11 Payments to labor (outside the village economy)

In village economies, labor may be hired from outside the village economy. In other words, households from within the village hire (foreign) labor from individuals who reside outside the village. It is a monetary flow to individuals beyond the boundaries of the village.

<u>Calculation:</u>

*Payments to hired labor = Wage rate * number of days/hours worked*

<u>Example:</u>

Households in the village employ a total of 10 workers of a neighboring village, who work a total of 89 days in the year for a wage of 5 $ per day.

Payments to hired labor = 10 workers * 89 days * 5 $/day = 4,450 $.

The payment flow is entered in the labor factor column and ROW line.

| | Factors | | | | |
|---|---|---|---|---|---|
| Rest of World Account | Payments to labor outside: | Labor | Land | Forest | Fish |
| | ROW | **4,450** | | | |

Table 11: Payments to labor outside the village economy.

### 3.12 Payments from labor (outside the village economy)

The inhabitants of the village may travel (on a daily basis) outside the village to earn their income (e.g. salaries from off-farm employment in a nearby city). The value of income earned by rural residents outside the village boundaries is captured by payments from the ROW account to the factor account. It is a monetary flow to individuals residing inside the village economy.

<u>Calculation:</u>

*Payments from labor outside the village = Wage rate * number of days/hours worked*

<u>Example:</u>

Some members of the community travel every day to the city nearby for work (construction and trade). There are 15 residents that receive payments of 100 $ per person and year for their work.

Payments from labor outside the village = 15 persons * 100 $/person = 1,500 $.

The payment flow is entered in the ROW column and labor factor row.

| | Rest of World account | |
|---|---|---|
| | Payment from labor outside: | ROW |
| Factors | Labor | **1,500** |
| | Land | |
| | Forst | |
| | Fish | |

Table 12: Payments from labor outside the village economy.

### 3.13 Inter-household and social transfers

Monetary flows exist between various institution accounts in village economies. These are defined by payments between households (inter-household transfers) and payments from the government account to household accounts (social transfers). Inter-household transfers are for example gifts (money or in-kind goods), loans and/or debt repayments.[4] Social transfers describe social security payments such as retirement/pension, illness/disability and/or orphan allowances. In addition, transfers may also appear from households to other

[4] Without a village census and/or social network survey, inter-household transfers are inherently difficult to capture as it is problematic to identify the source or destination of all transfers. Hence, researchers often make assumptions of inter-households transfers (e.g. transfers are always between similar households, ethnicities or groups) (Subramanian, 1996).

institutions (e.g. church donation) and from private enterprises/businesses to households (e.g. benefits).

<u>Calculation:</u>

*Inter-household or social transfer = Monetary payment between institutional accounts*

<u>Example:</u>

Male headed households transferred 120 $ to female headed households and female headed households have donated various goods valued at 1,100 $ to each other. The government pays a pension of 1,500 $ to male headed households and 900 $ to female ones. In addition, female headed households obtain 700 $ in family allowances for the care of orphans.

Inter-household transfer = Male to female headed households = 120 $.

The entry can be found in the male headed household column and female headed household row.

Inter-household transfer = Female to female headed households = 1,100 $.

Social transfers = Government to male headed households = 1,500 $.

Social transfers = Government to female headed households = 900 $ + 700 $ = 1,600 $.

| | Institutions | | | |
|---|---|---|---|---|
| | Inter-household and social transfers: | Male households | Female households | Government |
| Institutions | Male households | 200 | 430 | **1,500** |
| | Female households | **120** | **1,100** | **1,600** |
| | Government | | | |

Table 13: Inter-household and social transfers.

### 3.14 Remittances transferred

Households may also transfer a part of their income to relatives outside the village economy. These payments capture monetary outflows from household's members residing in the village to relatives or friends (migrants) beyond the village borders.

<u>Calculation:</u>

*Remittances send = Monetary outflow to relatives or friends outside the village economy*

<u>Example:</u>

Male headed households of the village economy send money to their kids who are living and studying in a distant city. The sum of cash transfers is 1,200 $.

Remittances send by male headed households = 1,200 $.

Transferred remittances are in the male headed household column and ROW line.

| | Institutions | | | |
|---|---|---|---|---|
| Rest of World Account | Remittances (to outside): | Male households | Female households | Government |
| | ROW | **1,200** | | |

Table 14: Remittances transferred.

### 3.15 Remittances received

Received remittances may be part of rural households' income. These payments include monetary inflows from relatives or friends (migrants) outside the village to households residing in the village economy.

<u>Calculation:</u>

*Remittances received = Monetary inflow from relatives or friends outside the village economy*

<u>Example:</u>

Family members of female households work in a distant city where they also live. They have sent 4,310 $ back home during the year.

Remittances received by female headed households = 4,310 $.

Received remittances are recorded in the ROW column and female headed household row.

| | Rest of World account | |
|---|---|---|
| Institutions | Remittances (from outside): | ROW |
| | Male households | |
| | Female households | **4,310** |
| | Government | |

Table 15: Remittances received.

### 3.16 Savings

The capital account indicates payments received from households, companies, and the government, defined as private savings or fiscal surplus/deficit (Bellù, 2012). In a village SAM, the capital accounts are generally used as balancing accounts, because inputs rarely equal outputs based on survey data (Subramanian, 1996; Taylor and Adelman, 1996). Hence, household savings are the residual of the sum of the institution row (income) minus the sum of the institution column (expenditure) (Round, 2003b; United Nations, 2014).[5] The

[5] It might be the case that the survey already contains a question about household's savings. Ideally, the SAM residual size matches this. However, if survey cash savings do not fit with the residual value, researchers

approach is similar for the fiscal surplus or deficit, which is usually negative in village SAMs since the government tends not to generate sufficient funds to cover village welfare payments. In addition, investments (gross capital formation) that include changes in stocks must correspond to the row capital accounts (Breisinger et al., 2009). These payments from institutional accounts to the capital accounts record receipts or outflows due to stock changes (Bellù, 2012).[6]

Calculation:

*Cash savings (residual value) = Total institution row - total institution column*

*Stock changes (residual value) = Total capital account column * stock ownership*

Example:

The sum of the female households' income (total row) is 32,310 $ and expenditure (total column) is 31,170 $. The total value of the stored crops is 2,480 $, of which one half origins from male and the other to female headed households.

Cash savings of female households = 32,310 $ – 31,170 $ = 1,140 $.

The entry can be found in the female headed household column and cash savings row.

Stock changes for male/female headed households = 0.5 * 2,480 $ = 1,240 $.

