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A 2012 Social Accounting Matrix (SAM) for Bhutan with a detailed representation of the agricultural sector

WORKING PAPER

A 2012 Social Accounting Matrix (SAM) for Bhutan with a detailed representation of the agricultural sector

Technical Documentation

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Abstract

This paper develops a 2012 Social Accounting Matrix (SAM) for Bhutan with a detailed representation of the agricultural sector. Given the availability of extensive household, labour force and agricultural survey data as well as a large dataset of audited company reports, a bottom-up approach is applied to estimate the 2012 SAM, including the estimation of 2012 supply and use matrices. In case of missing data, the SAM relies on information from Bhutan's 2007 supply and use table. The bottom-up approach allows for a detailed depiction of economic activities and their interlinkages with markets and institutions. The SAM consists of a total of 221 accounts, including 108 commodity, 52 activities, 31 factor and 16 household accounts. There are 14 agricultural and 5 post-harvest activities producing 48 agricultural commodities. Agricultural commodities are differentiated by marketed and home-produced-home-consumed (HPHC) commodities to account for the large prevalence of subsistence farming in Bhutan and the differences in prices due to transportation and trade margins. Important features of farming systems and rural livelihoods in Bhutan such as the role of manure, bullock draught power, crop residues, community forestry and brewing of ara, a widely consumed local alcoholic beverage made of cereals, are depicted. Given the increasing importance of hydropower generation within Bhutan's economy, the SAM also represents significant level of detail of the electricity generation sector and the input structure of energy intensive industries. The final SAM is estimated using an information-theoretic, cross-entropy approach. Taking a Bayesian perspective, uncertainties of cell entries' prior values are set such that they reflect the availability and quality of data sources.

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List of Abbreviations

ADB	Asian Development Bank
AEZ	Agroecological zone
AFS	Annual Financial Statements
AMC	Agricultural Machinery Center
ASS	Agricultural Sample Survey
BCCL	Bhutan Calcium Carbide Limited
BFAL	Bhutan Ferro Alloy Limited
BLSS	Bhutan Living Standard Survey
BoP	Balance of Payments
BPC	Bhutan Power Corporation
BTS	Bhutan Trade Statistics
CGE	Computable General Equilibrium
CIF	Cost, Insurance and Freight
COTI	Countries Other Than India
CPC	Central Product Classification
CSI	Cottage and small industries
DGPC	Druk Green Power Corporation
DHI	Druk Holding Investment
DM	Dry matter
EBOPS	Extended Balance of Payments Services
ENT	Enterprise
FOB	Free on Board
GDP	Gross Domestic Product
GAMS	General Algebraic Modeling System
HH	Household
HPHC	Home Produced Home Consumed
HS	Harmonized System
ILO	International Labour Organization
ISCO	International Standard Classification of Occupations
ISIC	International Standard Industrial Class.
K	Potassium
LC	Livestock Census
LMIS	Labour Market Information System
LU	Livestock Unit
MLI	Medium and large industries
MoAF	Ministry of Agriculture and Forests
MoEA	Ministry of Economic Affairs
MoF	Ministry of Finance
MoLHR	Ministry of Labour and Human Resources
N	Nitrogen
NA	National Accounts
NRDCL	Natural Resources Development Corporation Limited
NRR	National Revenue Report
NSB	National Statistics Bureau (of Bhutan)
Nu.	Ngultrum (1 US-$ = 53.40 Nu.)
P	Phosphorus
PCAL	Penden Cement Authority Limited
PPC	Plant Protection Chemicals
RGoB	Royal Government of Bhutan
RMA	Royal Monetary Authority
RNR	Renewable Natural Resource (RNR)
RoW	Rest of the World
SAM	Social Accounting Matrix
SOE	State Owned Enterprise
SUT	Supply Use Table

1   Introduction

A social accounting matrix (SAM) is a detailed snapshot of an economy's circular flow. Depending on its disaggregation level, it may contain more or less detail. It is referred to as a social accounting matrix, because in contrast to other economic statistical frameworks such as national accounts, input-output and supply and use tables it does also capture transactions of households and other institutions within the economy. A SAM is an essential database for multiplier analysis and economy-wide models such as computable general equilibrium (CGE) models.

For most countries, SAMs have been developed already. Bhutan is one of few countries for which until recently no SAMs have been developed so far. The first SAM for Bhutan has been developed by Feuerbacher (2014), based on the year 2007 largely drawing from a supply and use table (SUT) developed by the Asian Development Bank (2012). The 2007 SAM however does not have a detailed representation of the agricultural sector. Instead it has one single agricultural activity producing five commodities. The objective of this SAM development is to produce a SAM with a recent base year and with a detailed depiction of the agricultural sector. To achieve this objective, this technical documentation pays pronounced detail on how the information on agricultural activities and commodities is derived and estimated.

Ideally, a SAM is developed for the most recent year, particularly if a country's economic structure is undergoing a transformational process as it is the case for Bhutan. Three decades ago, in 1981, agriculture still accounted for about 61% of GDP (UNCTAD, 2016). However, industrialization is catalysed by the rapid growth within Bhutan's electricity sector as Figure 1 shows. While agriculture only makes up 16% of GDP in 2012 according to the national accounts, it still is the largest sector in terms of employment provide work for almost 60% of labour force in 2012 (ADB and NSB, 2013a). The year 2012 was chosen at the beginning of the SAM development process as it is the year with most recent data on national accounts, household consumption and trade.

The final SAM consists of a total of 221 accounts. There are 108 commodity accounts, of which 48 are directly produced by agricultural activities and post-harvest activities. Including forestry commodities, a total of 52 commodities are represented in the SAM that are produced by farm households. Commodities are disaggregated according to marketed and home-produced-home-consumed commodities, in order to account for transport and trade margins as well as sales taxes only in case of marketed goods. The SAM includes 52 activities, of which 14 are agricultural activities and five are post-harvest activities. 31 factors are represented, of which there are ten labour, 12 capital and nine land factors. Households are disaggregated "strategically" into a total of 16 accounts by source of income, nationality (Bhutanese versus foreign) and area (urban versus rural). In addition, there are two enterprise accounts differentiated by private or public ownership. The remaining 14 accounts consist of two margin accounts (trade and transportation), the government and six tax accounts, the capital account (savings and investments), stock changes and the rest of the world (RoW) account.

Figure 1 – Bhutan's structural transformation since 1981
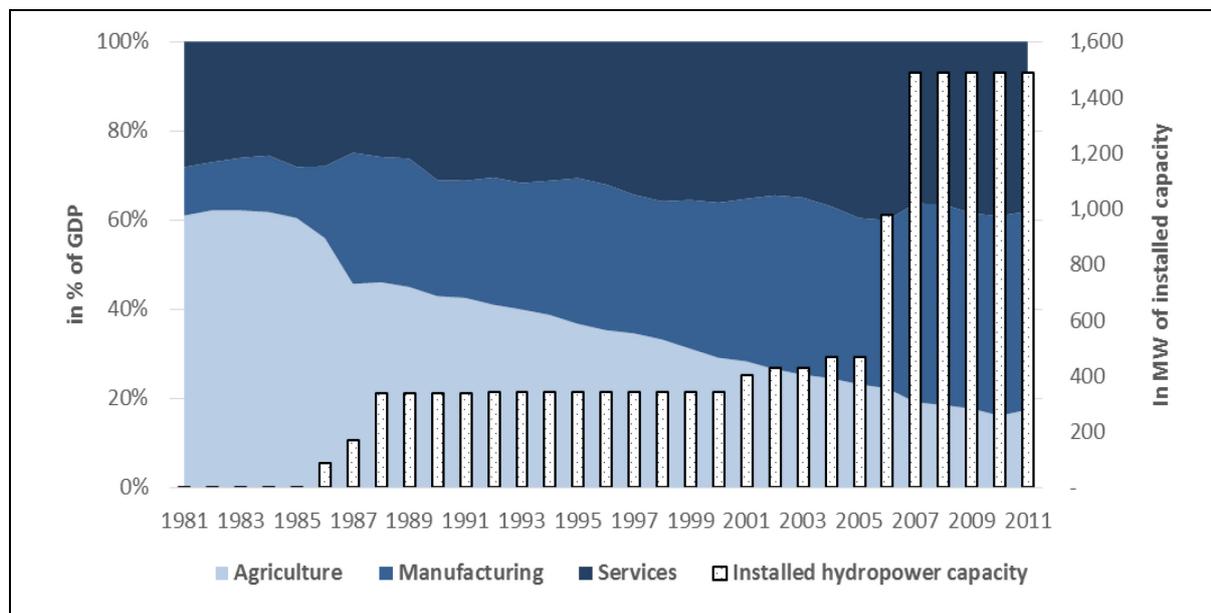
Source: NSB, 2015a; UNCTAD, 2016

Social-Accounting-Matrices as a Statistical Framework[1]

The underlying concept of SAMs is already captured by the "Tableau Economique" of the French economist François Quesnay (Pyatt and Round, 1985). A SAM is a representation of an economy's circular flow (as presented in Figure 2). It is an accounting framework of economic agents' expenditure and income within a given time period, usually a year (King, 1985; Dervis et al., 1982). Expenditure of agents is recorded in the column accounts of the matrix, while analogously income is recorded in row accounts as shown in the schematic representation in Table 1. All economic agents are represented in the SAM by assigning them with a respective column and row account. Total expenditure of an account needs to equal that account's total income received, which makes a SAM a consistent dataset and compliant with a fundamental law of economics: each recorded expenditure needs to relate to a corresponding income (Pyatt, 1988).

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[1]   This chapter draws from Feuerbacher, 2014

Figure 2 – Circular flow of transactions within an economy
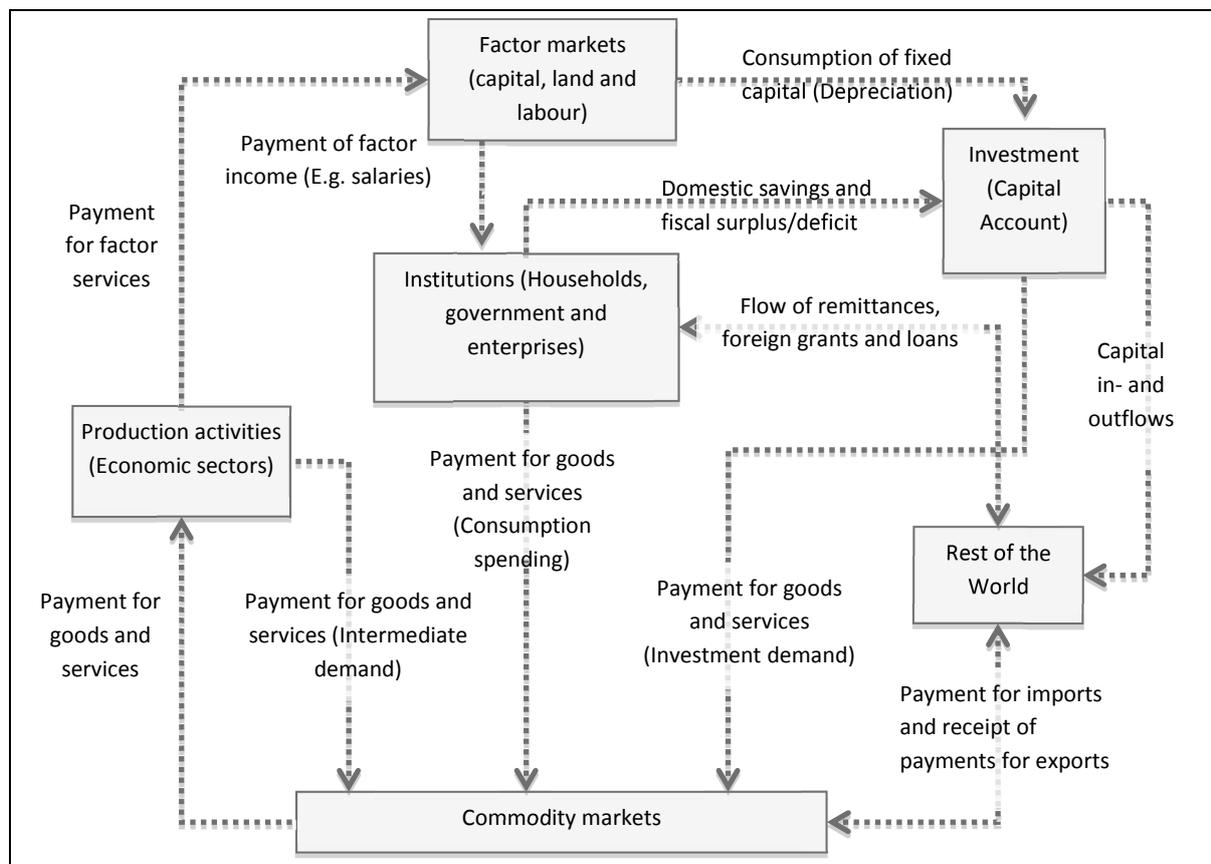
Source: adapted from Pyatt, 1988

The development of the concept of a SAM is attributed to Richard Stone, who in 1984 was awarded the Nobel Prize for his work on the national account system. Stone published the first ever SAM in 1960, which is based on the economy of Great Britain (Stone, 1962). Comprising all economic agents, SAMs became the underlying databases for economy-wide models such as computable general equilibrium (CGE) models. This extended the scope of economy-wide modelling, as previous models are based on input-output tables that did not incorporate the linkage between economic output and living standards.

