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A Social Accounting Matrix for a Rural Agricultural Economy of Sri Lanka: An Analysis of Sectoral Income Flows

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ABSTRACT. *This study develops an economic model to understand forward and backward economic linkages in a rural agricultural economy of Sri Lanka. Data gathered form Uda-walawe left bank irrigation project area in southern Sri Lanka was used for the analysis. The model, developed by extending the conventional social accounting matrix, incorporated all production, consumption and expenditure linkages in selected regional economy. The model was further extended in estimating accounting multipliers that illustrate impact of any exogenous intervention in this regional economy. Agriculture was the predominant sector in this economy and it contributed to 80% of total household income of an average family. Estimated multipliers for major production sectors showed that impact of any external injection in crop production sector was higher than that of any other sector. In average, the return from a unit of external injection on crop production sector was 2.5 times as the initial injection. Out of all major crops, paddy can create highest multiplier impact in its own sector as well as in other sectors.*

INTRODUCTION

Impact of any development policy intervention on an economy is directly depended on established linkages or structure of that economy. Hence, an economic model that identifies sectoral income flows is very important in proper planning of development interventions. A social accounting matrix (SAM) is a proven statistical basis for analyzing economic linkages and the effects of different policy interventions. Though many countries have developed SAM based economic models in the last four decades, Sri Lanka has limited experience in the use of SAM based models to analyze regional economies (Naranpanawa and Bandara 2006).

This study developed a social accounting matrix for the regional economy of Uda Walawe left bank irrigation project area of Sri Lanka, to understand established economic linkages of an irrigated agricultural settlement. It quantifies magnitude of forward and backward economic linkages with estimated accounting multipliers.

Uda walwe Left bank irrigation Project (WLB) area of Sri Lanka was selected for this study. Uda Walawe irrigation development project is one of the major multipurpose development projects implemented by the Government of Sri Lanka after independence. The

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Uda Walawe reservoir is located on the boundary of the Wet and Dry Zones of Sri Lanka, around 200 km southeast of Colombo.

The Uda Walawe reservoir was constructed during the period 1963 – 1967, as part of a plan to develop irrigation infrastructure in 32,000 ha of land in the dry zone of southern Sri Lanka. Development of identified command area of Uda Walawe scheme was carried out in several steps (Nippon Koei, 2005). Initial construction of left bank main canal was completed up to Kiriibbanwewa tank by 1969. Command area of the left bank was divided into four blocks and scheduled to develop in five steps. Head reach or the first block was identified for sugarcane cultivation and developed under the Sevenagala sugar cane project in 1983. Under this project, a total of 2,300 households were settled in 2,000 hectare (ha) of irrigated lands. Another 1,200 farm households were settled in 2,100 ha of un-irrigated lands. Households in irrigated area were provided an allotment of 0.75 ha of land to cultivate sugar cane and 0.25 ha of paddy. Settlers in un-irrigated area were provided an allotment of 1.75 ha of lands to carry out sugarcane cultivation under rainfed condition. The second block Kirriibanwewa was developed for paddy cultivation. Construction of field level canal system of the block was completed in 1993. About 2,000 farmers were settled in the area and two acres of irrigable lands and half an acre of highlands for homestead were provided to each farmer household. Development of third block Sooriyawewa was completed in 2000. About 3000 families were settled in the area within 2300 ha of irrigated lands (Hussain *et al.*, 2007). While majority of the lands in the area were developed for paddy cultivation some lands were developed to grow Other Filed Crops (OFC). Considering the limitations in water availability, farmers with irrigable low lands were also encouraged to cultivate OFC instead of paddy in their irrigable lands. Developments in fourth and fifth blocks named Mayurapura and Tissapura were planed to develop in two phases and the construction of first phase began in 2001. By 2002 irrigation water was available only up to the Sooriyawewa block. But some farmers settled in non irrigated areas of Mayurapura area carried out rainfed chena cultivations and paddy in small pockets with water from small tanks in the area (Wijerathna 2005).

By 2002, there were approximately 38,000 households (farm and non farm) in the Uda walawe project area. About 40 percent of them were in left bank area. Over 70 percent of farm households were directly depend on agriculture. Even non farm households were linked with agriculture in various ways and earn major part of their income from agriculture. Estimated population in the WLB in 2002 was 75, 000, and it was largely rural (Hussain *et al* 2007).