The entry is in the male/female headed household row and storage column account.

| | | Institutions | | |
|---|---|---|---|---|
| Capital accounts | Savings: | Male households | Female households | Government |
| | Cash savings | 3,840 | **1,140** | -3,100 |
| | Storage | **1,240** | **1,240** | |

Table 16: Savings.

### 3.17 Current account balance

Finally, the current account balance is used for balancing the ROW and capital accounts. When the balance of payments is positive (budget surplus) the ROW line account is credited with the corresponding amount from the capital account (savings) column. It is a balance of the payments surplus and considered as foreign expenses (investment). A capital transfer from the ROW column to the capital account (savings) row arises when the balance of payments is negative (budget deficit). A budget deficit is offset by a transfer from outside

assume that households do not tell the truth since money is a sensitive topic (hide money or present themselves better).

[6] Alternatively, the stock changes row account may also be closed via the cash savings column account (Lofgren et al., 2002).

the village to the rural economy, called foreign savings. The current account balance then equals the difference between foreign exchange inflow (exports, payments from labor outside the village economy, remittances received) and outflow (imports, payments to labor outside village economy, remittances transferred). Since the residual value of the current account balance is linked to the capital accounts, the entire SAM is finally balanced.

Calculation:

*Balance of payments surplus (foreign expenses) = Total ROW account column – total ROW account row*

*Balance of payments deficit (foreign savings) = Total ROW account row - total ROW account column*

Example:

The total ROW account column is 8,330 $. Total ROW account row is 6,450 $. The sum of the ROW receipts is higher than sum of ROW payments. Hence, a balance of payments surplus occurs.

Balance of payments surplus (current account balance) = 8,330 $ – 6,450 $ = 1,880 $.

The entry is in the cash savings column and ROW line.

| | Capital accounts | | |
|---|---|---|---|
| Rest of World account | Balance of payments surplus: | Cash savings | Storage |
| | ROW | **1,880** | |

Table 17: Current account balance.

### 3.18 Final output

The various accounts and blocks of the village SAM are grouped together in Table 18. Each row total equals the respective column total. The SAM is balanced. Up to now, hypothetical data has been used to learn how to construct a village SAM step by step. The illustrated calculations and table constructions can be carried out by using Microsoft Excel. In the following we will focus on real data, and interpret a village SAM from rural Zambia.

Table 18: Village SAM construction.

| | | Activities | | | | | Commodities | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Village SAM** | Maize farming | Cassava farming | Cassava processing | Firewood collection | Fishing | Maize | Cassava | Cassava processed | Firewood | Fish |
| Activities | Maize farming | | | | | | 7,500 | | | | |
| | Cassava farming | | | | | | | 5,000 | | | |
| | Cassava processing | | | | | | | | 3,000 | | |
| | Firewood collection | | | | | | | | | 4,200 | |
| | Fishing | | | | | | | | | | 1,800 |
| Commodities | Maize | | | | | | | | | | |
| | Cassava | | | 1,500 | | | | | | | |
| | Cassava processed | | | | | | | | | | |
| | Firewood | | | | | | | | | | |
| | Fish | | | | | | | | | | |
| Factors | Labor | 10,000 | 3,800 | 3,900 | 8,000 | 3,800 | | | | | |
| | Land | 7,200 | 8,400 | | | | | | | | |
| | Forest | | | | 10,500 | | | | | | |
| | Fish | | | | | 5,000 | | | | | |
| Institutions | Male households | | | | | | | | | | |
| | Female households | | | | | | | | | | |
| | Government | | | | | | | | | | |
| Capital | Cash savings | | | | | | | | | | |
| | Storage | | | | | | | | | | |
| Rest of World | ROW | | | | | | 200 | | | | 600 |
| | TOTAL | 17,200 | 12,200 | 5,400 | 18,500 | 8,800 | 7,700 | 5,000 | 3,000 | 4,200 | 2,400 |

Table 18: Village SAM construction (continued).

| | | Factors | | | | Institutions | | | Capital | | Rest of World | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Village SAM** | Labor | Land | Forest | Fish | Male households | Female households | Government | Cash savings | Storage | ROW | TOTAL |
| Activities | Maize farming | | | | | 5,100 | 4,600 | | | | | 17,200 |
| | Cassava farming | | | | | 4,000 | 3,200 | | | | | 12,200 |
| | Cassava processing | | | | | 800 | 1,600 | | | | | 5,400 |
| | Firewood collection | | | | | 6,500 | 7,800 | | | | | 18,500 |
| | Fishing | | | | | 4,400 | 2,600 | | | | | 8,800 |
| Commodities | Maize | | | | | 2,100 | 3,800 | | | 1,800 | | 7,700 |
| | Cassava | | | | | 2,400 | 900 | | | 200 | | 5,000 |
| | Cassava processed | | | | | 1,200 | | | | | 1,800 | 3,000 |
| | Firewood | | | | | | 3,000 | | | 480 | 720 | 4,200 |
| | Fish | | | | | 1,500 | 900 | | | | | 2,400 |
| Factors | Labor | | | | | | | | | | 1,500 | 31,000 |
| | Land | | | | | | | | | | | 15,600 |
| | Forest | | | | | | | | | | | 10,500 |
| | Fish | | | | | | | | | | | 5,000 |
| Institutions | Male households | 14,750 | 10,920 | 3,000 | 3,800 | 200 | 430 | 1,500 | | | | 34,600 |
| | Female households | 11,800 | 4,680 | 7,500 | 1,200 | 120 | 1,100 | 1,600 | | | 4,310 | 32,310 |
| | Government | | | | | | | | | | | 0 |
| Capital | Cash savings | | | | | 3,840 | 1,140 | -3,100 | | | | 1,880 |
| | Storage | | | | | 1,240 | 1,240 | | | | | 2,480 |
| Rest of World | ROW | 4,450 | | | | 1,200 | | | 1,880 | | | 8,330 |
| | TOTAL | 31,000 | 15,600 | 10,500 | 5,000 | 34,600 | 32,310 | 0 | 1,880 | 2,480 | 8,330 | 226,100 |

## 4. Application of a village SAM

This section uses a case study from rural Zambia to illustrate how a village SAM can be constructed from survey data and finally interpreted.

### 4.1 Study area and data

The case study area is Mantapala, which is located in Zambia's Nchelenge District (Figure 1). Nchelenge is centered in northern Luapula Province at Lake Mweru, which marks the boundary to the Democratic Republic of Congo. It is about 1,100 km north to the national capital Lusaka and 250 km north of the provincial capital Mansa. Mantapala lies about 20 km east of Nchelenge town, accessible by a gravel road. It is located in the inland forest area with a hardly developed inner road network. The area covers about 130 km² (around 3% of the district) and hosts approximately 500 households. Mantapala comprises 15 villages with a size of about 10 to 150 households per village. For further information see Gronau et al. (2018a).