Table 1 – Schematic representation of a macro-SAM

	A	C	B	D	E	F	G	H	
	Commodities	Margins	Activities	Factors	Households and enterprises	Government	Investments	Rest of the world	Total
1 Commodities		Margins	Intermediate consumption (Use-Matrix)		HH and ENT consumption	Gov. consumption	Investment demand	Exports	Total demand
2 Margins	Margins								Margins
3 Activities	Output (Supply-Matrix)								Domestic output
4 Factors			Payment for factor services					Factor returns from abroad	Total factor income
5 Households and enterprises				Factor returns		Gov. transfers to HH		Inward remittances	Total income of HH and ENT
6 Government and tax accounts	Taxes on products		Taxes less subsidies on production		Income from property; tax income		Government borrowing	Taxes and transfers from RoW	Total government income
7 Savings				Capital depreciation	HH and ET savings	Government savings		Balance of transactions with RoW	Total savings
8 Rest of the world (RoW)	Imports			Factor returns to RoW	Transfers to RoW	Gov. transfers to RoW	Balance of transactions with RoW		Total expenditure to RoW
9 Total	Total supply	Margins	Cost of domestic production	Total factor income	Total HH and ENT expenditure	Total Government expenditure	Total investment	Total income from RoW	

2   Data Sources and 2012 Macro-SAM

2.1   Data Sources

The data used to develop the Bhutanese SAM is obtained from various sources such as macroeconomic data reported in national accounts (NA), balance of payments (BoP), supply and use tables (SUT); government reports on revenue and budget; survey data from living standard surveys, labour-force surveys, agricultural production surveys and any other sources containing information on the transaction between agents within the economy. All monetary flows are recorded or converted to Bhutan's national currency, the Ngultrum (abbreviated by Nu.). The average annual Nu-US-Dollar exchange rate for the year 2012 is 53.40 (Nu./US-$).

Table 2 lists the main datasets used for the SAM development. In order to ease reading, data sources are not referred to by author name and year of publication in the subsequent chapters, but instead are cited according to the abbreviations as presented below.

Table 2 – Data sources used for the construction of the 2012 Bhutan SAM

Author, Year	Title	Comment	Abbr.
Asian Development Bank and National Statistics Bureau (ADB and NSB, 2013a)	Bhutan Living Standard Survey (BLSS) 2012 microdata		BLSS 2012
ADB and NSB (ADB and NSB, 2013b)	Supply and use table (SUT) 2007		SUT 2007
Ministry of Agriculture and Forests (MoAF, 2013a)	Agricultural sample survey (ASS) data 2012		ASS 2012
MoAF (2014)	Agricultural sample survey (ASS) data 2013		ASS 2013
MoAF (2013b)	Livestock Census (LC) data		LC 2012
MoAF (2009)	Renewable Natural Resource (RNR) Census 2009 microdata	Refers to data collected in 2008	RNR 2009
Ministry of Economic Affairs (MoEA, 2015a)	Corporate annual reports 2012		CAR 2012
MoEA (2015b)	Cottage and small industries (CSI) 2013 - data		CSI 2013
MoEA (MoEA, 2015c)	Medium and large industries (MLI)2012 - data		MLI 2012
Ministry of Finance (MoF, 2012a, 2013a)	Annual Financial Statements (AFS) 2011/2012 and 2012/13		AFS 2012
MoF (MoF, 2013b)	Bhutan Trade Statistics (BTS) 2013		BTS 2013
MoF (MoF, 2013d)	National Revenue Report (NRR) 2012-2013		NRR 2013
National Statistics Bureau (NSB, 2014)	National Accounts (NA) 2014 – report	Used to extract the national account statistics for 2012	NA 2012
Royal Monetary Authority (RMA, 2013, 2014)	Annual report 2011/12 and 2012/13	Used to compute balance of payment data for 2012	BoP 2012

Source: Own compilation

In Bhutan, a significant share of official statistics is reported per fiscal year periods. The fiscal year runs from first of July of one year to end of June of the next year. As the SAM is based on the 2012 calendar year, data that is only available for fiscal year periods needs to be converted to calendar year basis. If quarterly information is available from the fiscal year, all quarters in 2012 are summed up to arrive at 2012 annual numbers. This is for instance the case to derive the 2012 balance of payments statistics using the Royal Monetary Authority's (RMA) annual reports for 2011/12 and 2012/13. If only information from two fiscal years is available, then the simple mean of both years is computed (e.g. average of both 2011-12 and 2012-13 is equivalent to 2012). The National Statistics Bureau (NSB) of Bhutan also explicitly applies this simple mean approximation procedure when including figures published on a fiscal year, for instance when including export data from the Royal Monetary Authority to compute national account statistics (NSB, 2011 p. 26).

In a perfect world, all data from different sources would be consistent to each other. However, in reality data entails measurement errors. This is why a balanced SAM, in which each account's expenditure equals income, needs to be estimated either using a manual approach (if there are few and small deviations) or using statistical procedures. For the development of this SAM an information theoretic approach applying cross-entropy methods is used to estimate the final SAM from a prior-SAM (Robinson *et al.*, 2001).

2.2   2012 Macro-SAM for Bhutan

The 2012 macro-SAM for Bhutan is compiled based on macro aggregates following a top-down process. This leads to deviations compared to aggregating data sources from bottom-up. National accounts data are sometimes difficult to reconcile with data from individual sectors. For example, gross output calculated for certain crops (e.g. paddy, maize, citrus and apple) using estimated agricultural production and farm-gate prices vary substantially from the gross output statistics reported by the national account statistics.

In general, a bottom-up approach is used for the development of the 2012 micro SAM for Bhutan, primarily for those accounts and cell-entries where – according to the authors' judgement – detailed and representative data is available. The unbalanced prior macro-SAM in Table 3 is thus primarily a reflection of macroeconomic statistics and is particularly helpful to develop a micro SAM that is – given a certain error margin – consistent with macroeconomic indicators such as gross domestic output, total economic output, government spending, trade deficit. Cell entries of the unbalanced prior macro-SAM in Table 3 that are computed as residuals are highlighted in bold and blue font colour.

Table 3 –Unbalanced prior 2012 macro-SAM for Bhutan in Million Nu.

		A	B	C	D	E	F	G	H	I	J	
		Commodities	Margins	Activities	Factors	House-holds	Enter-prises	Govt.	Taxes	Invest-ments	Rest of the world	Total
1	Commodities		13,376	**73,587**		42,690		18,691		66,253	34,388	248,985
2	Margins	13,376										13,376
3	Activities	165,538										165,538
4	Factors			90,740							900	91,640
5	Households				44,238		8,944	1,502			692	55,377
6	Enterprises				37,976							37,976
7	Govt.						5,278		14,616		9,733	29,627
8	Taxes	5,813		1,211		1,072	6,520					14,616
9	Savings				7,328	**10,079**	8,944	9,434		1,949	**28,135**	65,869
10	Rest of the world (RoW)	61,925			2,098	1,535	8,291					73,849
11	Total	246,652	13,376	165,538	91,640	55,377	37,976	29,627	14,616	68,202	73,849	

Source: Own compilation

The underlying data sources, imputations or assumptions of each cell entry of the unbalanced prior macro-SAM are documented in Table 4.

In the unbalanced prior 2012 macro-SAM shown in Table 3 income of commodities exceeds expenditure by Nu. 2,333 Million (i.e. 0.95% of commodity's total) and investments exceed savings by the identical amount. This deviation could be manually balanced by subtracting Nu. 2,333 Million from the investment account in cell I1. Instead, we estimate the balanced prior macro-SAM using the *SAM Estimation Program, Version 3.3* developed by Scott McDonald and Sherman Robinson (2006). The estimation procedure is largely based on earlier methods of using cross-entropy techniques for SAM estimation (Robinson *et al.*, 2001) and the same procedure will also be used to estimate the final micro SAM in section 9.

The program is grounded in Bayesian statistical philosophy, i.e. the compiled and unbalanced prior SAM represents prior values. The estimation program allows to enter pre-defined error bounds (denoted by σ), within which the program is able to change cell entries. This procedure allows to fix cell entries by assigning an error of zero (σ = 0). We assign a higher error margin (σ = 0.5) for the stock changes entry in cell I9 (Stock changes are recorded in a separate account during the estimation procedure). The program is coded in the General Algebraic Modeling System (GAMS) software package and the data is imported from an excel sheet, in which various estimation settings can be controlled. The program is run using the CONOPT solver.

The balanced prior macro-SAM as shown in Table 5 is used for the compilation and estimation of the micro-SAM. However, as the estimation of the final micro SAM largely follows a bottom-up approach, the final macro-SAM derived from micro-SAM will be still different from the balanced prior SAM. These deviations will be presented and discussed in section 9.2

Table 4 – Underlying data sources and imputations of the unbalanced prior 2012 macro SAM

Cell entry:		Data source / Imputation method:
A2/ B1	Trade and transport margins	Estimated using SUT 2007 and margins between purchaser and farm-gate prices for agricultural goods
A3	Gross output of domestic activities (Supply-matrix)	Gross value of output measured in basic prices and based on the NA 2012.
A8	Taxes on products	Estimated on basic price basis and includes sales tax, excise tax and custom duty as reported in the NRR 2013.
A10	Imports of goods and services	Measured in basic prices (CIF terms) and based on the BTS 2013 and UN COMTRADE data for 2012; Re-imports are subtracted.
C1	Intermediate consumption (Use-matrix)	Measured in purchaser prices and imputed as a residual by subtracting total payment to factors and taxes from total gross output.
C4	Payment for factor services	Total compensation of employees and operating surplus as reported by the NA 2012. Includes both factors owned domestically and abroad
C8	Taxes less subsidies on production	Includes taxes, fees and royalties as reported by the NRR 2013. In case of non-incorporated businesses, it also includes the business income tax
D5	Factor returns paid to households	Estimated using the share of labour in GDP and adding an assumed 10% to adjust for mixed income and unincorporated capital
D6	Factor returns paid to enterprises	Residual of total factor return after subtracting factor returns to households, labour from abroad and consumption of fixed capital
D9	Consumption of fixed capital	Capital depreciation is based on the NA 2012
D10	Return to labour from abroad	Based on the BoP 2012.
E1	Household consumption	Final consumption expenditure of households in purchaser prices reported by the NA 2012.
E8	Direct taxes paid by households	Personal income taxes paid by households as reported by the NRR 2013.
E9	Household savings	Imputed as a residual.
E10	Household transfers to RoW	Outward remittances to institutions (i.e. households) abroad, data is based on BoP 2012.
F5	Dividends paid to households	Assumed to be 50% of the residual after subtracting payment of direct taxes, dividends to the government and transfers to RoW.
F7	Dividends paid to the government	As reported in the AFS 2012.
F8	Direct taxes paid by enterprises	Based on the NRR 2012.
F9	Retained earnings (savings) by enterprises	Assumed to be 50% of the residual after subtracting payment of direct taxes, dividends to the government and transfers to RoW.
F10	Enterprise payments to RoW	Based on the BoP 2012.
G1	Government consumption	Current expenditure of government as reported in the NA 2012.
G5	Government transfers to households	Current and capital grants to individuals and non-profit organizations based on AFS 2012.
G9	Government savings	Net government savings calculated as a residual
H7	Tax revenue	As reported in AFS 2012.
I1	Investment demand	Equal to the gross capital formation as reported in NA 2012.
I9	Stock changes	A prior value of 2% of GDP is assumed for changes of inventory
J1	Export of goods and services	Measured in purchaser prices (FOB terms) and based on BTS 2013 and UN COMTRADE data for 2012; Re-exports are subtracted.
J4	Factor returns from RoW	Income from factors employed abroad based on BoP 2012.
J5	Transfers from RoW to househ.	Inward remittances based on BoP 2012.
J7	Transfers from RoW to government	External grants received in cash (budget support, development aid) as reported in the NRR 2013.
J8	Taxes/royalties earned from RoW	Mostly royalties charged from international tourists, based on NRR 2013.
J9	Capital account deficit with RoW	Inflow of foreign capital calculated as a residual.

Table 5 – Balanced prior 2012 macro-SAM

	Commodities	Margins	Activities	Factors	House-holds	Enter-prises	Govt.	Taxes	Invest-ments	Rest of the world	Total
Commodities	-	13,381	73,706	-	42,650	-	18,660	-	64,338	34,264	246,999
Margins	13,381	-	-	-	-	-	-	-	-	-	13,381
Activities	165,712	-	-	-	-	-	-	-	-	-	165,712
Factors	-	-	90,794	-	-	-	-	-	-	900	91,694
Households	-	-	-	44,249	-	8,939	1,502	-	-	692	55,382
Enterprises	-	-	-	37,996	-	-	-	-	-	-	37,996
Govt.	-	-	-	-	-	5,278	-	14,620	-	9,731	29,629
Taxes	5,817	-	1,211	-	1,072	6,520	-	-	-	-	14,620
Savings	-	-	-	7,352	10,124	8,975	9,467	-	1,948	28,420	66,286
Rest of the world (RoW)	62,089	-	-	2,097	1,535	8,285	-	-	-	-	74,006
Total	246,999	13,381	165,712	91,694	55,382	37,996	29,629	14,620	66,286	74,006	-

Source: Own compilation

The estimation of the balanced prior macro-SAM slightly alters the original data of macro aggregates as shown in Table 6 below. GDP measured using the expenditure approach equals Nu. 99,771 million and deviates from the official estimates of GDP by 3.9%. The deviation is only 0.4% according to the production approach. The deviation between the expenditure and production approach based GDP estimates of the prior balanced macro-SAM is only 2.0%. In contrast, the estimates of the national accounts have a discrepancy of 6.6% (NSB, 2014).

Table 6 – GDP calculations (in Million Nu.) based on macro-SAM

Expenditure approach			Production approach		
Item	Unbalanced prior macro-SAM	Balanced prior macro-SAM	Item	Unbalanced prior macro-SAM	Balanced prior macro-SAM
Consumption	42,690	42,650	Output of activities	165,538	165,712
Gov. expenditure	18,691	18,660	Intermediate Inputs	73,587	73,706
Net exports	-27,537	-27,825	Taxes on products less subsidies	5,813	5,817
Investments	66,253	66,286			
GDP, prior macro-SAM	**100,098**	**99,771**	**GDP, prior macro-SAM**	**97,765**	**97,823**
National Accounts 2012 estimate		103,868	**National accounts 2012 estimate**		97,453

Note: Following the expenditure approach, GDP equals the sum of final uses of goods and services, less the value of imported goods and services. Following the production approach, GDP equals the difference between output and intermediate consumptions plus taxes on products less subsidies (UN, 2009).

Bhutan's macroeconomic structure can be analysed by investigating the expenditure shares (column shares) and income shares (row shares) of the balanced prior macro SAM. Analysing the column shares in Table 7, we see that the majority (67.1%) of the value of consumed commodities originates from domestic production, while imports account for 25.1%. Intermediate inputs comprise 44.5% of total output value and the average value added share accounts for 54.8%. The largest part of household expenditure is current expenditure (77.0%) and the savings rate equals 18.3%, which includes any capital expenditure of households.