This paper discusses the concept of SAM followed by the method used in developing a SAM for Uda Walawe left bank irrigation project area. Method of calculating accounting multipliers and their interpretation is also discussed in this section. The third section discusses the structure of the regional economy, with the estimates extracted from developed SAM model. Analyzes are conducted to perceive the impact of any exogenous intervention on major production sectors of this economy. The final section on conclusions highlights the importance of estimated multiplier values in analyzing a regional economy.

METHODS

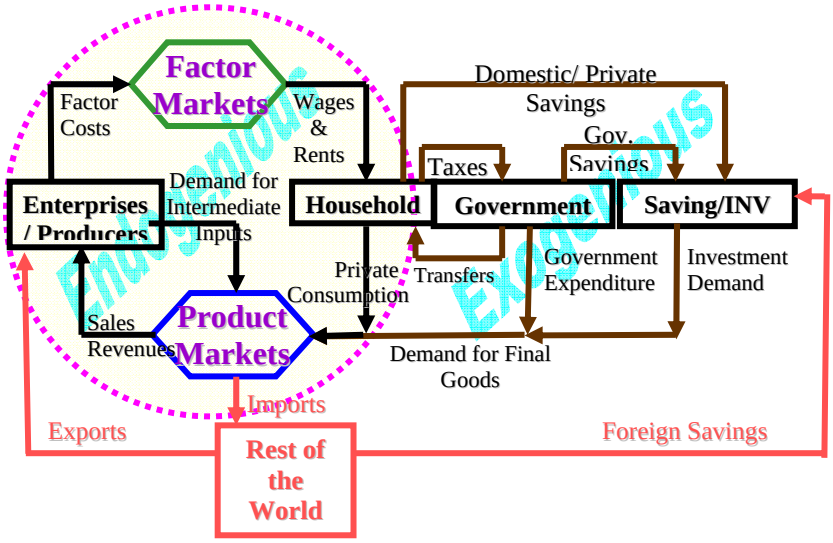
Social Accounting Matrix

The SAM is a comprehensive economy-wide data framework that represents the circular flow of income and expenditure in the economy of a nation or region, within a given time (Lofgren *et al.*, 1999; Punt, C. 2003). It presents all transactions in the economy in a matrix format as opposed to double entry accounting format. A SAM was first developed by Richard Stone (in association with Brown) in 1960's for Cambridge Growth Project (Pyatt and Round, 1977). Thereafter a number of authors has used SAM in various studies. Initially, SAMs were used for national level accounting purposes but later, the demand grew to apply them at regional and local levels (Kinlen, 2003). It can be used in descriptive or prescriptive analysis of a economy. SAM differs from other economic models since it is explicitly designed to depict how income is generated and distributed in an economy.

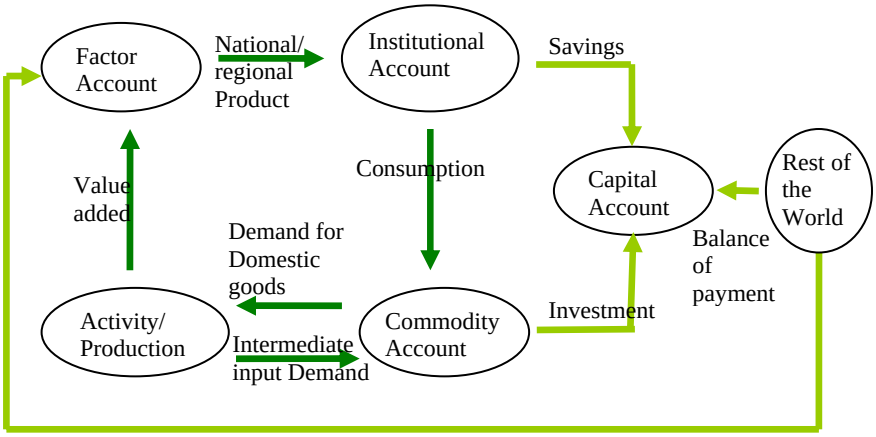
Traditionally, the rows of SAM represent income and columns of represent expenditure. Accounting identity used in SAM is for every income there exists a expenditure (Nokkla, 2001); sum of expenditures by a given account (or sub account) must equal to the total sum of receipts or income for the corresponding account (Thorbecke, 2001). The structure may differ from one SAM to another. Typically, SAM contain six types of accounts; production activities, goods and services (commodities), factors of production, institution (divided into households, firms and government), capital account and rest of the world accounts. It shows how sectoral value added accrues to production factors and their institutional owners; how these incomes corrected for net current transfers, are spent; and how expenditures on commodities lead to sectoral production and value addition.