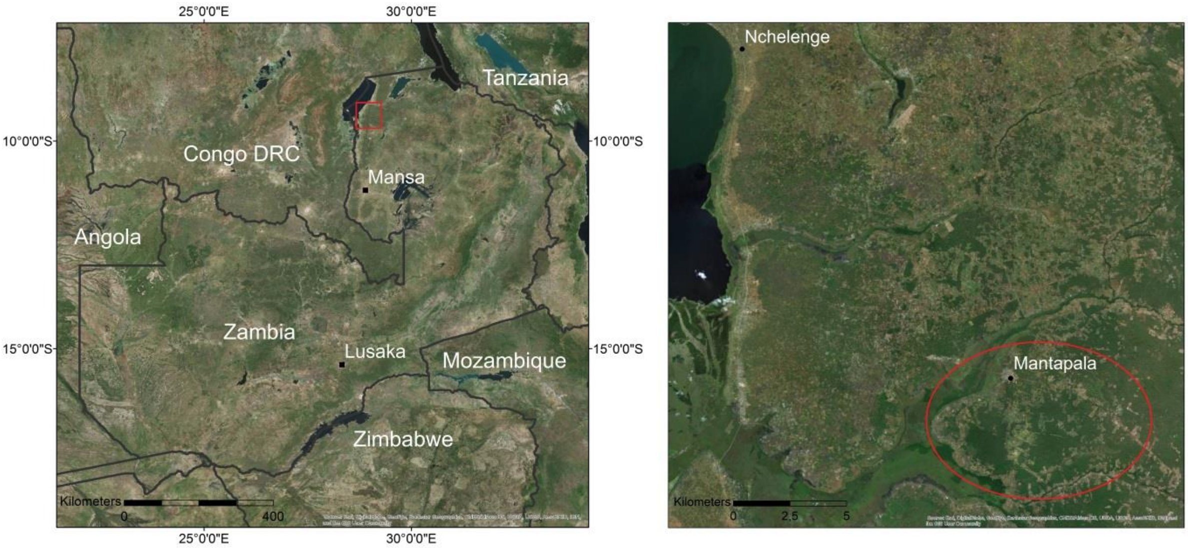


Figure 1: Mantapala in the Luapula Province, Zambia. Source: Gronau et al. (2018a).

Focus of the data collection was the main village (Nsemiwe/Piyala) of Mantapala, which comprises about 150 households. Primary data from the village was collected during a three-week period in September 2015. The objective was to obtain extensive descriptive information to enable the construction of a SAM for the village. For data collection a household list was obtained by the head of the village.[7] A total of 105 households (643 residents), which represent around 70% of total households of the village, were randomly sampled. The survey covered a broad range of household's socio-demographics, networks, socio-economic activities, income sources, time allocation, consumption and expenditure, use of fish and forest resources as well as livestock and crop management. For all transactions, the performing household as well as the origin and the destination of goods produced and traded were recorded. Secondary data (mainly price data) was used to complete some information gaps. Table 19 shows the village SAM of the Mantapala area, based on the 2015 data collected (Gronau et al., 2018a). The SAM is balanced (total rows equals total columns) and is available for further interpretation and modelling applications.

[7] In the villages in Mantapala, autonomous households are organized under a village head, which is mainly seen as a leader. A regional chief provides leadership to the head and is consulted for important decisions within a geographical area.

Table 19: Social Accounting Matrix of the Mantapala village. Source: Gronau et al. (2018a).*

| | | Activities | | | | | | | | | | | Commodities | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mantapala village SAM** | (A1) | (A2) | (A3) | (A4) | (A5) | (A6) | (A7) | (A8) | (A9) | (A10) | (A11) | (C1) | (C2) | (C3) | (C4) | (C5) | (C6) | (C7) | (C8) | (C9) | (C10) |
| Activities | (A1) Maize farming | | | | | | | | | | | | 91,595 | | | | | | | | | |
| | (A2) Cassava farming | | | | | | | | | | | | | 78,586 | | | | | | | | |
| | (A3) Other farming | | | | | | | | | | | | | | 10,523 | | | | | | | |
| | (A4) Fishing | | | | | | | | | | | | | | | 15,879 | | | | | | |
| | (A5) Firewood collection | | | | | | | | | | | | | | | | 52,313 | | | | | |
| | (A6) Livestock farming | | | | | | | | | | | | | | | | | 13,716 | | | | |
| | (A7) Maize processing | | | | | | | | | | | | | | | | | | 7,587 | | | |
| | (A8) Cassava processing | | | | | | | | | | | | | | | | | | | 23,983 | | |
| | (A9) Other farm processing | | | | | | | | | | | | | | | | | | | | 745 | |
| | (A10) Charcoal production | | | | | | | | | | | | | | | | | | | | | 126,904 |
| | (A11) Trade | | | | | | | | | | | | | | | | | | | | | |
| Commodities | (C1) Maize | | | | | | | 19,775 | | | | | | | | | | | | | | |
| | (C2) Cassava | | | | | | | | 42,998 | | | | | | | | | | | | | |
| | (C3) Other farm goods | | | | | | | | | 2,263 | | | | | | | | | | | | |
| | (C4) Fish | | | | | | | | | | | | | | | | | | | | | |
| | (C5) Firewood | | | | | | | | | | 50,052 | | | | | | | | | | | |
| | (C6) Livestock | | | | | | | | | | | | | | | | | | | | | |
| | (C7) Maize processed | | | | | | | | | | | | | | | | | | | | | |
| | (C8) Cassava processed | | | | | | | | | | | | | | | | | | | | | |
| | (C9) Other farm processed | | | | | | | | | | | | | | | | | | | | | |
| | (C10) Charcoal | | | | | | | | | | | | | | | | | | | | | |
| | (C11) Trade | | | | | | | | | | | 1,978 | | | | | | | | | | |
| | (C12) Food items | | | | | | | | | | | 2,317 | | | | | | | | | | |
| | (C13) Non-food items | | | | | | | | | | | | | | | | | | | | | |
| Factors | (F1) Farmland | 37,519 | 73,727 | 9,033 | | | | | | | | | | | | | | | | | | |
| | (F2) Labor | 56,669 | 15,168 | 4,073 | 27,442 | 19,090 | 4,542 | 7,321 | 42,656 | 1,363 | 168,748 | 1,841 | | | | | | | | | | |
| | (F3) Fish | | | | 17,452 | | | | | | | | | | | | | | | | | |
| | (F4) Livestock | | | | | | 7,563 | | | | | | | | | | | | | | | |
| | (F5) Grassland | | | | | | 5,053 | | | | | | | | | | | | | | | |
| | (F6) Forest | | | | | 99,903 | | | | | | | | | | | | | | | | |
| Agents | (H1) Male headed | | | | | | | | | | | | | | | | | | | | | |
| | (H2) Female headed | | | | | | | | | | | | | | | | | | | | | |
| | (H3) Government | | | | | | | | | | | | | | | | | | | | | |
| Capital | (S1) Cash Savings | | | | | | | | | | | | | | | | | | | | | |
| | (S2) Livestock capital | | | | | | | | | | | | | | | | | | | | | |
| | (S3) Storage | | | | | | | | | | | | | | | | | | | | | |
| | (ROW) Rest of World | | | | | | | | | | | | | | | 38,170 | | 297 | 800 | | 6,400 | 240 |
| | **Totals** | **94,188** | **88,895** | **13,106** | **44,894** | **118,993** | **17,158** | **27,096** | **85,654** | **3,626** | **218,800** | **6,136** | **91,595** | **78,586** | **10,523** | **54,049** | **52,313** | **14,013** | **8,387** | **23,983** | **7,145** | **127,144** |