Table 7 – Column shares of balanced prior 2012 macro-SAM

	Commodities	Margins	Activities	Factors	House-holds	Enter-prises	Govt.	Taxes	Invest-ments	Rest of the world	Total
Commodities		100.0%	44.5%		77.0%		63.0%		97.1%	46.3%	
Margins	5.4%										
Activities	67.1%										
Factors			54.8%							1.2%	
Households				48.3%		23.5%	5.1%			0.9%	
Enterprises				41.4%							
Govt.						13.9%		100.0%		13.1%	
Taxes	2.4%		0.7%		1.9%	17.2%					
Savings				8.0%	18.3%	23.6%	32.0%		2.9%	38.4%	
Rest of the world (RoW)	25.1%			2.3%	2.8%	21.8%					
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	

Source: Own compilation

The row shares in Table 8 show the sources of income of markets and institutions. 29.8% of commodities are used as intermediate inputs, while 17.3% and 7.6% is consumed by households and the government. Investment demand and exports make up 26.6% and 13.8%, respectively. Households receive the largest share of income directly from factors (79.9%), which mainly consists of labour returns and a small share of returns from unincorporated capital. Another 16.2% of income is derived from enterprises in form of dividends. Transfers from the government (2.7%) and rest of the world (1.3%) are small in comparison. Tax revenue makes up the largest share of government income (49.3%), while the government budget's dependency on external aid is still substantial (32.9%). Also the capital account deficit is large, roughly making up 44.0% of total investments and 38.1% total expenditure of the rest of the world (see column shares).

Table 8 – Row shares of balanced prior 2012 macro-SAM

	Commodities	Margins	Activities	Factors	House-holds	Enter-prises	Govt.	Taxes	Invest-ments	Rest of the world	Total
Commodities		5.4%	29.8%		17.3%		7.6%		26.0%	13.9%	100.0%
Margins	100.0%										100.0%
Activities	100.0%										100.0%
Factors			99.0%							1.0%	100.0%
Households				79.9%		16.1%	2.7%			1.2%	100.0%
Enterprises				100.0%							100.0%
Govt.						17.8%		49.3%		32.8%	100.0%
Taxes	39.8%		8.3%		7.3%	44.6%					100.0%
Savings				11.1%	15.3%	13.5%	14.3%		2.9%	42.9%	100.0%
Rest of the world (RoW)	83.9%			2.8%	2.1%	11.2%					100.0%
Total											

Source: Own compilation

3   Supply-Matrix

The supply matrix is a sub-matrix within a SAM that records the output *supplied* by activities valued at basic prices to the respective commodity account. Activities within the 2012 Bhutan SAM are either single- or multiple-product industries, i.e. they produce either one single or multiple outputs (a set of commodities). The output is an income for the activities account and at the same time an expenditure to the commodity accounts.

The presentation of the supply matrix is divided into three parts. First, the part of the supply matrix concerned with agriculture- and forestry-based activities and commodities is discussed. This part is discussed most extensively, given the SAM's focus on agriculture and rural livelihoods. Furthermore, a high share of this sector's output falls under home-produced home-consumed (HPHC) goods, which is taken into account by differentiating commodities accordingly. The second part describes mining, manufacturing and energy activities and commodities. Third, we discuss the part of the supply matrix dealing with services. Data sources, methods of computation and imputation as well as assumptions are carefully documented. Commodities are classified with reference to the Central Product Classification (CPC Ver. 2) codes (UN, 2008). Activities are classified using the International Standard of Industrial Classification (ISIC 3.1 revised) code (UN, 2002). The respective correspondence tables are found in the appendices A and B.

3.1   Supply of Agriculture- and Forestry-based Commodities

3.1.1   Grouping of Agricultural Crops

Farmers in Bhutan, due to the high variety in agro-ecological zones, are growing a large range of agricultural crops. Still, there is an observable pattern and dominance of some cultivated crops that often serve as either staple food or cash crops. Data on agricultural output is derived from the various agricultural surveys (MoAF, 2013a, 2014) and the 2009 renewable natural resource (RNR) census (MoAF, 2009). Appendix C reports total production and area harvested per crop as well as farm-gate prices (using 2012 data) of all crops covered in the SAM. The last column shows to which specific SAM activity the respective crop is grouped in.

3.1.2   Structure of Agriculture- and Forestry-based Activities and Commodities

Most agriculture- and forestry-based activities represented in the 2012 SAM are multi-product activities, either because they produce a HPHC and a marketed commodity, or because they produce by-products (e.g. crop residues) or because they produce a range of products in certain ratios (e.g. milk and beef).

Table 9 presents the underlying information used to compute the output value (i.e. supply measured in value) of each agriculture and forestry-based commodity. Data sources to compile the supply matrix for the agriculture- and forestry-based sectors predominantly consist of the agricultural sample surveys (ASS) 2012 (MoAF, 2013a); the livestock census (LC) 2012 (MoAF, 2013b); the renewable natural resource (RNR) census 2009 (MoAF, 2009); the national accounts (NA) for 2012 (NSB, 2014); as well as the cottage and small industry (CSI) 2013 dataset and data from corporate annual reports (referred to as *company data* in short) from agriculture and wood-based industries (MoEA, 2015b,

2015a). In a few cases, data is obtained through expert interviews (e.g. the animal feed production activity). If available, quantities measured in metric tons are reported in the second column. This allows to incorporate a quantity satellite account in a later CGE model in order to interpret model results in terms of quantity changes instead of value changes, which is otherwise only the case when prices are calibrated equal to one. Basic-prices are reported in the third column. Farm-gate prices for crops derived from the agricultural sample survey 2012 are used as a proxy for the basic price. This is reasonable, as farm-gate prices include no transportation and trade margins and as there are no production subsidies. Total national output in million Nu. is presented in the fourth column and comments are provided in a separate column.

Unfortunately, the agricultural sample survey does not include questions related to livestock ownership and output.[2] Therefore, we had to resort to the RNR census 2009[3], which included questions on animal products sold and amount of revenue earned, from which the 2008 farm-gate prices are imputed. The imputed farm–gate price for livestock products is then adjusted for the difference in inflation between 2008 and 2012.

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[2]   Separate data collection on livestock and crop indicators is owned to the organizational structure of the Ministry of Agriculture and Forests (MoAF) in Bhutan. Conducting integrated surveys that include both crop and livestock indicators would greatly improve the data quality for agricultural research purposes.

[3]   The renewable natural resource census 2009 was conducted in 2008, but is officially referred to as the RNR census 2009.

Table 9 – Computation of output value of agriculture and forestry based commodities

Commodity	Qty. produced (in metric tonnes)	Basic price (Farm gate price in Nu./kg)	Output (in million Nu.)	Data Source	Comment
Agriculture – crops					
Paddy	54,876	26.32	1,445	ASS 2012	Paddy basic price was derived from the final output value of milled rice accounting for the value of milling by-products and the milling charge.
Maize	59,993	14.86	891	Ibid.	
Other cereals and oilseeds	12,201	26.70	328	Ibid.	
Crop residues	168,680	1.00	169	Ibid.	Assumption: Price of crop residue is 1.00 Nu./kg.
Pulse	4,953	33.21	165	Ibid.	
Low-value vegetables	30,951	15.65	484	Ibid.	
High-value vegetables	9,814	60.68	596	Ibid.	
Potato	59,004	14.36	847	Ibid.	
Beverages and spices	4,569	129.78	593	Ibid.	
Agriculture – fruits and nuts					
Other nuts and fruit	16,888	21.31	360	Ibid.	
Apples	6,905	33.39	231	Ibid.	
Citrus fruits	41,809	19.93	833	Ibid.	
Agriculture – livestock					
Milk	29,625	30.68	909	LC 2012, RNR 2009	
Beef	620	121.13	75	Ibid.	
Manure	193,830	1.01	195	LC 2012, RNR 2009	Assuming a 68% dry matter content per ton. See sub-section on manure.
Live animals			187	RNR 2009	See sub-section on live animals.
Bullock draught power			281	LC 2012, RNR 2009	See sub-section on bullock draught power.
Chicken meat	909	159.48	145	Ibid.	
Eggs	2,901	136.24	395	Ibid.	
Other animal meat and products	1,337	120.85	162	Ibid.	

Commodity	Qty. produced (in metric tonnes)	Basic price (Farm gate price in Nu./kg)	Output (in million Nu.)	Data Source	Comment
Milled cereals					
Milled rice	31,230	51.37	1,604	ASS 2012; NSB (2015b) SUT 2007	Basic price is estimated by taking the simple mean 2012 annual national price of the three main rice varieties and subtracting the SUT 2007 8.82% trade and transport margin for cereals.
Milled other cereals	2,789	48.29	135	ASS 2012	
Food manufacturing					
Dairy products	8,664	202.43	1,754	LC 2012 BLSS 2012; RNR 2009	Basic price estimated using BLSS 2012 data and SUT 2007 margins.
Processed rice	3,574	67.77	242	ASS 2012	
Processed maize	1,775	69.11	123	ASS 2012	
Other grain mill products			496	BLSS 2012; SUT 2007	Calculated as the residual of total output of grain mill production minus processed rice, maize, vegetable oils and animal feed.
Vegetable oils	674	77.16	52	BLSS 2012, SUT 2007	Basic price estimated using the unit price from the BLSS 2012 and subtracting the SUT 2007 transport margin for grain mill products of 15%: Consumed domestic quantity reported by BLSS as a proxy for total production.
Ara	15,913	34.67	552	BLSS 2012	Multiplying up-scaled household consumption of ara times average unit price as recorded by BLSS 2012 data.
Animal feed	19,462	20.59	401	MoEA, 2015a; SUT 2007	Imputed total animal feed production assuming that Karma Feed represents 90% of total domestic feed production. Total production is multiplied with mean sales price of 2013 after adjustment for inflation and trade and transport margin as reported by SUT 2007.
Processed fruits and vegetables			449	MoEA, 2015a, 2015b; CSI 2013	Revenue of the three largest agro-processing companies plus sales of processed fruits and vegetables of small and cottage industries.
Non-alcoholic beverages			457	MoEA, 2015a; CSI 2013	Revenue of the two largest bottling companies plus sales of beverages of small and cottage industries.
Alcoholic beverages and tobacco			913	Company data	Revenue of the only large-scale brewery and the state-owned distillery plus sales of alcoholic beverages of small and cottage industries excluding sales tax and excise duty.

Commodity	Qty. produced (in metric tonnes)	Basic price (Farm gate price in Nu./kg)	Output (in million Nu.)	Data Source	Comment
Forestry					
Logs (in m3)	216,784	4,781.58 (Nu/m3)	1,036	van Noord, 2010 and NRDCL, 2012	Production of logs (in m3) is estimated using average rural construction timber from 2005-07 (van Noord, 2010) and commercial logs extraction by NRDCL in 2012. Basic price is derived from NRDCL, 2012.
Firewood (in m3)	946,949	539.35 (Nu/m3)	511	BLSS 2012 and NRDCL, 2012	Quantity of firewood consumed is estimated from BLSS 2012 consumption data, wood chips consumption and estimated institutional demand (10% of household consumption). Price is a weighted average of firewood and wood chip prices.
Non-wood forest products			157	RNR 2009 Census; MoEA, 2013	Estimated using RNR 2009 production data of NWFP and export value of cordyceps assuming a transport and trade margin of 25%.
Wood-based industries					
Products of wood and cork			772	Corporate annual reports 2012; CSI 2013	Revenue of the only large-scale wood-based industry (Bhutan Boards industry) plus sales of small and cottage industries such as sawmills.
Paper products			379	Corporate annual reports 2012; CSI 2013	Assuming that revenue of the largest media and print company (Kuensel) represents 50% of sector output.
Furniture			414	Corporate annual reports 2012; CSI 2013	Revenue of the largest wood-based industry (Wood Craft Centre) plus sales of small and cottage industries (e.g. furniture units).

Source: Own compilation

3.1.3 Adjustment of Output for HPHC

In Bhutan, farmers consume a considerable share of their own production themselves, which is referred to as home-production-home-consumption (HPHC). HPHC also applies for raw materials which the farmers produced themselves and then use on their farm as intermediate inputs for milling, animal feeding or production of ara (the Bhutanese traditional home-brewed alcohol). In these cases, goods should not be valued at purchasing prices, as it is the case for goods consumed by non-farm households and enterprises. The significant difference is that the price of HPHC goods equals the basic price of output, while the purchasing price includes the mark-up for trade and transport margins as well as sales and VAT taxes. Depending on infrastructure and the value chain characteristics, differences in prices can be substantial. Hence, the consumption of HPHC goods by farm households would be significantly overstated if valued at purchasing prices. In order to avoid this mis-representation, the 2012 SAM for Bhutan disaggregates the major HPHC goods into the two channels: HPHC goods (denoted by the prefix ch* e.g. chmaize) or marketed goods (denoted by the prefix cm* e.g. cmmaize).

The BLSS 2012 included the question whether food consumption is from own source (i.e. HPHC) or bought on the market, here it is differentiated again whether the food is domestically produced or imported. Using this information, shares of HPHC are derived for a wide range of food commodities as presented in Table 10.

Table 10 – Home-production home-consumption (HPHC) shares

Commodity	Total Domestic Supply	Total HPHC	% HPHC share	% intermediate demand	% final household demand
	(in Million Nu.)	(in Million Nu.)	of total domestic supply	of total HPHC	of total HPHC
Paddy	*See Milled domestic rice*				
Maize	891	708	79.5%	50.2%	49.8%
Other cereals and oilseeds	328	258	78.6%	80.3%	19.7%
Pulse	165	62	37.7%	17.8%	82.2%
Low-value vegetables	484	155	32.1%	21.1%	78.9%
High-value vegetables	596	147	24.8%	10.7%	89.3%
Potato	847	235	27.8%	57.6%	42.4%
Beverages and spices	593	42	7.0%	76.1%	23.9%
Other nuts and fruits	374	68	18.3%	5.3%	94.7%
Apple	231	26	11.1%	5.8%	94.2%
Citrus	891	75	8.4%	8.7%	91.3%
Milk	909	752	82.7%	96.2%	3.8%
Beef	75	42	56.4%	0.0%	100.0%
Chicken meat	145	22	15.1%	0.0%	100.0%
Eggs	395	70	17.7%	0.0%	100.0%
Other animal products and meat	162	29	18.1%	0.0%	100.0%
Milled domestic rice	1,604	924	57.6%	6.6%	93.4%
Milled Other Cereals	135	58	42.8%	22.1%	77.9%
Dairy Products	1,754	671	38.2%	0.0%	100.0%
Processed Rice	242	85	35.1%	1.7%	98.3%
Processed Maize	123	52	42.2%	0.0%	100.0%
Ara	552	384	69.7%	0.0%	100.0%

Source: Own compilation

The data is adjusted to reflect only HPHC of farm households. Non-farm households also report home consumption of home-produced goods in the BLSS 2012, which can have manifold explanations. It is known that through sharecropping non-farm households receive a share of the harvest which they might report as HPHC. Further, non-farm households produce agricultural goods for example from kitchen gardens, which is then largely a HPHC good. In general, the share HPHC of total consumption from non-farm households can be regarded as negligible and thus only the share of HPHC of total consumption of farm-households is considered. Further, also the farm output that is processed or consumed as an intermediate input on the farm, e.g. fed to animals, is considered as a HPHC good. This differentiation for intermediate input is also reflected within the use-matrix. On-farm and thus mostly small-scale processing activities use the HPHC good. In contrast, large-scale industrial processing activities consume the marketed commodity.