Developing a social accounting matrix for a given economy

Construction of a SAM for a given economy starts with the identification of all economic agents and circular flows of income among these agents. After identifying all transactions and relevant accounts, they are categorized into two main groups as endogenous and exogenous. All transactions within the selected economy can be considered as endogenous while transactions between any external parties are considered as exogenous. Even though a national level SAM considers any activity beyond country as rest of the world, a sub national SAM considers any activity outside the interested economy as rest of the world. Rest of the world account is usually categorized as exogenous. Capital accounts of all institutions and current account of government are mostly considered as exogenous accounts. Since hypothesis based on a SAM model directly depend on defined exogenous and endogenous accounts, this classification has to be done with a clear idea on the expected analysis. Figure 1 shows classification of accounts of a SAM (for analyzing household level transactions) with respect to circular flow of income. A thematic SAM for an economy is given in table 2.



a). Circular flow of income



b) . Classification of accounts

Figure 1. Circular flow of income and classification of accounts for a social accounting matrix.

Source: Adapted from Punt C. (2003).

Table 1. A thematic social accounting matrix for an economy.

			2	3	4	5	6	7	8	
	Payments / **Receipts**	**Factors of Production**	**Production activities**	**commodities**	**Institutions - current account**			**Institutions - Capital Account**	**Rest of the world (RoW)**	**Total**
					Households	**Firms/ enterprises**	**Government**			
1	Factors of Production		Factor income/ value added						factor income from RoW; eg-salaries from foreign employers	**Total Factor income**
2	Production activities			production						**Gross Value of output**
3	commodities		intermediate consumption		HH s consumption expenditure on domestic goods	Firms' consumption expenditure on domestic goods	Govt s' consumption expenditure on domestic goods	Investment expenditure	Export of goods and services/ exogenoius final demand	**Agregate demand**
4	Institutions (Household) - curent account	Allocation of factor income to HH			inter household transfers	distributed profits to households	current transfers/ transfer payments to Households		net curent transfers from RoW	**Total current receipts to HH**
5	Institutions (firms)- curent account	Allocation of factor income to firms							net curent transfers from RoW	**Total current receipts to firms**
6	Institutions (government) - curent account	Allocation of factor income to government	indirect taxes	import tarifs	direct tax - income tax	direct tax - cooperate tax			net curent transfers from RoW	**Total current receipts to government**
7	Institutions - Capital Account								net capital transfers from RoW	**Total capital receipts**
8	Rest of the world	leakage of factor income	Other taxes on production	import of row materials	household expenditure on imports	payments to agents in RoW	payments of debt	import of capital goods		**Leakages/ payements to abroad**
	Total	**Payments to Factors / Factor income**	**Total Cost of Production**	**Aggregate supply**	**total current outlays of HH**	**total current outlays of firms**	**total current outlays of Govt.**	**Total capital payment of HH**	**Total injections/ receipts from abroad**	**Total**

The data and the social accounting matrix for regional economy of Uda Walawe left bank area of Sri Lanka.

Constructing a village SAM requires a very thorough knowledge of the functioning of the village economy, markets and institutions that govern the distribution of factor incomes across households. It is often very difficult to construct village SAMs based on standard household surveys that gather data on farm budgets and consumption, mainly because such data often do not contain information on the origin and destination of transactions on both revenue and expenditures. A SAM for Uda Walawe left bank region was developed by using a set of data collected for the region, during 2001-2002 period.

Data related to all economic transactions of the households were obtained with a structured questionnaire administered to a sample 858 households. The questionnaire was organized into five different modules as basic information and employments, infrastructure, production, expenditure and credit. Employments and production modules had questions to collect data on all sorts of employments and all kinds of production activities. Expenditure module had questions on all expenditure items.

Data Analysis

Designing a social accounting matrix for the study area

A Social accounting Matrix (SAM) for the Uda Walawe Project area was prepared by expanding the typical SAM with six categories of accounts. Concerning the availability of different activities, commodities and institutions, total of 30 accounts were identified for the purpose of developing a disaggregated/ micro SAM for Uda Walawe Project area. Later this detailed SAM was summarized into a macro SAM with 7 accounts.

In micro SAM, land and labor were identified as basic factors. Labor used in all kind of farming activities including livestock keeping is considered as unskilled labor while labor employed in service sector within and outside of the region is considered as skilled labor. Lands, houses and machinery for renting is also considered as factors of production.