*Values reported in Zambian Kwacha (ZMK).

Table 19: Social Accounting Matrix of the Mantapala village (continued).

| | | Commodities | | | Factors | | | | | | Agents | | | Capital | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Mantapala village SAM** | (C11) | (C12) | (C13) | (F1) | (F2) | (F3) | (F4) | (F5) | (F6) | (H1) | (H2) | (H3) | (S1) | (S2) | (S3) | (ROW) |
| Activities | (A1) Maize farming | | | | | | | | | | 2,551 | 41 | | | | | |
| | (A2) Cassava farming | | | | | | | | | | 8,996 | 1,312 | | | | | |
| | (A3) Other farming | | | | | | | | | | 1,765 | 818 | | | | | |
| | (A4) Fishing | | | | | | | | | | 25,392 | 3,622 | | | | | |
| | (A5) Firewood collection | | | | | | | | | | 17,531 | 49,149 | | | | | |
| | (A6) Livestock farming | | | | | | | | | | 2,490 | 952 | | | | | |
| | (A7) Maize processing | | | | | | | | | | 17,727 | 1,783 | | | | | |
| | (A8) Cassava processing | | | | | | | | | | 38,933 | 22,737 | | | | | |
| | (A9) Other farm processing | | | | | | | | | | 2,866 | 15 | | | | | |
| | (A10) Firewood processing | | | | | | | | | | 57,491 | 34,405 | | | | | |
| | (A11) Trade | 2,825 | 3,310 | | | | | | | | | | | | | | |
| Commodities | (C1) Maize | | | | | | | | | | 10,600 | 1,031 | | | | 59,890 | 300 |
| | (C2) Cassava | | | | | | | | | | 9,555 | 2,161 | | | | 16,373 | 7,500 |
| | (C3) Other farm goods | | | | | | | | | | 4,896 | 3,264 | | | | | 100 |
| | (C4) Fish | | | | | | | | | | 41,618 | 11,652 | | | | | 780 |
| | (C5) Firewood | | | | | | | | | | | | | | | 2,260 | |
| | (C6) Livestock | | | | | | | | | | 327 | 218 | | | 13,228 | | 241 |
| | (C7) Maize processed | | | | | | | | | | 1,702 | 1,135 | | | | | 5,550 |
| | (C8) Cassava processed | | | | | | | | | | 9,467 | 6,311 | | | | | 8,205 |
| | (C9) Other farm processed | | | | | | | | | | 6,025 | 1,119 | | | | | |
| | (C10) Firewood processed | | | | | | | | | | 6,867 | 2,666 | | | | 116,161 | 1,450 |
| | (C11) Trade | | | | | | | | | | 509 | 339 | | | | | |
| | (C12) Food items | | | | | | | | | | 18,737 | 9,052 | | | | | |
| | (C13) Non-food items | | | | | | | | | | 74,289 | 34,562 | | | | | |
| Factors | (F1) Farmland | | | | | | | | | | | | | | | | |
| | (F2) Labor | | | | | | | | | | | | | | | | |
| | (F3) Fish | | | | | | | | | | | | | | | | |
| | (F4) Livestock | | | | | | | | | | | | | | | | |
| | (F5) Grassland | | | | | | | | | | | | | | | | |
| | (F6) Forest | | | | | | | | | | | | | | | | |
| Agents | (H1) Male headed | | | | 86,210 | 211,077 | 13,255 | 6,464 | 4,504 | 77,554 | 1,051 | 275 | 2,760 | | | | 6,730 |
| | (H2) Female headed | | | | 34,069 | 137,833 | 4,197 | 1,099 | 550 | 22,349 | 289 | 75 | 560 | | | | 900 |
| | (H3) Government | | | | | | | | | | | | | | | | |
| Capital | (S1) Cash Savings | | | | | | | | | | 34,023 | 10,393 | -3,320 | | | | 153,588 |
| | (S2) Livestock capital | | | | | | | | | | 11,494 | 1,734 | | | | | |
| | (S3) Storage | | | | | | | | | | | | | 194,684 | | | |
| | (ROW) Rest of World | | 26,796 | 108,851 | | | | | | | 2,690 | 1,100 | | | | | |
| | **Totals** | **2,825** | **30,106** | **108,851** | **120,279** | **348,910** | **17,452** | **7,563** | **5,054** | **99,903** | **409,881** | **201,921** | **0** | **194,684** | **13,228** | **194,684** | **185,344** |

## 4.2 Analysis of a SAM

### 4.2.1 Overview

A comprehensive descriptive analysis can be carried out once a village SAM is constructed. First of all, the Gross Domestic Product (GDP) can be calculated, which also serves as a quality check for the SAM. There are three formulas for village GDP calculations (Table 20):

a. *GDP accumulation = Marketed production (Accumul. 1) + Home consumption (Accumul. 2) – Intermediate demand (Accumul. 3)*
b. *GDP expenditure = Consumption expenditure (Expenditure 1) + Investment demand (Expenditure 2) + Exports (Expenditure 3) + Home consumption (Expenditure 4) – Imports (Expenditure 5)*
c. *GDP factor cost = Value added (Factor cost 1)*

