

Chapter 2

Social Accounting Matrix of India: Concepts and Construction

Social accounting matrix (SAM) is a technique related to national income accounting, providing a conceptual basis for examining both growth and distributional issues within a single analytical framework in an economy. It can be seen as a means of presenting in a single matrix the interaction between production, income, consumption, and capital accumulation. In this Chapter, we describe the concept and methodology for construction of a SAM for India. The novelty of this SAM is a detailed account of disaggregated energy sectors, electricity sectors, energy intensive sectors, and biomass as an alternative source of fuel. Further, this is one of the latest SAMs for India with such a high level of disaggregation.

2.1 Concept and Structure of SAM

A social accounting matrix is simply defined as a single entry accounting system whereby each macroeconomic account is represented by a column for outgoings (payments) and a row for (receipts) incomings (Round 1981). It is represented in the form of a square matrix with rows and columns, which brings together data on production and income generation as generated by different institutional groups and classes on the one hand and data about expenditure of these incomes by them on the other. In a SAM, incomings are indicated as receipts for the row accounts in which they are located and outgoings are indicated as expenditure for their column accounts. Since all incomings must be, in a SAM, accounted for by total outgoings, the total of rows and columns must be equal for a given account.

SAM is essentially a database, including both social and economic data for an economy for an accounting year. The data sources for a SAM come from input-output (IO) tables, national income statistics, and household income and expenditure statistics. Therefore, a SAM is broader database than an IO table and typical national account, showing more detail about all kinds of transactions within an economy. An IO table generally records economic transactions alone irrespective of the social background of the transacting actors. A SAM, on the contrary the national accounts, "...attempts to classify various institutions to their socio-economic backgrounds instead of their economic or functional activities" (Chowdhury and Kirkpatrick 1994, p. 58).

At this point, it would be good to describe the various components of a hypothetical SAM in a schematic diagram (Table 2.1). As this table shows, there are four agents in the hypothetical economy, namely, the households, the private corporate, the public nondepartmental enterprises and the government. Here, interindustry flows are presented by A11. This table indicates that the factor incomes generated through production process (A21) are transferred to institutions according to the ownership of their factors of production (A32, A42, A52, and A62). In addition, a household gets its income from current transfers from the government as well as from interest on public debt (A36) and the net current transfers from the rest of the world (ROW; A39). The households spend on consumption of goods and services (A13) and pay income taxes (A63) and indirect taxes on purchase (A73) and they keep the residual income as savings (A83).

The income of the private corporate sector comes from its operating profit (A42) and interest on holding public debt (A46). After payment of corporate tax (A64), the residual is savings (A84).

The receipts and expenditures of the other two institutions, public-nondepartmental enterprises and government administration including departmental enterprises, are specified in this table. The income of the first category is only the operating surplus (A52) which is also its saving (A85). The receipts of the government consists of income from its enterprises (A62), direct taxes paid by the households and private corporations (A63, A64), the total indirect taxes generated within the economy (A67) and the net capital transfer from ROW (A69). On the other hand, its outlay includes its final consumption expenditure on goods and services (A16), transfers and interest payments to households (A36) and interest payments to private corporate sector (A46).

The receipts of the capital account are from the net savings of the different institutions (A83, A84, A85, and A86), foreign savings (A89), and depreciation (A82). The expenditure is equal to gross domestic capital formation (A18) and indirect taxes paid on purchases of the investment goods (A78).

The ROW represents the equality between foreign exchange expenditures on the one hand and foreign exchange earnings on the other. Foreign exchange expenditure equals imports (A91). On the other hand, foreign exchange earnings equals sum of exports (A19), net factor income from abroad (A29), net current transfers (A39), net capital transfer (A69), net export taxes (A79), and foreign savings (A89).

2.2 Purpose of Constructing SAM

India has been an early leader in SAM-based model users. To the best of our knowledge, Sarkar and Subbarao (1981) constructed the first SAM for India back in the 1980s, which provides the consistent database for their computable general equilibrium (CGE) model. Subsequently, a number of SAMs are constructed over the years by the different researchers. In the following Table 2.2, we have described a brief outline of these various SAMs and their salient features.