In Table 11 below, a snapshot of the HPHC adjusted supply matrix including the first five agricultural commodities is presented.

Table 11 – Snapshot of the HPHC adjusted supply matrix

Output in million Nu.								
	Chpaddy	chmaize	cmmaize	chcereals	cmcereals	chpulse	cmpulse	cfodder	Total
apaddy	1,445	-	-	-	-	-	-	-	1,445
amaize	-	654	183	-	-	-	-	54	891
aothcereals	-	-	-	238	70	-	-	19	328
apulse	-	-	-	-	-	62	102	-	165

Output shares in % of total output								
	chpaddy	chmaize	cmmaize	chcereals	cmcereals	chpulse	cmpulse	cfodder	Total
apaddy	100.0%								100.0%
amaize		68.6%	20.5%					10.9%	100.0%
aothcereals				74.9%	21.4%			3.7%	100.0%
apulse						37.7%	62.3%		100.0%

Source: Own compilation

Table 11 also shows that the share of crop output fed to animals is accounted within a separate fodder commodity (cfodder). That commodity is simply an aggregation of all crops fed to animals and also represents an HPHC commodity.

3.1.4   Supply of Agricultural Inputs

There is no agrochemical industry in Bhutan. Other agricultural inputs that are used as intermediate inputs are manure, live animals and bullock draught power. The estimation of the supply value of these inputs is described in the following.

Manure

The most recent statistic on the applied quantity of manure is from the RNR census 2009, according to which farmers use 1.47 tons of manure on average. This only relates to manually spread manure, not including manure droppings on cropland that originate from animals being tethered on cropland (i.e.

in-situ manuring), which is a common practice in Bhutan. An average manure consumption of 1.47 tons translates to just 1.1 tons /hectare, which seem to be a very low estimate as more than 60% of farmers only rely on manure as their source of fertilizer. Assuming that in 2012 the average utilization of manure per farmer is identical, we arrive at a total estimated manure quantity of 93,529 tons for 2012. In the following, due to the reasons provided, we use this imputed quantity as a lower bound estimate.

An alternative approach of estimating the applied quantity of manure is a top-down approach using the livestock population data from the 2012 Livestock Census. Following this approach, we convert animal populations into livestock units (LU) using conversion factors from Wangchuk and Dorji (2008). LUs are multiplied with daily manure production and recovery rates derived from available literature. Doing so allows estimating the output of manure per livestock activity by computing the relative contribution of each livestock type.

As a first step, the dry matter manure production for each livestock type (cattle, poultry, goat, sheep and pigs) is estimated using values on animal size, daily manure production and water content from Moore and Gamroth (1982). Based on these values, cattle produce 3.2 kg of dry matter (DM) manure per day and livestock unit. DM manure production for other animals is in the range of 1.8 to 4.5 kg depending on the livestock type. As a second step, the share of total manure available as nutrients brought on cropland is determined for each livestock type. Samdup *et al.* (2010) found that improved and local cattle[4] spent 27% and 33% of the day on pasture land, resulting in the assumption that during the remaining time manure is deposited on the cropland. Hence, we assume an availability of 73% and 67% for improved and local cattle. For other animals we assume an availability of 50%, yet they play a minor role, as cattle represents the majority (94.8%) of total livestock units. This yields a total quantity of applied manure of 227,264 tons, which can serve as an upper boundary. The largest share of manure originates from cattle (95.8%), while 2.4% and 1.7% of manure comes from other animals and poultry, respectively.

The final estimated amount of manually applied manure is the average of both the lower and upper boundary estimate, which equals 160,396 tons. The tethered amount of manure is assumed to equal half of the difference of the upper boundary estimate and final estimate of manually applied manure, which equals 33,433 tons. Hence, total applied manure is estimated to equal 193,830 tons of manure.

The monetary value of manually applied manure can be approximated by determining its NPK content and multiplying the individual content by observable market prices of fertilizer. We have to account for the fact that farmers do not value the identical nutrient content in organic fertilizer the same as they do in case of chemical fertilizer due to reasons of storability, timing of nutrient release and handling amongst others. To account for this, we simply assume a 50% discount to impute the nutrient value of manure.

Long-term experiments on manure in Bhutan have determined a dry matter content of 68% and nutrient contents of 1.6% Nitrogen (N), 0.8% Phosphorus (P) and 2.9% Potassium (K) of dry matter manure (Chettri *et al.*, 2003). These experiments have been conducted with a sample of farmers that used heap-storage methods. Adjusting for the DM content, one ton of manure thus contains 10.9 kg N,

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4   An improved cattle breed in Bhutan is predominantly a Jersey cattle, but occasionally Brown Swiss cattle are found. The predominant local breeds are Nublang, Mithun and Jatsa, which is a cross between the two former ones.

5.4 kg P and 19.7 kg K. Using prices of commercially available fertilizer published by the MoAF for 2013, adjusting for inflation and converting prices for each chemical element of NPK, we arrive at market prices of 27.81 Nu./kg for N, 150.34 Nu./kg for P and 45.46 Nu./kg for K. Considering the previously justified discounts, the average price of one kg of manure is 1.01 Nu./kg and we arrive at a total value of Nu. 195 million of which manually applied manure and tethered manure comprise 83% and 17%, respectively.

Live animals

The RNR 2009 census includes information on live animals sold of each livestock type. For simplicity reasons, all live animals are grouped together into one commodity account. In total, live animals being worth Nu. 187 Million are sold, of which sold cattle made up 81.1%, other animals 16.6% and poultry 2.3%.

Bullock Draught Power

According to the RNR 2009 census, 78.9% of farmers relied on bullocks to plough their land. The value of bullock draught power can be decomposed into the capital cost of a bullock and the cost of feed, i.e. fodder (mainly crop residues) and compound feed. The initial cost of a bullock is Nu. 12,000 for a local breed and Nu. 10,000 for an improved breed. In the RNR 2009 census it is not differentiated which breed farmers use for ploughing. However, it is a well-known fact that pre-dominantly local breeds are used for ploughing, as they are known to be more robust and powerful. Improved male cattle are rather needed for breeding purposes. Local male cattle account for 88% of the total male cattle population in Bhutan and since the difference in initial cost is small, we only use available data on the local breed to impute the cost of bullock draught power.

The economic life expectancy of a local breed is 10 years, but it is reasonable to assume that a bullock can only be used for ploughing over a span of 7 years. Using a 10% discount rate, we arrive at an estimated annualized capital cost of Nu. 1,953. It is further estimated that the annual cost of fodder per bullock corresponds to 2,460 Nu./yr. On days in which the bullock is used to plough, it is assumed that in addition to fodder compound feed is fed to bullocks. Usage levels of compound feed in Bhutan are very low and thus we assume that per bullock only 12 kg of compound feed per year is fed on average, resulting into an annual consumption value of Nu. 246 per bullock.

Adjusting the RNR 2009 census to 2012 levels, the number of bullocks used for ploughing in 2012 is estimated to be 54,252 animals. This yields a total capital cost of bullocks of Nu. 134 Million. After accounting for the cost of fodder (Nu. 133 million) and compound feed (Nu. 13 million), we arrive at a total value of bullock draught power of Nu. 280 Million.

3.1.5   Forestry

Forestry policies in Bhutan separate the timber markets strictly between rural and urban regions. Further, productive management of forests is separated into commercial management of forests (i.e. commercial forestry, which is discussed subsequently) and forests accessed or managed by rural communities (Feuerbacher *et al.*, 2016).

Community Forestry

Generally, rural households are allowed to extract logs and firewood from the surrounding forests for their own needs. The annual consumption quota is regulated by the forest and nature conservation rules 2006 (RGoB, 2006), which allows households depending on whether they have access to electricity to harvest either 8 or 16m^3 of firewood annually. Logs used for own construction or renovation purposes can also be harvested from rural households directly on a standing-tree basis through forestry officers or supplied on a subsidized rate through the NRDCL. In case of forests explicitly designated as community forests, a management plan regulates the annual harvest limit. If the quantity harvested for the participants remains below the annual harvest limit, households are allowed to sell the remaining quantity of non-wood forest products and timber on the market. Community forests are an increasing forest governance scheme found in Bhutan, however the area under community forest regime still only accounted for 2.5% of total forest area in 2014 (MoAF, 2015). Data on total extracted rural timber for construction purposes (logs) is provided by van Noord (2010) for the years 2005 to 2007. More recent data is not available and thus the average of these three years, 147,095 m^3, is used as a proxy. Data on timber harvested by rural households is hardly available. The BLSS 2012 data set reports consumption of firewood in truck- and backloads, which are measures for 8 m^3 or 43 kg, respectively. The consumption reported in backloads of rural households serves as an estimate for the quantity of firewood collected and equals 638,403 m^3. Firewood consumption reported in terms of truckloads is assumed to be supplied by the commercial forestry sector.

Data on non-wood forest products (NWFP) is reported by the RNR 2009 census. Non-wood forest products collect by rural people include a large variety of products such as bamboo shoots, mushrooms, lemon grass and medicinal plants. The most important non-wood forest product, which in most cases is found on high-altitude land with little or no forest cover, is cordyceps. Cordyceps are highly demanded in East-Asia and fetch export prices of 517,403 Nu./kg (9,689 USD/kg) (MoF, 2013c). In 2012, 196.35 kg of cordyceps worth Nu. 102 million are exported (MoF, 2013). It is assumed, that the farmgate price of cordyceps makes up 75% of the FOB export price, with the remaining 25% accounting for trade and transport margin. Thus, total estimate output value of cordyceps is estimated to be Nu. 76 Million in 2012. Value of the remaining non-wood forest products is estimated to be Nu. 81 Million in 2012, using the RNR 2009 census data and after having adjusted for inflation. Total estimated value of NWFPs sums to Nu. 157 Million in 2012.

Commercial Forestry

Commercial logs and firewood are extracted by the Natural Resource Development Corporation Limited (NRDCL), which is a state-owned enterprise that is in charge of sustainably utilizing and managing natural resources such as forests, stone and sand (NRDCL, 2013). They operate forest management units and annual production statistics is available from annual reports.

In 2012, NRDCL reported to have extracted 69,689 m3 of commercial logs being worth Nu. 294 Million. Besides the NRDCL, there are contractors that receive the mandate to extract logs and tops that are not suitable for prime timber and are instead used as firewood or wood chips.

No information on the quantity of firewood supplied by contractors is available, yet as both total quantity of firewood consumed and collected by rural households has been estimated previously, we

compute total commercial extraction of firewood as a residual being equal to 201,182 m³. This, however, would not include the consumption of firewood by other institutions than households, such as monasteries and government buildings as well as the consumption of firewood by industries. The NRDCL has supplied 23,406 m³ wood chips to mostly ferro-alloy industries worth Nu. 37 million. We assume an additional institutional demand equal to 10% of total household demand, which amounts to 83,958 m³ or a value of Nu. 43 million if valued at average firewood prices. The total firewood supply by commercial forestry thus amounts to 308,546 m3. The NRDCL reported to have supplied only 4,478 truckloads of firewood equivalent to 35,824 m3 (NRDCL, 2013) as well as the 23,406 m³ of wood chips. Thus the remainder of 249,316 m³ is estimated to be supplied by contractors only.

In Table 12 the output of both NRDCL and contractors for timber, wood chips and firewood is presented. Wood chips are a component of the firewood commodity within the SAM and they are predominantly consumed by mineral industries in the South.

Table 12 – Supply of timber and firewood from commercial forestry

Supplier	Commodity	Supply in m³	Supply in million Nu.	In % of total output
NRDCL	Timber	69,689	333	64.5%
NRDCL	Wood Chips	23,406	37	7.1%
NRDCL	Firewood	35,824	18	3.6%
Contractors	Firewood	249,316	128	24.8%
Total Timber		**69,689**	**333**	**64.5%**
Total Firewood (including woodchips)		**308,546**	**183**	**35.5%**
Total Output		**378,235**	**516**	**100.0%**

Source: Own compilation based on prior 2012 macro-SAM

3.2   Mining, Manufacturing and Energy Commodities

Data sources to compile the supply matrix for the mining, manufacturing and energy outputs are largely based on aggregate gross output for activities reported in the national accounts 2012; the 2007 SUT (ADB and NSB, 2013b); the medium and large industry (MLI) 2012 dataset (MoEA, 2015c) and information from various corporate annual reports provided by MoEA. Except for cottage and small industries such as textile manufacturing, industries in Bhutan are structured relatively simple, because they are dominated by few and large companies. Information contained in corporate annual reports is used to estimate total output for a large part of activities. In a few cases in which data from national accounts or corporate annual reports is insufficient, the respective sector's share in total output as reported in the 2007 is multiplied by the 2012 total output as reported by national account data. This approach of course implies that the sector's share in output in 2007 has not changed in relative terms over the years. The output value and the corresponding data sources of the mining, manufacturing and energy commodities is presented in Table 13.

Table 13 – Output value of mining, manufacturing and energy commodities (in Million Nu.)