All three calculations must be the same in the result. Households' subsistence production (home consumption) is included in the GDP calculations, as it forms a great part in village economies and therefore may not be neglected in economic analyses. However, it may easily be excluded it the calculations above, if wanted. The GDP of the village in Mantapala is almost 600,000 Kwacha. The survey included 105 households (643 residents), i.e. the GDP per capita is around 930 Kwacha. This value can easily be compared with national/regional/local GDP statistics (if such secondary data is available).[8] The value of GDP can also be understood as the value of income earned by the factors.

| SAM | Activities | Commodities | Factors | Institutions | Capital | ROW |
|---|---|---|---|---|---|---|
| Activities | | Accumul. 1 | | Accumul. 2<br>Expenditure 4 | | |
| Commodities | Accumul. 3 | | | Expenditure 1 | Expenditure 2 | Expenditure 3 |
| Factors | Factor 1 | | | | | |
| Institutions | | | | | | |
| Capital | | | | | | |
| ROW | | Expenditure 5 | | | | |

Table 20: GDP calculations.

A more general analysis of the village SAM can already be carried out without going directly into the numbers. The activities, commodities, factors, agents, capital and ROW accounts enable initial statements to be made about the village's economic structure: Two agricultural activities are particularly pronounced, which is maize and cassava farming. There is also the aggregate "other farming". Data from tomato, nuts, rice, beans, pumpkin, mango and millet farming were aggregated to one account, since they have only marginal influence and were

[8] Information on GDP for different sectors is usually found in national accounts (Breisinger et al., 2009).

not the focus of SAM construction. It can also be observed that processing of farming output plays a role in the economy. Furthermore, livestock farming is an integrated part of the village. Livestock was aggregated to "livestock farming" in the SAM framework. The aggregate includes goat, chicken, duck and pig as well as the by-product eggs. For example, if the focus of the analysis would be on livestock, it would make sense to disaggregate this account. Fish and forest resource are of great importance in the rural community. Forest resources are collected but also processed in charcoal. The SAM structure shows that off-farm activities play no role, but some households are involved in the trade, i.e. purchasing and selling commodities. Generally, activities produce commodities. However, there are also commodities that are not produced, but only traded. This concerns food items (e.g. sugar, chicken meat, bread and flour) as well as non-food items (clothing, education, transport and mobile phone expenses).

Based on production, six factors are differentiated, namely farmland, labor, livestock, grassland, fish and forest resources (timber/fuelwood). The values of natural resources, i.e. fish and forest, can be used for sustainability analyses. The village SAM further differentiates between two household groups, male and female headed households,[9] and the government as another relevant institution in the economic system. In the case of the capital accounts, cash savings, livestock capital and storage are important for households in the region. The ROW account is defined as anything geographically outside the village boundaries.

Using the quantitative information contained in the SAM, various macroeconomic indicators can be calculated for the village economy. Furthermore, microeconomic (household level) information can be derived from the database.

#### 4.2.2 GDP analysis

GDP production shares help to identify the structural characteristics of the village economy, highlighting which activities and sectors generate the most income for households and institutions in the village:

*GDP production shares = SUM of activity(i) / Total GDP*

The calculation shows that Mantapala depends heavily on firewood collection and charcoal production, contributing 48% to GDP. Maize and cassava farming also accounts for a large

[9] Most SAMs split households into different groups (e.g. rural and urban). This information enables the evaluation of distributional effects of policies (Breisinger et al., 2009).

share of the GDP (39%). Fishing (7%), livestock farming (3%), other crops (2%) and trade (0.3%) show lower production values.

Value added shares help to identify which factors generate the most income for each sector and reveal factor intensities:

*Value added shares = Factor(f) for activity(i) / GDP for activity(i)*

The most labor intensive agricultural activity in the village SAM is maize farming. 60% of maize farming value added is paid to labor, whereas cassava farming is rather land intensive (83%). Fishing is quite balanced and requires labor and fish factors, whereas firewood collection is more forest intensive. 84% of firewood collection value added is attributed to forest resources and only 16% to labor. Livestock farming even requires three production factors, namely land, labor and livestock, whereas processing activities are only done by labor.

Factor shares to GDP show the contribution of each factor the overall GDP:

*Factor shares = SUM of factor(f) / Total GDP*

In Mantapala, 58% of GDP is generated by labor, implying that it is a rather labor-intensive economy. Around 17% is from forest resources, whereas fish accounts for 3%, which indicates that timber is a more relevant economic resource than fish.

### 4.2.3 Gross output analysis

The gross output value of the economy is the sum of the activities column or row. By calculating the share of each factor (value added) and commodity (intermediate input) payment in the value of gross output, it is possible to determine sectors' production shares. Activity production (gross output) shares help to identify which sectors are dependent on one another for inputs, revealing interdependency (linkages) between sectors. It shows the share of inputs needed to produce the output:

*Activity production shares = Input of factor(f) or commodity(j) for activity(i) / Gross output of activity(i)*

The analysis shows that the processing activities require the factor labor (value added) and the commodities to be processed (intermediate input). For example, 73% input from raw maize is required for the production of processed maize and 27% from labor. This also applies to charcoal production, which is rather labor-intensive. 77% of input is required by labor, while 23% of the input value is accounted for by firewood. The trade activity requires the goods to be traded and the labor factor.

**4.2.4 Trade analysis**

Trade analysis sheds light on the structure of imports and exports in the village economy. Import and export shares are calculated to get an initial overview of the trade structure:

*Import or export share of commodity(j) = Import or export of commodity(j) / Total imports or exports*

Calculations show that the majority of imports are non-food items (60%), such as clothes, education, transport and airtime. Fish has an import share of 21% and further food items 15% (e.g. sugar, chicken meat, bread, flour and sorghum). Primary exports of the village are raw and processed cassava (65%) as well as maize (24%).

Import penetration ratios (IPR) and export intensities (EI) are another way of understanding the relative importance of trade for different commodities. IPR is the share of imports in the value of total demand:

*IPR = Imports of commodity(j) / Total demand of commodity(j)*

The calculated IPRs reveal that food items, non-food items and fish are mainly supplied from outside the economy, with 89%, 100% and 71% supplied from outside, respectively. This makes sense in terms of food and non-food items as they can hardly be obtained in the village economy. Fish plays a minor role in the village due to reduced stocks. However, neighboring villages cultivate fish in ponds and sell them. Overall, 30% of total village demand is satisfied by imports (mainly food and non-food items as well as fish). By contrast, the village rarely imports agricultural goods and forest resources and is therefore fairly self-sufficient in agriculture and wood products.