Table 2.2 Stylized facts of social accounting matrices (SAMs) of India. (Source: Authors' collection)

Serial no.	Name of researchers and their SAM-based study	Salient features of SAM
1.	Sarkar and Subbarao (1981)	<i>Base year:</i> 1979–1980 <i>Sectors (3 in all):</i> agriculture, industry, and services <i>Agents:</i> nonagricultural wage income class, nonagricultural nonwage income class, agricultural income class, and government
2.	Sarkar and Panda (1986)	<i>Base year:</i> 1983–1984 <i>Sectors (6 in all):</i> agriculture (2), industry (2), infrastructure, and services <i>Agents:</i> nonagricultural wage income class, nonagricultural nonwage income class, agricultural income class, and government
3.	Bhide and Pohit (1993)	<i>Base year:</i> 1985–1986 <i>Sectors (6 in all):</i> agriculture (2), livestock and forestry, industry (2), infrastructure, and services <i>Agents:</i> government, nonagricultural wage income earners, nonagricultural profit income earners, and agricultural income earners
4.	Pradhan and Sahoo (1996)	<i>Base year:</i> 1989–1990 <i>Sectors (8 in all):</i> agriculture (2), mining and quarrying, industry (2), construction, electricity combined with water and gas distribution, and services (3) <i>Agents:</i> government, agricultural self-employed, agricultural labor, and nonagricultural self-employed and other labor
5.	Pradhan et al. (1999)	<i>Base year:</i> 1994–1995 <i>Sectors (60 in all):</i> agriculture (4), livestock products (2), forestry sector, mining (4), manufacturing (27), machinery and equipment (6), construction, electricity, transport (2), gas and water supply, other services (11) <i>Agents:</i> government, self-employed in agriculture (rural and urban), self-employment in nonagriculture (rural and urban), agricultural wage earners (rural and urban), other households (rural and urban), private corporate, and public nondepartmental enterprises
6.	Pradhan et al. (2006)	<i>Base year:</i> 1997–1998 <i>Sectors (57 in all):</i> agriculture (4), livestock products (2), forestry, mining, manufacturing (27), machinery and equipment (6), construction, electricity, transport (2), gas and water supply, other services (11) <i>Agents:</i> government, self-employed in agriculture (rural and urban), self-employment in nonagriculture (rural and urban), agricultural wage earners (rural and urban), other households (rural and urban), private corporate, and public nondepartmental enterprises
7.	Sinha et al. (2007)	<i>Base year:</i> 1999–2000 <i>Sectors (13 in all):</i> agriculture (informal), formal manufacturing (9), construction (informal), other services (formal and informal), and government service <i>Agents:</i> casual labor (rural and urban), regular wage earner (rural and urban), own account worker (rural and urban), employer (rural and urban), and government

Table 2.2 (continued)

Serial no.	Name of researchers and their SAM-based study	Salient features of SAM
8.	Saluja and Yadav (2006)	<p><i>Base year:</i> 2003–2004</p> <p><i>Sectors (73 in all):</i> agriculture (12), livestock products (4), forestry, mining (4), manufacturing (28), machinery and equipment (7), construction, energy, gas distribution, water supply, transport (2), other services (10)</p> <p><i>Agents:</i> five rural households' expenditure classes, five urban households' expenditure classes, private corporation, public enterprises, and government</p>
9.	Pal et al. (2012)	<p><i>Base Year:</i> 2003–2004</p> <p><i>Sectors (85 in all):</i> agriculture (19), livestock products (1), forestry, mining (9), manufacturing (32), construction, electricity (3), biomass, water supply, transport (5), other services (12)</p> <p><i>Agents:</i> five rural households' occupation classes, five urban households' occupation classes, private corporation, public enterprises, and government</p>

As Table 2.2 shows, the SAM constructed by Pal et al. for the year 2003–2004 provides detailed description about primary energy, biomass, electricity, and transport sector. Prior to this SAM the available SAMs, especially before 1996, were highly aggregated in nature and most of them have three household classes. These SAMs are old and their socioeconomic classifications are based on data for the year 1970. To some extent, SAM constructed in the post 1996 period addresses these shortcomings. However, the article published by Pal et al. does not provide detail description about the methodology for constructing such detail SAM for India. Moreover, the base year of this SAM is 2003–2004, whereas the government of India had published the IO table for the year 2006–2007 also (Central Statistical Organization, CSO 2010).