Production activities were divided into two basic categories as agricultural and non agricultural. Cultivation of major crops such as (1) paddy, (2) sugarcane, (3) banana (4) other OFCs like onion, chille, vegetables, pulses, other grains (eg. kurakkan), oil crops (eg. gingerly), (5) other tree crops such as fruits and coconut, and also (6) livestock keeping were considered as different agricultural activities and recorded in separate accounts. Non agricultural activities were recorded in 6 accounts as (7) fishing, (8) mining, (9) manufacturing, (10) construction work in canals and other construction work, (11) labor employed in service sector, and (12) any other activities (retail and whole sale trading and other business activities, renting houses, hiring machinery, etc).

Commodity account is disaggregated into 9 accounts to represent major household consumption categories and the domestic product market. Separate accounts were created for (1) staple food rice, (2) other food mainly from domestic market, (3) foods from rest of the world, (4) other consumables (5) fixed and intermediate assets purchased/ constructed, (6) services consumed, (7) land and house rents, (8) loan repayments, and (9) others.

Institutions were divided into three basic categories as households, firms and government. Capital account represents savings, long-term borrowings and investment in fixed and intermediate assets.

The rest of the world account included all transactions with rest of the area, country and other countries. Basically, it included import of goods and services, remittances, income from and expenses for employment. Further, any transactions that were not recognized with our comprehensive data base such as operations of black market were also treated as operations of rest of the world.

After identification of accounts, a dummy table for the SAM was prepared. Values for relevant cells of SAM table were calculated with household level data base and included them in respective cells. Finally, some of the minor inconsistencies found in accounts were balanced by treating the unidentified transactions as transactions with rest of the world.

Estimating multipliers

Estimation of multipliers starts with classification of endogenous and exogenous accounts. Accounts of factors, activities, commodities and current account of households are considered as endogenous accounts while accounts of firms, government, capital account and rest of the world account are considered as exogenous. After classifying the accounts the above schematic diagram can be represented in matrix format as in the Table 2. Transactions within endogenous accounts are represented by matrices T_{ij}. Endogenous expenditures into exogenous accounts (leaks) are represented by matrices L_{ij}. Exogenous expenditures into endogenous incomes are represented in matrices X_{ij} while exogenous expenditures into exogenous accounts (residuals) are represented in matrices $Z_{ij.}$ Column vector Y represent total income of all accounts and row vector E represent total expenditure of respective accounts.

To analyze multipliers by concerning exogenous injections on endogenous accounts all exogenous accounts are summed up horizontally into a column vector. When average propensities of endogenous accounts to spent on endogenous accounts is given in another set of matrices A_{ij}, above schematic matrices can be given as follows (Table 3).

Table 2. A thematic social accounting matrix for Uda Walawe region.

		1	2	3	4	5	6	7	8	
		Factors of Production	**Production activities**	**commodities**	**Households**	**Firms/ enterprises**	**Government**	**Capital Account**	**Rest of the world (RoW)**	**Total**
1	Factors of Production		T_{12}						X_{18}	Y_1
2	Production activities			T_{23}						Y_2
3	commodities		T_{32}		T_{34}	X_{35}	X_{36}	X_{37}	X_{38}	Y_3
4	Households	T_{41}			T_{44}				X_{35}	Y_4
5	Firms/ enterprises	L_{51}							Z_{76}	Y_5
6	Government	L_{61}	L_{62}	L_{63}	L_{64}	Z_{65}			Z_{76}	Y_6
7	Capital Account				L_{74}	Z_{75}	Z_{77}	Z_{78}	Z_{76}	Y_7
8	Rest of the world (RoW)	L_{81}	L_{82}		L_{84}	Z_{85}	Z_{82}	Z_{82}		Y_8
	Total	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	

Table 3. A thematic social accounting matrix for Uda Walawe region.