Commodity	Output (in Million Nu.)	Data Source	Comment
Mining			
Coal	516	Corporate annual reports 2012;	Sale of coal as reported by the Eastern Bhutan Coal Corporation in their annual report.
Other minerals	2,159	National accounts 2012	Subtracting coal output of total mining gross output of mining sector as reported by NSB, 2014.
Manufacturing			
Clothing and wearing apparel	1,656	National Accounts 2012; SUT 2007	Estimated using the SUT 2007 output share (assuming constant shares over time) and total gross output of manufacturing from national accounts 2012
Basic chemicals	2,082	MLI 2013	
Rubber and plastics	1,182	MLI 2013	
Glass and glass products	3,117	National Accounts 2015;	Output by major sectors as provided by National Account department, NSB
Basic iron and steel	7,331	Corporate annual reports 2012	Total revenue of the major six ferro-alloy industries in Bhutan
Casted iron and steel, and non-ferrous metals	4,817	Corporate annual reports 2012	Total revenue of the major seven steel industries in Bhutan
Fabricated metal products, except machinery and equipment;	1,116	National Accounts 2012; SUT 2007	Estimated using the SUT 2007 output share (assuming constant shares over time) and total gross output of manufacturing from national accounts 2012
Electrical machinery and apparatus	1,075	National Accounts 2012; SUT 2007	Estimated using the SUT 2007 output share (assuming constant shares over time) and total gross output of manufacturing from national accounts 2012
Manufactured goods n.e.c.	257	Corporate annual reports 2012; CSI 2013; MLI 2012	
Energy and utilities			
Wholesale electricity	10,291	DGPC, 2013; BPC, 2013	Value of total electricity exports and electricity sold domestically by DGPC to BPC in 2012
Low-voltage (LV) electricity	563	Corporate annual reports 2012	Electricity sales to domestic LV customers valued at real average power tariffs (BPC, 2013)
High- and medium voltage electricity	2,533	Corporate annual reports 2012	Electricity sales to HV and MV customers valued at real average power tariffs (BPC, 2013)
Transmission of electricity	548	Corporate annual reports 2012	Revenue from export wheeling charges (BPC, 2013)
Water	39	National Accounts 2012; SUT 2007	Estimated using the SUT 2007 output share (assuming constant shares over time) and total gross output of manufacturing from national accounts 2012

Source: Own compilation

3.3 Service Commodities

Output of services is largely dependent on gross output data reported by national accounts and shares of output derived from the 2007 SUT. We disaggregate the gross-output of the aggregated sector *transport, storage and communication* into the following four commodities: (1) land transport services; (2) air transport services; (3) Supporting and auxiliary transport services; and (4) Post and telecommunication services. As Bhutan has a very small air-transportation sector, output for this sector adjusted using the annual financial data of the state-owned airline Drukair (DHI, 2013, 2014). Output of land transport services and supporting and auxiliary transport services are estimated by

multiplying the gross value added data from the national accounts 2012 with gross value added/output ratios derived from the 2007 SUT. Finally, the output of the post and telecommunication services is imputed as a residual. Output values of public administration, education and health are estimated using the output shares derived from the 2007 SUT in total gross output value as reported in the national account statistics 2012. Table 14 presents the output value and the underlying data sources of all services.

Table 14 – Output value of services (in Million Nu.)

Commodity	Output In Million Nu.	Data Source	Comment
Construction services	44,855	NA 2012	
Wholesale and retail trade services	9,421	NA 2012; SUT 2007	Estimated using the SUT 2007 output share (assuming constant shares over time) and total gross output of wholesale and retail trade from NA 2012
Lodging, food and beverages	2,413	NA 2012	
Land transport services	11,708	NA 2012; SUT 2007	Gross value added (GVA) for sector is reported in NA 2012; the sector's output is estimated using the SUT's gross value added/output ratio times the total GVA reported for 2012
Air transport services	2,761	Corporate annual reports 2012;	Revenue of Druk Air Corporation in 2012 (reported in DHI 2012 and 2012 annual reports);
Supporting and auxiliary transport services	1,373	NA 2012; SUT 2007	Gross value added (GVA) as in NA 2012; the sector's output is estimated using the SUT's gross value added/output ratio times the total GVA reported for 2012
Post and telecommunication services	3,142	NA 2012;	Residual of total gross output of transport, storage & communication as reported in NA 2012 minus output of transportation services (land + air) as well as supporting and auxiliary transport services.
Financial intermediation services	4,097	NA 2012; SUT 2007	
Insurance and pension services	1,922	NA 2012; SUT 2007	
Real estate services	2,068	NA 2012;	
Business services	382	NA 2012; SUT 2007	Estimated using the SUT 2007 output share of total gross output of wholesale and retail trade from NA 2012
Public administration services	11,954	NA 2012; SUT 2007	
Education services	3,483	NA 2012; SUT 2007	Estimated using the SUT 2007 output share of total gross output of community, social & personal services from NA 2012
Health and social services	2,793	NA 2012; SUT 2007	
Other services	651	NA 2012	

Source: Own compilation

3.4 Import and Export of Goods

In 2012, Bhutan imported goods worth about Nu. 52,366 Million of which 20.7% and 79.3% originated from countries other than India (COTI) and India, respectively (MoF, 2013c). On the contrary, goods worth about Nu. 28,261 Million are exported, of which only 6.3% came from COTI and the remainder of 93.7% is exported to India. These numbers show, that India is Bhutan's most

important trade partner by far. This is not only due to the geographic proximity, but also to the free-trade agreement between both countries. Bhutan has preferential trade agreements with many other countries, for instance Bangladesh. Also, Bhutan levies import duties on most imports from countries other than India. Data of exports and imports of goods conducted in 2012 is taken from the UN COMTRADE (UN, 2015a) database. This data is reported in HS 2007 classification code, which by using a HS 2007 – CPC v2 correspondence table can be mapped to the SAM's account structure. Imports and exports of goods as well as the import intensity and export share is presented in Table 15 below. Import intensity is measured as the share of imports valued at purchaser prices of total domestic demand. The export share is the share of exports of total domestic output measured in purchaser prices. Please note that goods that are differentiated by HPHC are aggregated in the Table 15 below.

Table 15 – Import and exports of goods in 2012 (in Million Nu.)

Commodity	Imports				Exports			
	COTI	India	Total	Import intensity	COTI	India	Total	Export share
Paddy	-	-	-	0.0%	-	-	-	0.0%
Maize	0	27	27	4.7%	-	-	-	0.0%
Other Cereals and Oilseeds	7	202	209	41.0%	0	1	1	0.3%
Pulse	2	198	200	55.9%	-	9	9	5.2%
Crop Residues	-	-	-	0.0%	-	-	-	0.0%
Low-value vegetables	0	102	102	22.2%	1	21	22	4.8%
High-value vegetables	0	71	72	11.6%	6	2	8	1.0%
Potato	-	61	61	10.0%	0	309	310	32.2%
Beverages and spices	2	81	84	22.8%	259	204	463	50.5%
Other Nuts and Fruits	120	56	175	39.0%	6	32	38	8.2%
Apple	-	4	4	2.0%	19	31	49	15.7%
Citrus fruits	0	8	8	1.5%	420	33	453	31.6%
Milk	-	-	-	0.0%	-	-	-	0.0%
Beef	3	434	437	88.4%	-	-	-	0.0%
Live Animals	8	14	22	11.5%	-	0	0	0.0%
Chicken Meat	0	73	74	34.2%	-	-	-	0.0%
Eggs	-	-	-	0.0%	-	-	-	0.0%
Other animal meat and products	6	302	308	67.2%	0	-	0	0.0%
Fish	6	241	247	100.0%	-	-	-	No domestic prod.
Milled rice	0	1,254	1,254	46.4%	6	0	6	0.4%
Milled other cereals	1	365	366	78.8%	1	29	30	20.1%
Dairy Products	1	369	370	18.1%	0	-	0	0.0%
Processed milk	3	577	579	100.0%	-	-	-	No domestic prod.
Processed rice	-	-	-	0.0%	-	-	-	0.0%
Processed maize	-	-	-	0.0%	-	-	-	0.0%
Other grain mill products	90	1,210	1,301	82.3%	22	194	215	36.9%
Vegetable oils	18	907	925	95.6%	-	8	8	13.2%
Animal feed	0	50	50	11.3%	-	8	8	1.8%
Processed fruits and vegetables	70	164	233	38.4%	1	72	73	13.0%
Alcoholic beverages and tobacco	57	341	398	27.4%	-	80	80	3.9%
Ara	-	-	-	0.0%	-	-	-	0.0%
Non-alcoholic beverages	6	0	6	2.1%	15	106	121	20.2%
Wood Chips / Firewood	-	3	3	0.8%	-	1	1	0.1%
Logs	0	125	125	10.8%	0	0	0	0.0%
Non-wood forest products	0	7	7	12.5%	102	2	104	64.0%
Products of wood, cork, etc.	14	235	249	33.0%	1	250	250	29.3%
Paper products	39	707	747	68.4%	0	20	20	4.8%

Commodity	Imports				Exports			
	COTI	India	Total	Import intensity	COTI	India	Total	Export share
Furniture	56	153	209	36.8%	1	14	15	3.0%
Coal and natural gas	16	788	804	72.7%	55	170	225	38.4%
Other Minerals	120	596	716	49.0%	454	1,298	1,752	66.3%
Clothing and wearing apparel; leather and leather products	198	765	963	39.3%	0	26	27	1.3%
Other transportabe goods	57	92	150	100.0%	-	0	0	No domestic prod.
Basic chemicals	532	1,743	2,276	92.6%	3	1,658	1,662	74.1%
Fertilizer	-	60	60	100.0%	-	-	-	No domestic prod.
Pesticides	12	35	47	100.0%	-	-	-	No domestic prod.
Charcoal	0	895	895	100.0%	0	-	0	No domestic prod.
Rubber and plastics products	173	1,487	1,660	68.5%	0	316	316	24.6%
Glass and glass products and other non-metallic products n.e.c.	200	2,068	2,268	57.7%	0	1,556	1,556	44.8%
Basic iron and steel	-	80	80	6.1%	418	6,410	6,827	80.6%
Basic metal	6	3,696	3,702	100.0%	-	-	-	No domestic prod.
Casted iron and steel, and non-ferrous metals	2,117	3,291	5,409	83.3%	1	4,310	4,311	77.1%
Fabricated metal products, except machinery and equipment	774	2,165	2,939	72.9%	3	0	3	0.2%
Electrical machinery and apparatus	851	1,733	2,584	71.4%	-	-	-	0.0%
Office, accounting and computing machinery	317	173	490	100.0%	-	-	-	No domestic prod.
Radio, television and communication equipment	577	231	808	100.0%	-	-	-	No domestic prod.
Medical appliances, precision and optical instruments	170	223	393	100.0%	-	-	-	No domestic prod.
Transport equipment	687	1,734	2,422	100.0%	-	-	-	No domestic prod.
General and special purpose machinery	3,508	2,425	5,933	100.0%	-	-	-	No domestic prod.
Manufactured goods n.e.c.	18	750	768	77.7%	-	43	43	14.9%
Coke	-	941	941	100.0%	-	-	-	No domestic prod.
Fuel oil, natural gas, fuels n.e.c.	-	645	645	100.0%	-	-	-	No domestic prod.
Gasoline and kerosene	-	1,831	1,831	100.0%	-	-	-	No domestic prod.
Diesel	-	4,719	4,719	100.0%	-	-	-	No domestic prod.
Wholesale electricity	-	13	13	1.1%	-	9,132	9,132	88.7%
LV electricity	-	-	-	0.0%	-	-	-	0.0%
HV electricity	-	-	-	0.0%	-	-	-	0.0%
Electricity transmission services	-	-	-	0.0%	-	-	-	0.0%
Water	-	-	-	0.0%	-	-	-	0.0%
TOTAL	**10,845**	**41,522**	**52,366**		**1,791**	**26,348**	**28,261**	

Source: Own compilation based on prior 2012 micro-SAM and UN, 2015a

3.5   Import and Export of Services

In 2012, Bhutan imported services worth Nu. 10,153 Million, of which 45% and 55% are imported from India and COTI, respectively (RMA, 2013, 2014). In general, data on trade of services is of significant lower quality than trade of goods. The UN ServiceTrade database (UN, 2015b) compiles trade data on services using the Extended Balance of Payments Services (EBOPS) classification code (UN, 2010). Some of the reported EBOPS categories can be mapped to CPC v2 codes, which also is presented in Appendix D. However, the categories of business and personal travel cannot entirely be mapped to CPC. We argue that travellers consume a wide range of goods and services, most

commonly comprising accommodation, food, beverages and transport as identified by the Manual on Statistics of International Trade in Services 2010 (UN, 2012). Purchases of gifts, souvenirs and other articles are also included, while valuables such as jewellery, consumer durable goods and any other items exceeding custom thresholds are not included (UN, 2012).

Table 16 presents the import of services in 2012 according to SAM accounts. The data on import of personal travel services are reported in more detail, by differentiating them between health-related, education-related and other travel services. For the import of personal travel services, the health-related share is thus directly mapped to the health services account and the education-related share to the education service account. The remaining shares of personal and business travel services, for which no further details are provided, are distributed among the SAM commodity accounts in the following way: 15% to supporting and auxiliary transport services, 30% to the lodging, food and beverage serving account; 20% to the land transportation service account; 15% to the air transportation service account and 20% to the public administration services account. These assumptions do not consider expenditures on gifts, souvenirs and other articles which of course does not reflect reality but prevents us from making further assumptions of what kind of goods are actually purchased. Further, it is reasonable to assume that travel agency fees and margins, accommodation, food, transportation and public administration (for visa fees, permits, etc.) represent the largest expenditure items for travellers. The export of travel services, whether personal or business, is not differentiated in more detail. Both, exported business and personal travel services are distributed in the same way as proposed for the import of these service, described above.

Table 16 – Import of services in 2012 according to SAM accounts (in Million Nu.)