Since our interest of SAM is for climate change policy analysis, we have planned to present a detail methodology of constructing a SAM for India with detail description of primary energy, biomass, electricity, and transport sectors. Moreover, we have decided to construct a SAM for the more recent year 2006–2007 than the 2003–2004 SAM as available in Pal et al (2012). However, looking at the data availability, our need, and time constraint, we have decided to construct a SAM of 35 sectors of the economy, 3 factors of production, and 9 categories of occupational households. The description of the sectors of our SAM and its concordance map with 130 sectors of IO flow table is shown in Table 2.3.

As Table 2.3 shows, some of the sectors of this SAM match with the sectors of the 130-sector IO table of the year 2006–2007. But the important aspect of our SAM is the decomposition of electricity sector into three separate sectors viz. hydro, nuclear, and non-hydro. The non-hydro energy sector includes thermal, wind power, solar energy, etc. However, given India's energy balance, thermal is the main constituent of this group (CSO, Energy Statistics 2007). Another salient feature of this SAM is the incorporation of biomass. The biomass is an alternative source of commercial and domestic fuel.

Table 2.3 Mapping between social accounting matrix (SAM) sectors and sectors of input-output (IO) table. (Source: Authors' estimate)

Serial no.	Sector code	Sectors for SAM	Sectors of IO table
1	PAD	Paddy rice	1
2	WHT	Wheat	2
3	CER	Cereal, grains, etc., other crops	Part of (3–7, 18, 19, 20)
4	CAS	Cash crops	8, 9, 10–17
5	ANH	Animal husbandry and production	Part of (21, 22, 23, 24)
6	FOR	Forestry	Part of 25
7	FSH	Fishing	26
8	COL	Coal	27
9	OIL	Oil	29
10	GAS	Gas	28
11	MIN	Minerals not elsewhere classified	30–37
12	FBV	Food and beverage	Part of (38–45)
13	TEX	Textile and leather	46–54, 59, 60
14	WOD	Wood	56
15	PET	Petroleum and coal production	63, 64
16	CHM	Chemical, rubber, and plastic production	58, 61, 62, 65, 66, 69–73
17	PAP	Paper and paper production	Part of 57
18	FER	Fertilizers and pesticides	67, 68
19	CEM	Cement	75
20	IRS	Iron and steel	77, 78, 79
21	ALU	Aluminum	80
22	OMN	Other manufacturing	55, 74, 76, 81, 82, 95–105
23	MCH	Machinery	83–94
24	HYD	Hydro	107
25	NHY	Thermal	107
26	NUC	Nuclear	107
27	BIO	Biomass	Part of (3–7, 18, 19, 20), part of (21, 22, 23, 24), part of 25, part of (38–45), part of 57
28	WAT	Water	108
29	CON	Construction	106
30	LTR	Land transport	110, 113
31	RLY	Rail transport	109, 113
32	AIR	Air transport	112, 113
33	SEA	Sea transport	111, 113
34	HLM	Health and medical	122
35	SER	All other services	114–121, 123, 124–126, 127–130

The description of 130 sectors of IO flow table is given in Appendix 1

We have considered four economic agents in our proposed SAM viz. households, government, public nondepartmental enterprises, and private corporate. Moreover, the households are decomposed into nine occupational households group. This household's classification is based on the household's classification given by National Sample Survey Organization (NSSO 2008). Thus, our SAM consists of 12 economic agents. The description of these 12 economic agents is given in Table 2.4.

Table 2.4 Description of economic agents. (Source: NSSO 2008)

Agent code	Description
RNASE	Rural nonagricultural self-employed
RAL	Rural agricultural labor
ROL	Rural other labor
RASE	Rural agricultural self-employed
ROH	Rural other households
USE	Urban self-employed
USC	Urban salaried class
UCL	Urban casual labor
UOH	Urban other households
PVT	Private corporate
PUB	Public nondepartmental enterprises
GOV	Government

Once we know the sectoral description of our proposed SAM of India, our next task is to construct this SAM for the Indian economy. In the following sections, we describe in detail the methodology of constructing the 35-sector SAM of India for the year 2006–2007.