EI is the share of exports in the value of gross output:

*EI = Exports of commodity(j) / Gross output of commodity(j)*

The calculated EI shows that exports of the rural community are only of importance for maize and cassava. Around 20% of maize gross output is exported and 18% of cassava, which provides households a source of income. This implies that most of the production remains within the economy. Overall, only 3% of total gross output is exported. However, it remains important to identify the trade-links exist. If natural resources are unsustainably extracted, and form a high percentage of exports, one may question the governance structure and the consequences of continued exports of natural capital.

Trade-to-GDP ratio is an indicator of the relative importance of trade in the village economy. It is used as a measure of the openness of the village to trade and is also called the trade openness ratio. The ratio is calculated by dividing the aggregate value of imports and exports by the GDP:

*Trade-to-GDP ratio = (SUM of imports + SUM of exports) / Total GDP*

The share of imports and exports in GDP is 34%, with only some commodities being traded.

#### 4.2.5 Total demand shares

Calculations consider various sources of commodity demand, including intermediate demand, consumption expenditure, investment demand and exports. Household demand shares show which institutions consume which commodity to what extent:

*Demand share of commodity(j) = Intermediate demand or consumption expenditure or investment demand or exports of commodity(j) / Total demand of commodity(j)*

The analysis shows that male headed households demand a larger proportion of commodities than female headed households. However, the number of aggregated male headed households is higher than that of female headed ones in the case study village SAM. Therefore, statements about consumption and nutrition require a more detailed analysis on the household level.[10] Furthermore, unprocessed maize and cassava account for a smaller part of household expenditure, whereas 22% and 55% of maize and cassava demand, respectively, are distributed to intermediate demand (processing) and 65% and 21% of total demand are stored. Marketed production of firewood, on the other hand, is almost entirely used for processing in charcoal (96%). Households have no consumption expenditure on firewood and the rest is stored. In other words, households cover their demand for firewood solely through subsistence activity. Households' consumption expenditure on livestock (eggs) is just 4% of total livestock demand, with over 90% coming from the livestock capital, i.e. the increasing stock of chicken, pigs, goats and ducks.

[10] For a nutritional analysis, it should be noted that in addition to households' consumption expenditure, home consumption also has to be considered. If the focus of the analysis is on nutrition, food consumption can also be linked to nutrient composition. However, if emissions are to be analyzed, the consumption of firewood and charcoal can be related.

### 4.2.6 Household expenditure and income shares

SAMs disaggregate consumption across different commodities and household groups, as consumption patterns can vary according to income groups. For example, poorer households may spend a larger share of their income on food than wealthier households, and so changes in the supply of foods will affect poorer households more. These differences can influence the distributional impacts of policies:

*Expenditure shares = Commodity(i) purchased by institution(a) / Total income of institution(a)*

The case study village SAM separates male and female headed households, which allows considering differences in the way these groups earn and spend their income. Male headed households spend 45% of their income on consumption expenditure. The largest share is allocated to non-food items (18%), fish (10%) and food items (5%). Female headed households spent 37% of income on consumption expenditure. Subsistence consumption accounts also for a large part of income, whereas expenditure on inter-household transfers, livestock capital and remittances is rather low for both groups. Households' expenditure shares can informative in developing policies to preserve natural resources, which can target the consumer and not only the producer level.

Total household income in the village SAM comprises factor income (e.g. from labor), inter-household and social transfers and remittances received. Household income shares can help to identify the key sources in a village that generate income for each institution. This can be particularly important when households are dependent on a single factor or transfer. For instance, fishing households that depend on the environment as a factor (fish) may be highly vulnerable to a collapse in the fish population. Similarly, households that depend on remittances may be especially vulnerable if the migrant loses job:

*Income share = Income category (factor income(z) or inter-household transfer(t) or remittances(r) for household(a)) / Total income of institution(a)*

Production in Mantapala is mostly labor intensive (58% of GDP comes from labor). Not surprisingly, most of the households' income is generated by the factor labor. This is 51% of income for male and 68% for female headed households. Most labor is used on farmland for agriculture (maize and cassava), which generates 21% income for men and 17% for women, but also for the collection of firewood in the forests. Forest resources (fuelwood) make up

19% of male headed households income and 11% of female headed ones.[11] The income share of fish, livestock, inter-institutional transfers and remittances is rather low. Most village SAMs split households into different groups to assess distributional impacts from policies. For example, if a SAM shows that low-income households rely more on labor earnings than higher-income households, then policies that increase production in labor-intensive sectors could disproportionately favor poorer households. Hence, the distribution of (factor) incomes is an important part of a SAM.

#### 4.2.7 Subsistence consumption analysis

A key part of many village economies is subsistence production. Share of home consumption to GDP is the sum of households' home consumption divided by the total GDP:

*Share of home consumption to GDP = Total home consumption / Total GDP*

In Mantapala, the share of home consumption to GDP is 48% and thus accounts for almost half of the total economic value added.

Share of subsistence activity to subsistence GDP is the share of subsistence activity divided by the subsistence GDP:

*Share of subsistence activity to subsistence GDP = SUM of activity(a) / Total subsistence GDP*

The main drivers of subsistence GDP are the production of firewood (23%) and charcoal (32%). Cassava contributes 25%, maize 8% and fish 10% to the total subsistence GDP.

Share of households' subsistence to total consumption is a further possibility for a subsistence analysis:

*Share of households' subsistence to total consumption = Subsistence consumption of institution(a) / Total consumption (subsistence + expenditure) of institution(a)*

Around 49% of male headed households' consumption is from subsistence consumption. For female headed households it is 61% with the remaining 39% obtained by consumption expenditures. In this context, it is also possible to investigate the shares of consumption goods to overall consumption. In Mantapala, it is obvious that households' consumption is dominated by cassava, maize and fish.

[11] From a SAM, it cannot be observed how much a household earns concretely with what activity. For example, male households earn 100,000 ZMK from maize farming. Instead, the SAM shows which factor contributes to income generation and to what extent. A descriptive analysis at household level offers a useful solution if necessary.

Share of households' subsistence consumption to total income is a further possibility to analyze subsistence values:

*Share of households' subsistence consumption to total income = Subsistence consumption of institution(a) / Total income of institution(a)*

Female households generate 57% and male households 43% of the income from subsistence.