	Import in million Nu.	Import intensity	Export in million Nu.	Export share
Construction services	2,806	5.9%	-	0.0%
Wholesale and retail trade services	172	1.9%	-	0.0%
Lodging; food and beverage serving services	462	29.1%	1391	53.3%
Land transport services	2325	17.7%	927	7.9%
Air transport services	454	64.6%	2512	91.0%
Supporting and auxiliary transport services	154	18.5%	695	50.6%
Post and telecommunication services	138	4.3%	49	1.6%
Financial intermediation services	18	0.4%	5	0.1%
Insurance and pension services	219	11.4%	214	11.1%
Real estate & dwellings	0	0.0%	0	0.0%
Business Services	786	63.6%	0	0.0%
Public administration services	308	2.7%	927	7.8%
Education services	1716	33.0%	-	0.0%
Health and social services	228	7.5%	-	0.0%
Other services, n.e.c	335	18.1%	116	7.1%
TOTAL Trade in 2012- WORLD	**10,121**		**6,836**	

Source: Own compilation based on UN, 2015b

4 Use-Matrix

The use-matrix contains the information on each activities' expenditure for intermediate inputs, recording the transactions between activity (column) and commodity (row) accounts. These transactions are either measured in purchaser prices if the purchased intermediate input originates from outside the production system or measured in basic prices (i.e. farmgate prices) if the origin lies within the production system. The latter is for example the case for retained seed, bullock draught power and manure for crop production and crop residues and fodder crops for livestock production. The following chapter describes the compilation of the use matrix in detail.

4.1 Agricultural Activities

There are sixteen agricultural production activities that can be differentiated into crop and livestock producing activities (Table 17).

Table 17 – Classification of agricultural activities

Activity Name	Output:	ISIC (3.1. rev) activity
Paddy production	Paddy, crop residues	0111
Maize production	Maize, crop residues	0111
Other cereals and oilseeds prod.	Other cereals and oilseeds, crop residues	0111
Pulses prod.	Pulses, crop residues	0111
Low-value vegetables prod.	Low-value vegetables	0112
High-value vegetables	High-value vegetables	0112
Potato prod.	Potato	0112
Beverages and spices	Beverage and spices	0112, 0113
Other nuts and fruits	Other nuts and fruits	0113
Apple	Apples	0113
Citrus	Citrus fruits	0113
Cattle husbandry	Milk, beef, manure, bullock draught power	0140
Poultry husbandry	Chicken meat, eggs, manure	0140
Other animals husbandry	Other animal meat, manure	0140

The use matrix of agricultural activities is presented in Figure 3. Crop producing activities are similar in their requirement for intermediate inputs such as seeds, manure, bullock draught power, pesticides and fertilizers. Some inputs for crop and livestock activities are directly available from the farm (i.e. "on farm inputs"). For crops, this includes seed, manure and draught animal services as highlighted with an "X" in quadrant I. For livestock this includes crop residues and fodder crops as recorded in quadrant II. Quadrant III records the expenditure of cropping activities on marketed inputs such as diesel (used for agricultural machinery), chemical fertilizer and pesticides. Quadrant IV comprises the marketed inputs of livestock activities such as compound animal feed and salt. The methods, data sources and necessary assumptions to derive the column shares for the agricultural activities' intermediate inputs are presented in the subsequent sections.

Figure 3 – Schematic representation of use matrix of agricultural activities

#	Commodity	Paddy prod.	..	Potato prod.	..	Bev. and spices prod.	..	Apple prod	..	Cattle	Poultry	Other animals
1	Paddy	X										
2	Maize											
3	Other cereals and oilseeds											
4	Pulses											
5	Crop residues									X	X	X
6	Crop fodder									X	X	X
7	Low-value vegetables											
8	High-value vegetables											
9	Potato			X								
10	Beverages and spices					X						
11	Other nuts and fruits											
12	Apple			Quadrant I							Quadrant II	
13	Citrus											
14	Raw Milk											
15	Beef											
16	Manure	X		X		X		X				
17	Live animals											
18	Bullock draught power	X		X		X		X				
..												
..												
33	Animal feed									X	X	X
..	..			Quadrant III							Quadrant IV	
49	Chemical fertilizer	X		X		X		X				
50	Pesticides	X		X		X		X				
..	..											
68	Diesel	X		X		X		X				

Source: Own compilation

4.1.1 Intermediate Inputs of Crop Producing Activities

Seeds

The information on the quantity of output retained as seed is provided by experts from the MoAF (Dukpa, 2015b). As with any other intermediate consumption, the information on seed consumption is recorded as the value of the quantity of output retained as seed (quantity multiplied times price). As the majority farmers use their own seed, we use the farmgate price of their respective output. This is a simplifying assumption, as in case of farmers using improved seeds the intermediate input of seeds is undervalued. Yet, there is not sufficient data available to determine the share of various seed inputs in crop producing activities. There are no cell entries for retained seed in case of permanent crops, as the plantation of a new orchard is not a current but a capital expenditure.

Manure

The question on manure application within the RNR census 2009 is on the farm level and not crop specific. Hence, it is not possible to directly assess the quantity of manure applied per crop. Instead, it is assumed that each respondent applies manure to all cultivated crops proportionally to the area harvested. This assumption, of course, simplifies reality – as farmers use more manure for some crops than others. Still using this approach allows estimating how much tons of manure each farmer applies per crop. Table 18 presents the distribution of farm yard manure input across crops.

Table 18 – Distribution of farm yard manure application across crops

Crop	Paddy	Maize	Other cereals	Pulses	Low-value veg.	High-value veg	Potato	Bev. and spices	Other fruits and nuts	Apple	Citrus fruits
% share	18.7%	27.2%	10.9%	3.4%	9.0%	3.9%	9.6%	7.7%	5.2%	1.2%	3.1%

Source: 2012 Bhutan prior-micro SAM

Diesel Consumption

Farmers using agricultural machinery such as powertillers and tractors also consume diesel. Based on expert opinions, we assume that powertillers and tractor are used 55 days per year (15% capacity factor) and that during one day the consume 5 and 15 litres of diesel per day, respectively (Thinley, 2015). The RNR 2009 census has surveyed the ownership of agricultural machinery. Aggregate ownership is scaled up by 40%, adjusting for the increased investments in agricultural machinery between 2008 and 2012. Diesel consumption is computed by multiplying aggregate ownership of machinery times capacity factor, fuel consumption and the price of diesel to arrive at annual estimated consumption of diesel. The price of diesel in 2012 is Nu. 43 per litre (NSB, 2015b) and total consumption of diesel within agriculture thus amounts to Nu. 34 Million.

Chemical Fertilizer

There is no domestic fertilizer production in Bhutan and in 2012, chemical fertilizers worth Nu. 60 Million are imported (UN, 2015a). The agricultural sample survey 2012, asks farmers on what area of crop cultivated they use chemical fertilizer, however it does not include a question on fertilizing intensity, i.e. how much kg of chemical fertilizer a farmer uses per crop. According to the 2012 data, the average farmer applies chemical fertilizer on 0.28 hectares corresponding to 13,043 hectares (or 13% of total cultivated area) on which chemical fertilizer is applied. The RNR census 2009 includes detailed questions on what type and quantity of chemical fertilizer farmers use, differentiating between Super-Single-Phosphate, Suphala NPK (15-15-15), Urea and other chemical fertilizers. On average, farmers use 81 kg of chemical fertilizers and in total 4,381 tons are applied in 2008 (MoAF, 2009). However, as it is the case with manure, the census data does not allow to assess how the applied fertilizer is distributed among the cultivated crops.

We assume that farmers distribute fertilizer proportionately to their cultivated area. Consequently, an average fertilizing rate of the quantity of chemical fertilizer used in kg per crop and hectare is derived from the 2008 census data. As cash crop farmers cultivating potatoes have high application rates and the largest part of their land under potato cultivation we still obtain realistic fertilizing rates per crop,

despite our simplifying assumption. The fertilizing rate is then multiplied with the fertilized area per crop derived from the ASS 2012 dataset to compute the distribution of chemical fertilizer across crops as shown in Table 19 below. Most chemical fertilizer is thus used in potato cultivation, followed by paddy and maize. This is in line with field observations made in Bhutan.

Table 19 – Estimated distribution of applied chemical fertilizer across crops

Crop	Paddy	Maize	Other cereals	Pulses	Low-value veg.	High-value veg	Potato	Bev. and spices	Other fruits and nuts	Apple	Citrus fruits
% share	19.7%	22.1%	2.0%	0.5%	3.1%	2.2%	44.9%	0.0%	0.0%	4.9%	0.6%

Source: 2012 Bhutan prior-micro SAM

Plant Protection chemicals

Similar to chemical fertilizer, there are no industries in Bhutan producing plant protection chemicals (PPCs). In 2012, Bhutan imported Nu. 47 Million of PPCs (UN, 2015a). The same method used to estimate the distribution of fertilizer across crops is applied, since the data sources available for the disaggregation are exactly the same. The RNR 2009 census included questions on the quantity of insecticides, fungicides, herbicides and other plant protection chemicals applied. According to the census data, the average farmer applied 11 kg and in total 608 tons of PPCs are applied. The ASS 2012 recorded the area per crop on which plant protection chemicals are applied. Most of plant protection chemicals are applied in paddy, potato and apple cultivation (Table 20).

Table 20 – Estimated distribution of applied plant protection chemicals across crops

Crop	Paddy	Maize	Other cereals	Pulses	Low-value veg.	High-value veg	Potato	Bev. and spices	Other fruits and nuts	Apple	Citrus fruits
% share	47.5%	7.3%	1.4%	0.5%	3.6%	3.4%	22.8%	0.0%	0.1%	12.0%	1.5%

Source: 2012 Bhutan prior-micro SAM

Bullock Draught Power

As with the ownership of agricultural machinery, the ownership of bullocks per farmer is only known from the RNR 2009 census. Further, the RNR 2009 census also includes a question on what ploughing technology farmers are using for their land preparation. Farmers could either respond that they use a) manual labour, b) bullocks, c) bullocks and other machineries or d) only other machineries (i.e. mostly powertillers). Total cost of bullock draught power is already estimated in the supply matrix chapter at Nu. 214 Million. The cost of bullock draught power is only distributed among those farmers that reported to rely on bullocks. Further, the cost of bullock draught power is distributed to each crop cultivated by the farmers in proportion of the farmer's total cultivated area. The distribution of the cost of bullock draught power is not linked to the ownership of bullocks, because bullock pairs are also hired and leased out between farmers.

4.2.2   Intermediate Inputs of Livestock Activities

Intermediate inputs of livestock activities consists mostly of fodder, feed, minerals (salt), medicine (vaccinations) and live animals (e.g. calves, chicks, piglets).[5] In the following, the expenditure for each of the intermediate input items are presented. Privately owned or leased pasture land on which livestock graze is not considered as an intermediate input but as a production factor (pasture land). Feed, whether from crops or compound feed, as well as crop residues are treated as commodities and are thus intermediate inputs.

Salt

There is no information available how much salt farmers are feeding to their cattle in Bhutan. For the cattle activity, it is assumed that for each LU of cattle 30g of salt are fed daily, which equals a total salt consumption of 1,000 tons of salt. The price of salt in 2012 is equal to 10 Nu./kg (NSB, 2015b), which results into a total consumption of salt worth Nu. 10 Million.

Feed and Fodder Sources

There is no information on the consumption of feed and fodder sources by each of the specific livestock activities in Bhutan. In 2015, Gurung *et al.* (2015) have assessed the various feed and fodder sources for Bhutan's overall livestock sector. They estimate total annual dry matter (DM) requirement at 760,225 tons, using an average DM requirement per livestock unit of 2.74 kg/day as determined by Samdup et al. (2010). Excluding forests, they estimate that pasture (improved and native), crop residues, fodder crops, plantations and trees cover 85.2% of total DM requirement. In Figure 4 the individual share of each fodder source is presented.

Figure 4 – Share of individual fodder resources
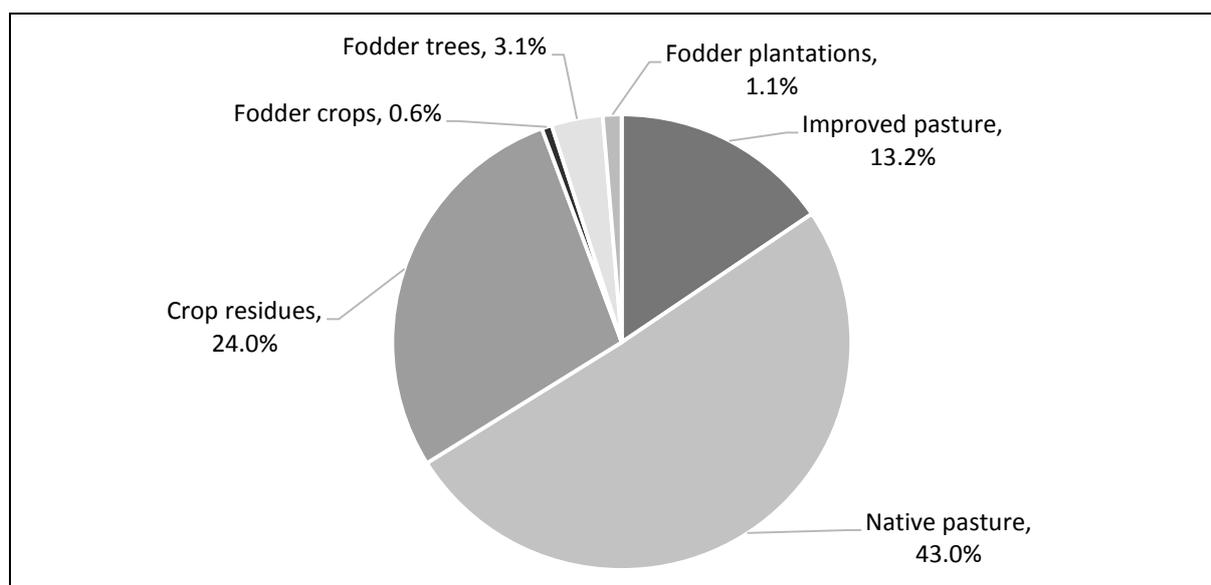
Source: according to Gurung *et al.* (2015)

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[5]   The 2012 SAM for Bhutan does not include information on the intermediate consumption of veterinary medicine, as no data is available.

Fodder Crops

The share of fodder crops, as assessed by Gurung *et al.* (2015) is very low (0.6%), corresponding to 4,718 tons. Analysing data from the ASS 2012 survey a total quantity of 12,174 tons of was crops fed to animals. Farmers reported to have fed any crop, except cardamom, to animals. Yet, for the SAM only low-value vegetables (mostly radish and turnips), maize, other cereals, other fruit and nuts and potato are considered as fodder-crops as they made up 97.5% of total quantity of crops fed to animals. The method and data sources used by Gurung *et al.* (2015) to estimate the quantity of fodder crops is not well documented, thus we prefer to use the estimate based on the ASS 2012 survey data. The implicit price of fodder-crops is estimated using farm-gate prices, yielding a weighted-average price of 16.3 Nu./kg.