2.3 Methodology of Construction of SAM

The core of a SAM is an IO table. CSO has prepared 130-sector commodity X industry absorption matrix and 130-sector industry X commodity make matrix and sectors commodity X commodity IO flow matrix for the year 2006–2007.¹ Since we have made an attempt to construct a SAM in a commodity X commodity framework for the year 2006–2007, we have considered commodity X commodity IO table for India for the year 2006–2007.

However, the concordance map of our sectors with the 130 sectors of IO table as shown in Table 2.3 indicates that sectors like biomass, hydroelectricity, nuclear electricity, and non-hydroelectricity do not have a one-to-one mapping with 130 sectors. So to complete our exercise, we need to construct rows and columns for these sectors, and the procedure is given below.

2.3.1 *Expansion of Electricity Sector (Hydro, Non-hydro, and Nuclear)*

The Hydro Power Corporation Limited of India (NHPCL) and Nuclear Power Corporation of India Limited (NPCIL) publish their annual accounts every year. The information from these reports has been used to construct the columns of hydro- and

¹ www.mospi.nic.in extracted on August 2010.

nuclear-electricity sectors. Once we get the column of hydro- and nuclear-electricity sectors, we subtract them from aggregate electricity sector to obtain the column of non-hydroelectricity sector. Thus, we get the total output (i.e., column sum) of each electricity sector and their corresponding share with aggregate electricity sector's output. We apply this share to the row of aggregate electricity sector to obtain the rows of these electricity sectors separately.

2.3.2 Construction of Biomass Sector

The biomass supplies originate in (1) agricultural residuals, (2) animal husbandry residual, (3) firewood, (4) food and beverages industry residuals, and (5) paper and paper industry residuals.² According to the national accounting methods, only the 5% of agricultural residuals are taken as biomass and rests of the part are considered to be consumed by the entire livestock population (CSO 1989).

The use of biomass can be divided into two parts viz. noncommercial purpose and commercial purpose (Fritz and Steininger 1998). Noncommercial biomass is mainly used as cooking fuels, which comes from agriculture, animal husbandry, and forestry sectors. On the other hand, commercial biomass use has two parts viz., commercial nonmodern biomass use and modern biomass use. The commercial nonmodern biomass use considers the use of charcoal and commercial fuel wood and these are available from forestry sector. The paper and sugar industry are the main contributors of modern biomass. This modern biomass is used mainly for bio fuels. Apart from this, the biomass can also be used for the production of chemicals, plastic, as well as reducing agent for steel production (charcoal) and for construction purpose.

Now the data on agricultural sector residuals, animal husbandry residuals, and firewood are available from National Accounts Statistics (NAS) of India. On the other hand, Annual Survey of Industries (ASI) gives data on commercial nonmodern biomass use as well as modern biomass use statistics for the year 2000–2001. We use ASI data on biomass use to obtain total biomass output originating from industries for the year 2000–2001. Again, this industrial biomass is originated from paper industry and food and beverages industry. We use their ratio of output of the year 2000–2001 to split up this industrial biomass according to their origin. To obtain the industrial biomass output for the year 2006–2007, we first estimate the share of paper and food and beverages industries in biomass production and apply this to their total output of the year 2006–2007. Thus, we get the total biomass output of the year 2006–2007.

Once we have derived total output data on biomass, we need to estimate its row and column. But, as data is not available on input structure of biomass sector, it is very difficult to make a column of this sector. In this case, we have considered these five types of residuals viz., agricultural residual, animal husbandry residual,

² See <http://edugreen.teri.res.in/explore/renew/biomass.htm>.

firewood, food and beverages industry residuals, and paper industry residuals as by-products of their mother sectors and apply the input structure of their mother sector to these by-products (Pradhan et al. 2006).