#### 4.2.8 Macroeconomic balances

The only connection the government has with the village economy is social transfers, i.e. governmental expenditures. By contrast, government revenue is not generated in the economy. Hence, a fiscal deficit is most common in poor village economies, as the government does not generate enough revenue to cover the social expenditures in the village. The fiscal balance in the village economy is -3,320 ZMK, which is less than 1% of GDP. The current account balance is recorded in the village SAM as a budget deficit (negative foreign savings). Most of the current account deficit is due to Mantapala's large trade deficit. The current account balance acts as a residual value, is linked to the capital accounts (cash savings) and finally balances the village SAM.

#### 4.2.9 Household level analysis

Households are generally grouped in a SAM framework. The grouping results from aggregating individual households. It is therefore possible to analyze equalities or inequalities in a village economy. For instance, 21% of households in the Mantapala village are female headed and generate 33% of total factor income or generate 40% of the total labor factor income. A direct comparison at household level with the SAM framework should therefore be critically assessed, as the proportion of male headed households is much higher than that of female headed ones. However, the basic database can also be used for a descriptive analysis at the microeconomic level. Information such as number of households in each group, number of members per household, average age of household head and education level, land endowment, income generation and production quantities can be illustrated at the individual level.

## 5. Modelling applications

A village SAM is a descriptive analytical tool that provides detailed macroeconomic and microeconomic insights of a rural area. In addition, it provides the database for numerous scientific tools such as multiplier analysis, mathematical optimization models and Computable General Equilibrium (CGE) analysis.

### 5.1 Multiplier analysis

Exogenous shocks to an economy have both direct and indirect effects. Direct effects are those pertaining to the sector that is directly affected. For example, an exogenous increase in demand for agricultural exports has a direct impact on the agricultural sector. Indirect effects stem from agriculture's linkages to other parts of the economy. These indirect linkages can be separated into production[12] and consumption linkages. A measure of the shock's multiplier effect is given by the addition of all direct and indirect linkages (how much direct effects are multiplied by indirect linkages). Multiplier effects thus capture all economic linkages over a period of time (Breisinger et al., 2009). A multiplier analysis is a simplified form of policy analysis. It helps identifying the linkages between activities, commodities and institutions. Multipliers effectively show the distributional ("trickle through") effects of exogenous shocks or changes in the economy (Round, 2003a). SAM multiplier models have been used for a wide range of issues such as trade policies, agricultural growth, agroforestry as well as farm and non-farm linkages (Diao et al., 2007; Faße et al., 2014; Haggblade and Hazell, 1989; Morton et al., 2016).

Multiplier effects are calculated by using matrix algebra. A multiplier formula is developed (for instance by using Microsoft Excel) that will include all direct and indirect linkages. Three types of multipliers can be distinguished (Breisinger et al., 2009): (1) An output multiplier combines all effects and reports the final increase in gross output of all production activities. (2) A GDP multiplier measures the total change of value-added. (3) An income multiplier measures the total change in households' income. However, an ex-ante multiplier analysis is based on certain assumptions (Breisinger et al., 2009; Round, 2003a):

(a) Structural links in the economy, between sectors and institutions, are linear and remain unaffected by exogenous changes.

[12] Production linkages are differentiated into backward and forward linkages: Backward production linkages are the demand for additional inputs used by producers to supply additional goods or services. Forward production linkages account for the increased supply of inputs to sectors.

(b) Prices are fixed (i.e. only output volumes change).

(c) Factors are unlimited (i.e. an increase in demand can be matched by an increase in supply).

The third assumption refers to the so-called unconstrained multiplier. However, by ignoring supply constraints linkages are typically overstated (Haggblade et al., 1991). Unconstrained multipliers are more simplified. At national level it is not as critical as at the village level because when an economy is relatively open, additional factors and capital resources can be easily available. Remote village economies, in contrast, often have no connection to broader economies. The constrained multiplier drops the assumption that the factor supply is unlimited (Breisinger et al., 2009). The limitations of the SAM multiplier analysis justify the use of more complex SAM-based methods, such as CGE models, which drop the assumption of linearity, fixed prices and unlimited factor resources.

### 5.2 Mathematical optimization models

Mathematical optimization is a widely-used problem solving approach in quantitative methods by private sector, governments and academia. Different scenarios can be simulated and analyzed. It is a method to achieve an optimal solution given a number of constraints and requirements (linear and non-linear equations). The optimization of households' collective well-being, maximization of individual income or minimization of farm cost, subject to a range of binding and non-binding constraints, are possible objective functions. The selection of certain activities may cause the exclusion of alternative ones, reflecting the context-specific opportunity costs incurred.[13] The method can support policy makers in their decision-making process. It is appropriate for problems related to the efficient utilization of scarce resources where multiple activities compete for the same resource and trade-offs have to be balanced (Hazell and Norton, 1986; Kaiser and Messer, 2011). Mathematical programming models have been applied to livelihood analysis, crop mix optimization, nutrition, land use planning, agricultural production, investment decisions and natural resource management (Adeniyi and Adasina, 2014; Gronau et al., 2017; Maruod et al., 2013; Niragira et al., 2015).

[13] Revealed marginal values (shadow prices) by programming runs are a special GAMS software feature (Brooke et al., 1992).

Mathematical optimization models often focus on household aggregates in their analysis. However, due to strong inequalities in village economies, the use of aggregates is a limitation of the method (Britz et al., 2013). In addition, optimization models provide partial analyses that do not capture economy-wide linkages. CGE models provide a more complete picture and could balance some of the limitations of a partial activity model (Gronau et al., 2017). However, optimization models can also cover general economic characteristics of a village economy and be formulated more flexible.

**5.3 Village CGE analysis**

A CGE framework is appropriate to cover economy-wide linkages and to carry out simulations (Robinson et al., 1999). The approach is favorable because of its ability to produce disaggregated results at the microeconomic level within a consistent macroeconomic framework (Dervis et al., 1982). The CGE parameters and variables are calibrated to a SAM, which captures the structure of the village economy. A village CGE model covers all transactions within a rural economy for a single year and follows a disaggregation of activities, commodities, factors, institutions and capital accounts. It is written as a comprehensive system of simultaneous equations, linear and nonlinear. For production and consumption decisions, the behavior of actors is captured by the maximization of profits and utility, respectively. The equations also include a set of constraints that have to be satisfied. These cover factor and commodity markets as well as macroeconomic balances. Price variables are linked and determined endogenously. The approach has successfully been applied to food security, poverty, agriculture, aquaculture and bioenergy (Arndt et al., 2012; Diao and Kennedy, 2016; Gronau et al., 2018a; 2018b; Winter et al., 2015).