		1	2	3	4	5	
		Factors of Production	Production activities	commodities	Households	Exogenous account	Total
1	Factors of Production		$A_{12}Y_1$			x_1	Y_1
2	Production activities			$A_{23}Y_2$		x_2	Y_2
3	commodities		$A_{32}Y_3$		$A_{34}Y_3$	x_3	Y_3
4	Households	$A_{41}Y_4$			$A_{44}Y_4$		Y_4
5	Firms/ enterprises	L_{51}					Y_5
6	Government	L_{61}	L_{62}	L_{63}	L_{64}	Z_6	Y_6
7	Capital Account				L_{74}	Z_7	Y_7
8	Rest of the world (RoW)	L_{81}	L_{82}		L_{84}	Z_8	Y_8
	Total	E_1	E_2	E_3	E_4	E_x	

Using matrix algebra, income received by endogens accounts Y_n can be given as,

$$Y_n = A_n Y_n + x_n \quad \text{..... 1}$$

$$\begin{bmatrix} FP = Y_1 \\ PA = Y_2 \\ CO = Y_3 \\ HH = Y_4 \end{bmatrix} = \begin{bmatrix} 0 & A_{12} & 0 & 0 \\ 0 & 0 & A_{23} & 0 \\ 0 & A_{32} & 0 & A_{34} \\ A_{41} & 0 & 0 & A_{41} \end{bmatrix} * \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ Y_4 \end{bmatrix} + \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

from equation 1,

$$Y_n - A_n Y_n = x \quad \text{..... 2}$$

Operating the reduced form,

$$Y_n = (I - A_n)^{-1} x_n = M_a x_n \quad \text{..... 3}$$

where $(I - A_n)^{-1}$ or M_a is the matrix of accounting multipliers.

Expression 3 shows how the effects of an exogenous injection on the income of endogenous accounts (Y_n) may be obtained by pre-multiplying the vector of exogenous income injections (x) by the accounting multiplier matrix (M_a), provided that M_a exists.

Each of the columns of accounting multipliers shows the effect of each corresponding exogenous injections on the income of endogenous accounts. Any exogenous injections into the system will increase the income of the corresponding account at first and it will trigger off effects on the income of all other endogenous accounts. Sum of column or row of the multiplier matrix indicates the backward and forward income or expenditure linkages. Row or column-wise total within basic accounts shows partial backward or forward linkages. (Alarcon, 2005)

RESULTS AND DISCUSSION

Structure of the regional economy

Developed Macro SAM for the regional economy shows magnitude of income and expenditure among main accounts (Table 4).

According to micro SAM, An average household of this economy earns about 86% of its total income from agriculture; 49% by using labor in agriculture, 33% as return to their land and management and another 4% by renting agricultural machinery and land. Skilled workers are mostly employed in service sector which contributes to 14% of the household income. (Figure 4)

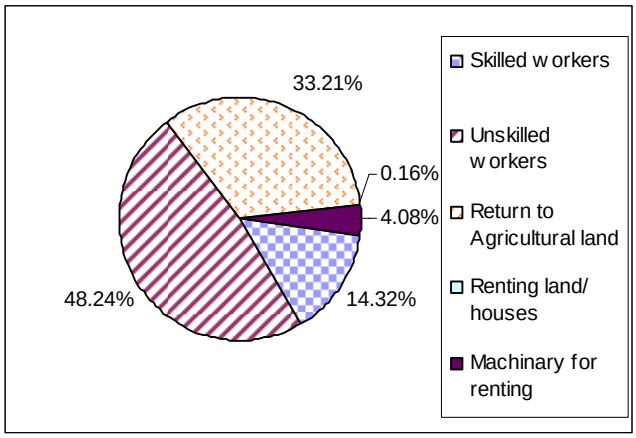


Figure 2. Sources of household income.

Majority (85%) of the unskilled labor is employed in crop production while the rest is employed in livestock production. About 39 % of skilled workers are employed in service sector. Another 31%, 17% and 11% of skilled workers are employed in manufacturing, construction and trade respectively (Figure 5).

Table 4. Macro social accounting matrix for the regional economy of Uda Walawe left bank (2001-2002).

	Factors of Production	Production activities	Commodities	Households	Government	Institutions - Capital Account	Rest of the world (RoW)	Total
Factors of Production	0.00	3,120.50	0.00	0.00	0.00	0.00	0.00	3,120.50
Production activities	0.00	0.00	3,890.10	0.00	0.00	0.00	1,521.77	5,411.86
Commodities	0.00	564.16	0.00	2,826.08	0.00	0.00	1,235.33	4,625.57
Households	3,115.69	0.00	0.00	0.00	0.00	0.00	0.00	3,115.69
Government	0.00	3.80	0.00	1.88	0.00	0.00	0.00	5.69
Institutions - Capital Account	0.00	0.00	0.00	131.42	0.00	0.00	0.00	131.42
Rest of the world (RoW)	4.81	1,783.66	531.12	156.31	5.69	131.42	0.00	2,613.02
Total	3,120.50	5,472.13	4,421.22	3,115.69	5.69	131.42	2,757.10	19,023.74

- *All values are in Million rupees*

Note: A period of one year was considered as it covered two agricultural seasons. Hence the period from October 2001 to September 2002 (Maha 2001-02 and Yala 2002) was considered as a year.