Forest Land

The above composition of feed and fodder resources does not include fodder from forests. A large share of cattle grazes in forest land, predominantly local cattle breeds because they are more resistant towards parasites and diseases, Forest land is, by law, entirely owned by the government and according to Roder *et al.* (2001), forests contribute between 20% and 24% of total dry matter requirement of Bhutan's livestock. There are legal grazing rights to be obtained for some forest areas, yet grazing in forests by livestock, especially cattle, is not limited to those areas (Roder *et al.*, 2002). The cost of DM provided by forest land is estimated to be zero, as farmers do not pay for grazing rights in the forest. It is assumed that 175,000 tons of DM are available from forest land. This translates to a contribution of about 22% to total DM requirement and is thus within the range reported by Roder *et al*. Based on total forest cover in Bhutan the assumed DM supply of forest land corresponds to an average extraction of about 60 kg of DM per hectare of forest land, which can be considered a realistic level.

Compound Feed

The country's only industrial-scale feed mill, Karma Feeds, produced 17,515 tons of compound feed in 2012 (Karma Feeds, 2015a), of which 72.6% is layer or broiler feed, 20.5% cattle feed and the remainder (6.9%) produced for other animals, mainly pigs. Karma Feeds is assumed to have a market share of 90% and total production is thus estimated to equal 19,462 tons.

Of total production, 1.6% are exported to India. The majority of exports, 83%, consisted of broiler feed. In 2012, 1,404 tons of compound feed are imported (UN, 2015a). Details on the composition of feed imports i.e. share of different type of feed is unknown. However, given the large share of broiler feed among exports, it is assumed that imported feed only consist of cattle and pig feed, with a similar ratio (75% to 25%) between both types as represented in domestic feed production. The purchaser price is estimated to be 23.38 Nu./kg after adjusting the base price for trade and transport margins.

Distribution of Fodder and Feed across Livestock Activities

Feed requirement per livestock type is calculated by multiplying the number of LUs per type of livestock times the daily DM requirement of 2.74 kg/day (Samdup *et al.*, 2010). Table 21 presents the total feed requirement per livestock type. The livestock population statistics and LU conversion ratios are used to arrive at the headcount in LU per livestock types well as the final quantity of DM

requirement. The quantity of compound feed is deducted from the total DM requirement to arrive at the DM gap requirement to be met by feed and fodder resources.

Table 21 – Dry-matter (in tons) requirement per livestock unit and type

Livestock Type	Livestock population in 2012	LU conversion ratio[6]	Head-count in LU	Total DM req'ment	From compound feed	Gap in DM req'ment	% of total DM req'ment
Improved - milk	18,070	1.0	18,070	49,512	5,477.44	44,035	11.1%
Improved - adult dry female	11,515	1.0	11,515	31,551	-	31,551	0.0%
Improved - adult male	10,766	1.0	10,766	29,499	66.73	29,432	0.2%
Improved - young female	24,434	0.5	11,969	32,796	-	32,796	0.0%
Improved - young male	7,369	0.2	1,474	4,038	-	4,038	0.0%
Local - milk	53,476	1.0	53,476	146,524	720.00	145,804	0.5%
Local - adult dry female	45,531	1.0	45,531	124,755	-	124,755	0.0%
Local - adult male	83,330	1.0	83,330	228,324	489.38	227,835	0.2%
Local - young female	64,489	0.5	32,697	89,589	-	89,589	0.0%
Local - young male	23,954	0.2	4,791	13,127	-	13,127	0.0%
Total Cattle	**342,934**		**273,619**	**749,715**	**6,754**	**742,961**	**0.9%**
Poultry	**549,733**	**0.01**	**5,497**	**15,063**	**12,488**	**2,575**	**82.9%**
Goats	39,019	0.1	3,902	10,691	-	10,691	0.0%
Pigs	19,191	0.23	4,478	12,269	1,318	10,951	10.7%
Sheep	10,783	0.1	1,078	2,995	-	2,995	0.0%
Total other animals	**68,993**		**9,458**	**25,955**	**1,318**	**24,637**	**5.1%**
Total livestock	**961,660**		**288,574**	**790,733**	**20,382**	**771,458**	**2.6%**

Source: Own compilation

There are only indications available in order to estimate the share of feed and fodder consumed by each livestock type. It is known that improved cattle consumes more fodder crops and improved pasture than local cattle breeds. Also, male cattle are grazing in forest land to a larger extent than female cattle. The share of dry matter obtained from fodder plantation and trees is very low (below 5%) (Gurung *et al.*, 2015) and is thus not considered within the SAM and the cost is assumed to be zero. The percentage of DM requirement met by a specific source of feed and fodder is estimated by the authors' best possible judgment. The resulting distribution among livestock types is presented in Table 22.

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6 The LU conversion ratio for young female cattle is a weighted average of calves and heifers with LU conversion ratios of 0.2 and 0.7.

Table 22 – Distribution of tons of DM from feed and fodder across livestock types

Livestock Type	Compound feed	Fodder crops	Improved pasture	Native pasture	Crop residues	Forests	TOTAL
Improved - milk	5,300	1,376	22,019	9,175	8,945	2,520	**49,335**
Improved - adult dry female	-	631	14,198	6,310	6,152	4,260	**31,551**
Improved - adult male	67	147	10,030	5,900	6,490	6,865	**29,499**
Improved - young female	-	656	15,842	6,559	6,695	3,044	**32,796**
Improved - young male	-	40	1,535	808	588	1,068	**4,039**
Local - milk	720	3,645	17,497	71,444	29,161	24,057	**146,524**
Local - adult dry female	-	1,248	12,475	58,635	28,694	23,704	**124,756**
Local - adult male	489	1,140	18,113	77,506	47,871	83,205	**228,324**
Local - young female	-	1,165	8,959	42,107	20,785	16,574	**89,590**
Local - young male	-	66	1,050	5,907	2,494	3,611	**13,128**
Total Cattle	**6,576**	**10,114**	**121,718**	**284,351**	**157,875**	**168,908**	**749,542**
Poultry	**12,488**	**1068**	**-**	**-**	**1,107**	**313**	**14,976**
Goats		107	-	6,842	2,118	1,624	**10,691**
Pigs	1,318	552	-	-	7,178	3,220	**12,268**
Sheep		30	-	1,891	611	463	**2,995**
Total Other Animals	**1,318**	**689**	**0**	**8,733**	**9,907**	**5,307**	
Total Livestock	**20,382**	**11,871**	**121,718**	**293,084**	**168,889**	**174,528**	**790,472**
In % of total DM requirement	2.58%	1.50%	15.40%	37.08%	21.37%	22.08%	
Availability	21,915	11,871	121,975	326,895	169,000	175,000	**826,656**
Price	23.38*	16.30	0.67	0.20	1.00	-	
Value (in Million Nu.)	**476**	**193**	**82**	**59**	**169**	**-**	**987**
% of total value	42.40%	17.60%	12.30%	5.90%	17.10%	1.50%	

* Price for compound feed is purchasing price including trade and transport margins
Source: Own compilation

Conservative assumptions are made about the price for one ton DM from improved pasture, native pasture and crop residues. As In total, the value of feed and fodder consumed by the livestock sector equals Nu. 987 Million, which is 42% of total livestock output. In Table 23, the expenditure for intermediate inputs of each livestock activity is presented both in terms of absolute value as well as percentage of total output (column shares).

Table 23 – Intermediate inputs (in Million Nu.) of livestock activities

Type of feed	Crop Fodder	Crop res.	Compound Feed	Minerals (Salt)	Improved pasture land	Native pasture land	Total output
Cattle	165	158	154	10	82	57	**1,615**
Poultry	17	1	292	0			**560**
Other animals	11	10	31	0		2	**199**

Source: Own compilation

Live Animals

Livestock purchased represents a capital expenditure as the expected average economic lifetime per animal is well above a year.

4.2   Food Manufacturing Activities

The 2012 SAM for Bhutan includes the following food-manufacturing or food-processing activities (Table 24):

Table 24 – Food manufacturing activities

Activity Name	Output	ISIC (3.1. rev) activity
Paddy milling	Milled rice	1531
Other cereals milling	Milled Other cereals	1531
Dairy production	Dairy products	1512;1520
On-farm cereal processing	Processed rice; Processed maize	1531;1532;
Ara production	Ara; animal feed	1551
Grain mill and other food production	Other grain mill products; Vegetable oils	1541-1549
Animal feed production	Animal feed	1533
Fruits and vegetables processing, beverage and tobacco production	Processed fruits and vegetables; Non-alcoholic beverages; Alc. Beverages and tobacco	1513-1514; 1551-1554

The production activities paddy milling, other cereals milling, dairy products, on-farm cereal processing, and ara production are performed by farm households in Bhutan. Consequently, for these activities it is assumed that they consume intermediate inputs as HPHC goods, for example *chmilk* (home produced and home consumed milk) in case of dairy production.

There are also minor shares of these products produced by large scale industries. For example, ara is also produced by the only liquor distillery in Bhutan, the Army Welfare Project (AWP). In such a case, this commercial large-scale produced ara is aggregated under the account for alcoholic beverages, which is also subject to sales tax and excise duty. The remaining activities (Grain-mill and other food production; animal feed production; fruits and vegetable processing, beverage and tobacco production) are dominated by small- to large-scale industries with a negligible share produced by households. The intermediate consumption of these activities are estimated using available information from corporate annual reports and the SUT 2007 use-matrix.

Cereals and Paddy Milling

The largest share of cereal grains of paddy and other cereals are milled to rice or flour. In case of paddy, 95.6% or 52,137 tons of paddy are milled to rice at a recovery rate of 60% (Rinzin, 2015), while only 1.7 % or 2.7% of paddy production is either processed to ara or retained as seed. 65.5% or 6,925 tons of other cereals production are milled to flour with an weighted average recovery rate of 60.8% (Dukpa, 2015b), while the remaining 34.5% is are either used for ara, seed or animal feed. We approximate intermediate-input use of the paddy and other cereal milling activity by using information on the cost of milling paddy provided by a rice production cost study conducted in 2012 (Rinzin, 2015).

Dairy Production

The use-matrix derived from the SUT 2007 does not contain any details on the intermediate consumption of dairy products. According to the livestock census (LC) 2012, 23,442 tons of milk, representing 79% of total milk production, are processed into dairy products. The value of processed milk at farm-gate prices (30.68 Nu) are Nu. 719 Million. In total, 4,251 tons of dairy products are produced (MoAF, 2013b), which corresponds to 5.56 litres of milk for every kg of dairy produce. This ratio is in the neighbourhood of other conversion rates. Joshi and Gurung (2009) reported that farmers processed 4.33 kg of milk into one kg of dairy, which consisted of 1/3 of butter and 2/3 of cheese. Besides milk, farmers mainly require firewood for dairy production. Other inputs are assumed to be negligible.

On-farm cereal processing

The two main cereals, rice and maize, are further processed into processed rice (referred to *Zaw,* a kind of puffed rice) or processed maize (referred to *Tengma*, similar to cornflakes). As farmers process their cereals on their farm, most intermediate inputs are HPHC commodities. The intermediate inputs are presented in Table 25.

Table 25 – Intermediate inputs for cereal processing activities

	Quantity (in tons)	Price (Nu./kg)	Value in Million Nu.	% of output	Source
Inputs					
Maize (chmaize)	3,550	14.77	52	14.4%	based on assumed loss rate of 50%
Milled rice (chbhtrice)	3,971	51.37	204	55.9%	based on assumed loss rate of 10%
Milk (chmilk)	-	-	4	1.1%	
Dairy products (chdairy)	-	-	11	3.0%	Assumption based on
Vegetable oils (cmvegoil)	-	-	4	1.0%	SUT 2007 column shares
Firewood (cfirewood)	-	-	14	3.8%	for grain mill products
Electricity (clowelec)	-	-	2	0.6%	
Rubber and plastic products (crubber)	-	-	3	0.8%	
Land transport (clandtrans)	-	-	6	1.7%	
Total intermediate inputs		300		82.2%	
Output					
Processed maize	1,775	69.11	123	33.6%	
Processed rice	3,574	67.77	242	66.3%	
TOTAL Output			**365**		

Source: Own compilation

Grain Mill and Other Food Production

The production activity of grain mill and other food products includes vegetables oils and any other grain mill products (e.g. bread) besides the previously described ones. Intermediate-input use is largely derived from the 2007 SUT (ADB, 2012). The major intermediate inputs are other agricultural goods

(mostly oilseeds) and milled other cereals (mostly wheat flour). The input-output structure of grain mill production activity is summarized in Table 26 below:

Table 26 – Intermediate inputs used for grain mill production

	Value in Million Nu.	% of output	Source
Inputs			
Other Agriculture	23	2.7%	Assumed 50% share of vegetable oils output value
Milled other cereals	165	30.1%	Assumed 33% share of grain mill product output value
Other grain mill products	23	4.2%	
Milk	6	1.1%	
Dairy products	4	0.7%	
Vegetable oils	6	1.0%	
Firewood	3	0.6%	Assumption based on SUT 2007 column shares for grain mill products
Electricity	27	4.9%	
Rubber and plastic products	4	0.8%	
Land transport	40	7.2%	
Financial intermediation services	14	1.6%	
Business service	13	2.3%	
Total intermediate inputs	316	57.6%	
Output			
Grain Mill products	496	90.4%	
Vegetable Oils	53	9.6%	
TOTAL Output	**548**		

Source: Own compilation

Ara Production

Ara is a traditional alcoholic beverage made from mostly maize and other cereals with an alcoholic content of about 20%. Annual consumption of ara according to the BLSS 2012 survey can be estimated at 11,839 tons[7], of which 81.9% is consumed in Eastern Bhutan. Yet, actual ara consumption is probably significantly higher as respondents tend to underreport alcohol consumption for instance due to social stigma. In expert and field interviews it is both stated that farmers in Eastern Bhutan use more than half of their maize harvest to produce ara, which would be equivalent to at least 27% of total maize production in Bhutan or 16,552 tons.