A CGE model can be formulated as an optimization problem, for example maximizing profit or minimizing costs, but also as Mixed Complementarity Problem (MCP).[14] Compared to the optimization format, the MCP approach accommodates the explicit treatment of activity analysis (i.e. the possibility of regime shifts between alternative activities) (Böhringer and Rutherford, 2005). There is no objective function in this class of models (Dirkse, 1994). CGE

[14] The formulation includes a mixture of equalities and inequalities (Rutherford, 1995). The key modelling power of complementarity is that it chooses which inequality to satisfy as equality (Bishop et al., 2001).

models can be formulated and solved using mathematical software such as the General Algebraic Modeling System (GAMS).[15]

An ex-ante CGE approach may predict the consequences of a policy (or shock) scenario. Effects may be assessed quickly and cost-effectively before a real intervention occurs. However, a CGE model is a solution to a real data set, which is subject to uncertainties (e.g. technical progress, external influence, elasticity, suitability) (Ackermann and Galagher, 2008). An equilibrium model incorporates direct and indirect effects among all actors and sectors of the village economy and offers a comprehensive economic framework for analyzing price and quantity interactions. However, it relies on theoretical simplifications (assumptions and functions) of reality, which however, any modelling exercise involves (Ackermann and Galagher, 2008; Böhringer et al., 2003). In addition, real agents' behavior may diverges from optimality conditions because they do not behave rationally and independently (Klapwijk et al., 2014); more readily they respond to other agents' actions (Röttgers, 2016). A CGE model, however, aggregates (microeconomic) agents that replace numerous single producers and consumers. Another limitation is the static comparison of two economic situations: An equilibrium before a policy change and a second one reached after the political change. The length and cost of the transition, an issue of great practical political significance, is outside the scope of most models (Ackermann and Galagher, 2008). A village CGE model can thus be extended by a dynamic structure to assess long-term impacts.

## 6. Additional remarks

### 6.1 Companies

In national SAMs, companies' (businesses, corporate enterprises) row accounts receive profit (or gross operating income) paid by the capital factor account and possibly governmental transfers. The companies' column records corporate payments of shared profits to household accounts, taxes on profit to government (public administration) accounts, corporate savings to the capital account and transfers abroad to the ROW. However, village SAMs often assume, for simplicity, that profit is paid directly to households

[15] GAMS is designed for the construction and solution of large and complex mathematical programming models (Brooke et al., 1992).

from the factor account (Breisinger et al., 2009). It is also possible that no companies are active in a village economy. In this case companies are neglected.

### 6.2 Taxes

In a national SAM taxes have to be paid to the tax accounts, disaggregated by tax type, each of which forwards its revenues to the government account. The tax types are divided into direct taxes (household's income/revenue, businesses profits and factors), indirect commodity sale taxes, import taxes, export taxes, activity taxes and value-added taxes on activities (Lofgren et al., 2002). In addition, local taxes (patents, urban taxes, council tax, registration fees, stamp duty) may exist (Bellù, 2012). Taxes are payments without direct exchanged benefits for the tax payer undertaken by households and businesses as well as goods and services accounts. The government row account records government revenue from taxes (Bellù, 2012). However, taxes may be ignored in a village SAM because rural households are often unaffected by taxes (Suriya, 2011). This should be consistent with the reality of the according case study region and therefore needs to be examined beforehand. In addition, since many local economies are not in direct contact with state structures, this also affects monetary cash flows, which therefore remain unaffected by tax structures.

### 6.3 Boundaries of village economies

The definition of geographical boundaries for a SAM is important as it guides which activities, commodities and resources to include (United Nations, 2014). Where geographical boundaries are unclear for the construction of a village SAM, researchers should consider the economic boundaries of the village, e.g. the surrounding forest area or fishing places. If members of the village work outside the boundaries but reside in the village (daily migration), their income can be included as factor income via the ROW account (Subramanian, 1996). Boundaries can also be set based on the distances that household members travel to harvest natural resources, such as forest resources (timber, mushrooms, edible insects, honey, etc.), fish or even fresh water. Furthermore, in many rural areas the fields where famers plant and harvest their crops are located kilometers away from their houses. The area between the fields and the households should then be included, as this form the basis of the economic activity (United Nations, 2014).

### 6.4 Transaction cost

A national SAM matrix explicitly associates monetary flows with transaction costs (trade and transportation). For each commodity, the SAM accounts for the costs associated with domestic, import and export marketing margins. In village SAMs, transaction costs can be handled in different ways: (1) A village SAM will work without the explicit treatment of transaction costs (Lofgren et al., 2002). The costs are already included in the prices and are not explicitly considered by farmers. (2) Cost of travelling to collect particular natural resources can be calculated as transaction costs.[16] (3) A commodity "transport services" can be used, which is a non-food item, to cover transaction costs (Siddig et al., 2011). In line with the System of National Accounts (European Commission et al., 2009), transaction costs are calculated as the value of trade and transport services.

### 6.5 Balancing a village SAM

The information and data needed to build a SAM comes from a variety of primary and secondary sources. Placing these data within the SAM framework may reveal inconsistencies between the incomes and expenditures of each account. A number of statistical estimation techniques exist to balance SAM accounts or reconcile incomes (receipts) and expenditures (payments), such as the cross-entropy method (Robinson et al., 1998; Robinson et al., 2001).[17] However, automated procedures (methods) to balance out the data set can modify structures without considering economic behavior (Savard, 2003). It is important to be well informed about the region and data in order to make decisions when constructing a village SAM (Lewis and Thorbecke, 1992). Capital accounts may be used for balancing purposes (Subramanian, 1996; Taylor and Adelman, 1996). If the differences between inputs and outputs are relatively small, balancing approaches are likely to be negligible (Round, 2003b). If there are significant differences between the input and output, or income and expenditure, researchers should first query their data quality before simply aggregating or balancing out their error (Lemelin et al., 2013).

## 7. Conclusion

A SAM framework plays an important role in policy planning and monitoring (Angelsen et al., 2014; De Anguita and Wagner, 2010). A developed matrix represents the total economic

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[16] Transaction cost for firewood collection = Distance to forest area (km) * average travel speed (hours per km) * opportunity cost (hourly wage of labor; $ per hour).

[17] An overview of the SAM balancing approaches can be found in Lemelin et al. (2013).

transactions within an economy for a single year and displays the linkages between economic activities and the use of natural resources in one table. Depending on the research question, different subregions, sectors and household groups can be depicted in separate accounts to derive the impact of specific development interventions on the economy and natural resources (Winter et al., 2018). The SAM thus provides the basic data structure for the design of advanced computer-based mathematical programming models, such as optimization and CGE models.

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