To make a row of biomass sector, we first make separate rows for the agricultural residuals, animal husbandry residuals, firewood, and industrial residuals. As we mentioned earlier, the agricultural and animal husbandry residuals are mainly used as cooking fuel. But in the agricultural production process, these residuals are also used as organic fertilizer. So, we distribute these residuals into the agriculture-related sectors on the basis of the rows of their mother sectors and the rest of the part is treated as Private Final Consumption Expenditure (PFCE). Since the firewood is mainly used as cooking fuel, we have treated the firewood output as PFCE. As the industrial biomass use statistics for the year 2000–2001 is available from the ASI, we use this ratio to distribute the industrial biomass output of the year 2006–2007. The point to be noted is that these residuals are included under their corresponding mother sectors described in IO table 2006–2007. So, after obtaining the columns and rows of these residuals, we have subtracted them from the columns and rows of their corresponding mother sectors to obtain the independent rows and columns of these residuals. At last, we add up these columns and rows to get a column and row of biomass sector. In this way, we have extended the IO table of the year 2006–2007 with the three electricity sectors and one biomass sector.

On the other hand, the IO table of the year 2006–2007 gives accounts for four transport activities and one separate account for services incidental to transport sectors. But in our SAM, there is no separate account for the services incidental to transport activities; rather it has been included in all these transport activities. Therefore, to complete the SAM of the year 2006–2007, we have to include the row and column of these services incidental on transport sector into four transport sectors and the method is given below.

2.3.3 Disaggregation of “Services Incidental to Transport” Sectors

The services incidental on transports described in IO table 2006–2007 comprises packing, crating, operations of travel agencies, etc. These services are associated with shipping, air, railways, and road transport. In our SAM, there is no separate account of this sector; rather it has been merged with sea, air, railways, and road transport sectors. Therefore, we are to break-up the row and column of this services incidental on transport sector according to transport activities in which these services are associated. To do this, we have applied the share of output of each transport sector to the row and column of this services incidental on transport sector. The rows and columns thus obtained are added to the row and column of sea, air, railways, and road transport sectors, and hence, we get the four transport sectors exactly matching with transport sectors described in our SAM.

2.3.4 *Aggregation of IO Table*

After expanding the 130-sector IO table 2006–2007, we obtain a 132-sector IO table of India for the same year. To be specific, the added three new sectors are hydroelectricity, nuclear electricity, and biomass, and the sector describing services incidental to transport have been merged with road, rail, sea, and air transport. According to our sectoral scheme, we aggregate the 132-sector IO table to obtain 35-sector IO table. The next step is to extend the accounts of 35-sector IO table into accounts for the 35-sector SAM. This involves primarily decomposition of gross value added into depreciation, wage and nonwage income, and of PFCE and personal income into economic categories of households. The next section describes the methodology of same.

2.3.5 *Extension of IO Table to SAM*

We describe below the methodology along with the data sources for the decomposition of gross value added into depreciation, wage, and nonwage income. The other relevant accounts for the SAM are also discussed in this section.

Decomposition of Gross Value Added into Depreciation, Wage, and Nonwage Income The decomposition of gross value added into wage (including imputed) and nonwage income (capital and land income) has been done for 35 sectors of the economy for 2006–2007. The sources of data and methods used are given below according to the broad sectors of our SAM.

Agriculture and Allied Activities (Sectors 1–7 of SAM) The aggregate net value added (NVA) for agriculture, forestry, and fishing sector is available from NAS. We first calculate the NVA separately for these sectors by using the depreciation to gross value added (GVA) ratio for the entire agricultural sector, as available from the NAS. As we have considered four sectors under agriculture and an animal husbandry sector as separate activity in our SAM, we divide the aggregate NVA of agricultural sector into these five sectors on the basis of above-mentioned method. The NAS also gives the breakdown of the NVA into compensation to employees (CE) and operating surplus/mixed income (OS). The CSO divides the mixed income under the unorganized part of agriculture and animal husbandry sectors into the income of family labor and operating surplus, for which data are available for the period 1980–1981 to 1999–2000 (CSO 2008). We use the proportion of 1999–2000 to disaggregate the mixed income of 2006–2007 into the above two categories. The wage income due to family labor, obtained in this way, has been added to the actual wage income from the organized and unorganized components to get the total income due to labor. Having obtained the total labor income of the aggregate agriculture sector, we distribute this labor income into four agriculture-related sectors by using the proportion of NVA as obtained earlier. The remaining part of the net domestic product is the operating surplus. We add depreciation with this operating surplus to obtain the sector specific capital income.

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