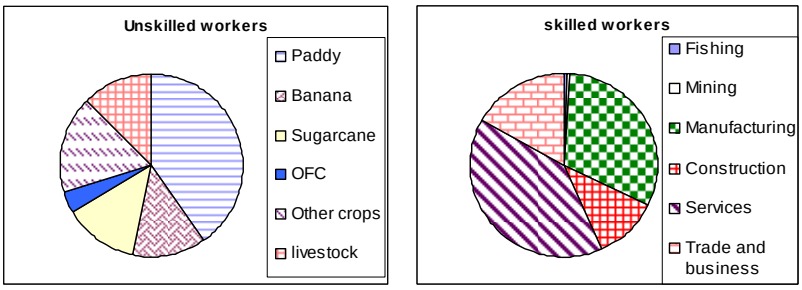


Figure 3. Source of income for skilled and unskilled labor.

The average annual expenditure of a household in this economy is Rs. 15,836. Expenditure shares show that an average household in this economy spends 42% of its total income on consuming foods while 17% and 11% are spent on other consumables and services respectively (Table 5). About 9% of their income goes to repayment of production and consumption loans. Another 8 % of their income is used in constructing houses etc. They allocate about 5% of their income for recreation and ceremonies.

Table 5. Composition of annual household expenditure.

Expenditure category	Average Household expenditure	Percentage share
Rice	1490	9.41%
Other foods local	2274	14.36%
Other foods imported	2891	18.26%
other consumables	2693	17.00%
Construction of houses etc	1247	7.87%
Services	1851	11.69%
Recreation and ceremony	807	5.10%
Land/house rent	54	0.34%
Repayment of Loans	1442	9.11%
Other total	1087	6.86%

Accounting multipliers

Tstimated accounting multipliers for the different sectors of the economy are presented in Table 6. It provides information on the own sector, linkages and total multipliers of main agricultural production sectors and service sector. Own sector multiplier indicate units of output increase per one unit of external resource input to the sector. Linkage indicates income increase in other sectors with a unit of external resource input to a given sector, due to forward and backward linkages. The paddy sector in this economy has the highest potential in increasing income with a unit of resource injected from any exogenous

source, either with own sector effect or including linkage effects (Table 6). While paddy sector can produce 2.71 units of income with a one unit of exogenous resource input, banana, sugarcane and OFC sectors can result in 2.57, 2.55 and 2.51 units of income increase with a unit of exogenous resource input. Consequently, paddy, banana, sugarcane and OFC sectors are able to transfer 1.68, 1.71, 1.71, 1.72 units of income to households (factor owners) with a unit of exogenous resources input to respective sectors (Table 6). Even though livestock and fishing sectors have lower total multiplier effect, these sectors are able to transfer higher potion of income to households with strong linkages they have with households. Other production activities including service sector can transfer only 0.86 units of income per one unit of external resource input.

Table 6. Accounting multipliers for production sectors of the regional economy.

	Total production	Own sector	linkage	Induced HH income
Paddy	2.713	1.234	1.478	1.680
Banana	2.576	1.041	1.535	1.708
Sugarcane	2.556	1.038	1.518	1.713
OFC	2.512	1.04	1.472	1.722
livestock	2.402	1.017	1.385	1.744
Fishing	2.402	1.023	1.379	1.744
Other	1.751	1.544	0.207	0.836

CONCLUSIONS

Development of a Social Accounting Matrix is really important in understanding the structure of any economy. The analysis indicates that agriculture is the most important sector in this regional economy and it contributes to 80% of domestic product. Paddy contributes to the major share of agricultural income followed by banana, sugarcane and OFC sectors. Any exogenous development intervention in agriculture can create multiplier impacts on income of the influenced sector as well as in other sectors, since these sectors are linked with forward and backward linkages. For example, a unit of exogenous resource injection on paddy sector can create 1.23 units of income within paddy sectors and 1.45 units of income increase in other production sectors. Hence, impact of any development intervention in this kind of regional economy has to be analyzed with a consideration of all economic linkages and multiplier impacts.

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