Producing ara with an estimated alcohol by volume level of 20%, a medium yeast alcohol tolerance of 72% (medium attenution), an efficiency of 50% and a wort-batch ratio of 3:2, results in 1.27 kg of (flaked) corn required to brew one litre of ara.[8] Assuming that 50% of Maize in the East is used for ara production, 16,552 tons of maize would thus produce 13,033 tons of ara. If the relative consumption ratios between regions hold, i.e. underreporting between regions does not differ, total ara production can be estimated at 15,913 tons. The ara price as reported in the BLSS 2012 is 34.67 NU/litre which then corresponds into a total value of output equals Nu. 552 Million.

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[7]   For simplicity reasons one litre of Ara was set equal to one kg.

[8]   Quantity of grains required for brewing are calculated with the tools available on www.brewersfriend.com

A total of 20,210 tons of cereal input would be required, of which 80% or 16,552 tons is from maize and for the remainder it would be assumed that paddy and other cereals make up 3% (606 tons) and 17% (3,436 tons). Other inputs needed are water, yeast (part of grain mill products commodity) and firewood (Dukpa, 2015a). Rural households are not charged water prices, thus it is not feasible to include it as an intermediate input. Two biscuits of yeast costing Nu. 10 and one backload of firewood (43 kg) to produce 10 litres of ara are required. Table 27 gives an overview over the input-output structure of ara production.

Table 27 – Intermediate goods for Ara production

	Quantity (in tons)	Price (Nu./kg)	Value in Million Nu	% of output
Inputs				
Maize	16,168	14.77	238.8	43.3%
Other Cereals	3,436	22.70	78.0	14.1%
Paddy	606	26.10	15.8	2.9%
Yeast (Grain Milled Products)	1,591	30.00	47.7	8.7%
Firewood	68,426	0.55	37.5	6.8%
Total intermediate inputs			418	75.7%
Total Output	**15,913**	**34.67**	**552**	

Source: Own compilation

Fruits and Vegetables Processing and Beverage Production Activity

The fruits and vegetable processing and beverage production activity produces three main outputs, of which alcoholic beverages makes up the largest share (66.8%), followed with almost equal shares of non-alcoholic beverages (16.8%) and processed fruits and vegetables (16.5%). The intermediate-inputs consumed are derived from the SUT 2007 SAM; from annual report information available for some of the sector's enterprises and from the 2007/08 SAM for India in order to approximate missing data.

The linkage between the fruits and vegetables processing and beverage production activity and the overall agricultural sector is fairly limited. Input of fruits and vegetables make up only 3.9% of the total output value of processed fruits and vegetables (Nu. 449 Million) and accordingly only 0.64% of the sector's overall output. In case of alcoholic beverage production (Nu. 1,821 Million), processed barley and other cereals are imported from India and there is no actual linkage between this sector and Bhutanese farmers. Output of the non-alcoholic beverages sector (total output of Nu. 457 Million) mainly consists of soft drinks produced by the two largest beverage companies in Bhutan, Tashi Beverages (Coca-Cola license) (63.9% of output) and Drangchu beverages (Pepsi license) (36.1% of output). This sector is also not known to demand significant quantities of raw materials from Bhutanese farmers.

Animal Feed Production

As previously mentioned, animal feed production in Bhutan is dominated by a single enterprise, Karma Feeds, which is situated in Phuentsholing - close to the border with India. Most of input-output data is obtained through personal communication with Karma Feeds (2015b). Further expenditure

shares are estimated using the SUT 2007 shares. The largest share of raw material for animal feed production consists of grains (maize) and processed grains (grain mill products such as soya bean meal or distiller residues). According to Karma Feeds, about 5% of raw materials can be sourced from Bhutan currently while the remainder is imported from India.

4.3   Forestry-based Activities

Community Forestry

Intermediate inputs consumed for forestry activities by rural households are largely negligible. Some households utilize power chains and consume fuel, however detailed information is not available. Thus we do not consider any intermediate inputs of forestry activities conducted by rural households. This is also supported by the fact that intermediate consumption of the overall forestry sector as presented in the 2007 SUT only makes up 3.1% of total output.

Commercial Forestry

The general forestry sector is included as a separate activity within the 2007 SUT. According to the column shares of the use-matrix based on the SUT 2007, intermediate consumption represents 3.1% of total sector output. For a commercial forestry operation, this share seems to be too low and also is not consistent with the share of intermediate inputs in total revenue reported by the NRDCL. We therefore use data from NRDCL 2012 annual report to derive intermediate input use for the commercial forestry sector. Doing so yields an intermediate input share of 22.6% of total output.

Manufacturing of Wood, Paper and Furniture Products

The intermediate-input consumption of manufacturing of wood, paper and furniture products is estimated based on the SUT 2007. The SUT 2007 has disaggregated this sector into three distinct activities: Manufacture of wood and of products of wood and cork; manufacture of paper and paper product; and manufacture of furniture. The sector's output (Nu. 1,564 Million) consists largely of 49.3% products of wood and cork, followed by furniture (26.4%) and paper products (24.2%). 65.0%% of total output are intermediate inputs, of which products of wood and cork (23.9%), textiles (8.4%), basic chemicals (7.5%), land transportation (7.9%) and logs (6%) are the items with the largest share.

4.4   Mining, Manufacturing and Energy Activities

Mining and Quarrying Activity

The mining and quarrying sector had an output of Nu. 2,674 Million of which 19.3% represents coal and 80.7% other minerals. The intermediate-input consumption of the mining and quarrying activity is entirely estimated based on the SUT 2007 and intermediate-inputs make up 32.6% of total output.

Manufacturing Activities

The SUT 2007 is used to estimate intermediate input consumption for the textile, rubber and plastics and fabricated metal manufacturing activity as well as the manufacturing n.e.c. sector. Intermediate

input consumption for the remaining sectors listed in Table 28, of which many are energy-intensive industries, is estimated primarily based on corporate annual report information and – in case of missing data – on SUT 2007 information.

Table 28 – Manufacturing activities

Activity Name	Output	ISIC (3.1. rev) activity
Textile manufacturing	Clothing and wearing	1711-1920
Basic chemicals manufacturing	Basic Chemicals	2411-2430
Rubber and plastics manufacturing	Rubber and plastics	2511-2520
Glass product manufacturing	Glass and glass products	2610-2699
Ferro-alloy manufacturing	Ferro-alloys	2710-2720
Casted iron, steel and non-ferrous manufacturing	Casted iron and steel, and non-ferrous metals	2731-2732
Fabricated metal manufacturing	Fabricated metal products, except machinery and equipment; Electrical machinery and apparatus	2811-3330
Manufacturing n.e.c.	Manufactured goods n.e.c.	3410;3599;3691;3720

Source: Own compilation

Textile Manufacturing

The textile manufacturing activity has a total output of Nu. 1,656 Million (MLI 2013), of which 46.2% is comprised of intermediate inputs. Most important inputs are textile products (output share of 26.0%), followed by products of wood and cork (7.9%) and basic chemicals (7.2%).

Basic Chemicals Manufacturing

The basic chemical manufacturing sector in Bhutan is dominated by the Bhutan Calcium Carbide Limited company (BCCL), which produced output worth Nu. 1,133 Million Nu in 2012 or 60.4% of total sector output (Nu. 1,875 Million) (BCCL, 2014; MoEA, 2015c). Intermediate inputs made up 85.3% of total output. Production of basic chemicals in Bhutan is largely based on minerals and further requires various forms of energy. The commodity other minerals is the most important raw materials comprising 21.2% of output. Reducing agents are further important inputs with high input shares, including charcoal (11.6%), coke (6.2%) and coal (1.4%). Manufacturing of basic chemicals in Bhutan is also energy intensive, requiring high shares of electricity (17.2%) and fuel oil (4.4%).

Rubber and Plastics Manufacturing

The rubber and plastics manufacturing activity has a total output of Nu. 1,001 Million (MoEA, 2015c), of which 72.2% is comprised of intermediate inputs. Most important inputs are rubber and plastics products (output share of 32.6%), followed by insurance and pension services (9.6%) and business services (6.6%).

Glass and Glass Products Manufacturing

The glass and glass products manufacturing activity had a total output of Nu. 3,117 Million (MoEA, 2015c) and is dominated by cement producers. In 2012, the largest cement producer (Penden Cement Authority) produced an output worth of Nu. 1,982 Million, equal to 66% of total sector output (PCAL,

2014). Intermediate inputs make up 64.6% of total output. Other minerals represent the largest intermediate-input with an output-share of 17.2%, followed by coal (12.2%) and manufactured goods n.e.c. (6.0%). Electricity makes up only 3.6% of intermediate inputs.

Basic Iron and Steel Manufacturing

The basic metal sector as represented in the SUT 2007 is split into two activities for the 2012 SAM for Bhutan; in basic iron and steel manufacturing and casted iron and steel; and non-ferrous metals manufacturing. Basic iron and steel manufacturing is the largest manufacturing activity, producing an output of Nu. 7,331 Million in 2012. The sector consists mainly of ferro-silicon (i.e. a ferro-alloy) producers. Almost all ferro-silicon produced in Bhutan is exported and utilized in the upstream steel sector in India and other major steel producing countries. The largest producer is Bhutan Ferro Alloy Limited (BFAL), a public-listed company with an annual output of Nu. 2,084 Million in 2012 (BFAL, 2014). Detailed information on intermediate-inputs is taken from annual reports from BFAL and other ferro-alloy producers. 75.5% of output are intermediate-inputs and energy and reducing agents inputs are the most important ones. Electricity makes up 21.3% of output and other carbon sources make up a combined 29.8% split up into charcoal (10.5%), coke (10.1%) and coal (9.2%). Further raw materials are other minerals (mostly quartzite) and basic iron and steel (sponge iron and iron scrap) comprising 5.3% and 7.4% of output and being mostly imported from India.

Casted Iron, Steel and Non-ferrous Manufacturing

The casted iron, steel and non-ferrous manufacturing activity produces steel bars and rods. Most companies are mini-steel mills using electric arc furnaces. Total output in 2012 is estimated at Nu. 4,792 Million and 80.3% of output is made up by intermediate inputs. Information of intermediate inputs is derived from various annual reports. Output shares are determined using the simple mean across companies. By far, imported basic iron and steel (sponge iron and iron scrap) make up the largest share of intermediate-inputs representing 65.5% of output value, followed by electricity with an output share of 4.7%.

Fabricated Metal Manufacturing

Information and data on intermediate-inputs by the fabricated metal manufacturing activity is solely based on the SUT 2007. nad There is no information available from annual reports or other sources. Total output is estimated to be Nu. 2,192 Million and 66.5% of output is made up by intermediate-inputs. Casted iron and steel, and non-ferrous metallic products have the largest output share of 32.6%, followed by land transport services with 20.5%.

Manufacturing n.e.c. (not elsewhere considered)

The manufacturing n.e.c. activity's intermediate-input structure is also estimated based on the SUT 2007. Intermediate-inputs make up 66.6%, of which other minerals contribute 23.1% and manufactured goods n.e.c. 6.6%.

Energy and Utilities

Within the SUT 2007, energy and utilities are represented by two activities: Electricity, gas, steam and hot water supply (electricity sector) as well as collection, purification and distribution of water (water

sector). In the SAM, the electricity sector is, as previously mentioned, disaggregated into two separate activities: electricity generation and electricity transmission and distribution.

Electricity Generation

Hydropower generation is a very capital-intensive activity. Intermediate-inputs are derived from expenditure schedules as published within Druk Green Power Corporations' annual reports (2014; 2013) and comprised only 10.2% (Nu. 1,092 Million) of total sector output, of which wheeling charges (Nu. 548 Million) represented the largest share with an output share of 5.1%.

Electricity Transmission and Distribution

Intermediate-inputs for electricity transmission and distribution are derived from expenditure schedules reported within the annual report of Bhutan's national public utility, Bhutan Power Corporation (2013). The sector required Nu. 1,472 Million of intermediate-inputs representing 40.4% of total output. Naturally, purchase of electricity is the most important input with an output-share of 32.1%.

Collection, Purification and Distribution of Water (Water Sector)

The intermediate input structure of the water sector is estimated using the SUT 2007 shares. This activity is the smallest activity within the 2012 Bhutan SAM with an output of only Nu. 39 Million. Intermediate inputs make up 30% of output. Casted iron and steel; and non-ferrous metals is the largest intermediate-input with an output share of 13.5%. Electricity has the second largest share with 10.5%.

4.5   Service Activities

The SUT 2007 use matrix is used as the major data source to derive the intermediate input structure of service activities. However, for some service activities the SUT use-matrix reported an unrealistic intermediate-input structure, because activities have very low intermediate-input shares or only few or even single intermediate-input items. These activities are denoted with an asterisk in Table 29 and are adjusted by considering input shares from the 2007/08 India SAM (Pradhan *et al.*, 2013).

Table 29 – Output of service activities (in Million Nu.) and their most relevant inputs by share

Activity Name	Total output	Intermediate-input share (%)	Comment – most relevant inputs by share
Construction	44,855	52.3%	Glass and glass products (8.5%); Fabricated metal products (9.3%); Other minerals (5.6%)
Wholesale and retail trade, repair of motor vehicles and other goods	9,421	21.8%	Supporting and auxiliary transport services (4.6%); Financial services (3.4%); Telecommunication services (7.5%)
Hotels and restaurants	2,413	42.7%	Adjustments as in Table 31; Beverages and spices (6.0%); imported rice (4.4%), domestic rice (3.9%)
Land transportation	11,708	49.3%	
Air transport	2,761	61.9%	
Supporting and auxiliary transport activities; activities of travel agencies	1,373	40.0%	
Post and telecommunications	3,142	18.9%	
Financial intermediation	4,097	10.3%	
Insurance and pension funding; Activities auxiliary to financial intermediation	1,922	2.3%	
Real estate activities*	2,071	5.0%	SUT 2007 reports only one intermediate input (Forestry an logging products)
Business services n.e.c.*	187	49.3%	SUT 2007 reports only one intermediate input (Telecommunication services)
Public administration	11,954	44.4%	
Education	3,483	37.6%	
Health and social work	2,793	40.5%	
Other services	651	40.3%	

Source: Own compilation

Adjustment of Use of Agricultural Commodities and Fossil Fuels

Another adjustment necessary for the use matrix of service activities concerns the SUT 2007's aggregation level of commodities that does not directly match the commodity structure of the 2012 Bhutan SAM. This particularly concerns agricultural commodities and petroleum fuels. Agricultural commodities are represented at a high aggregation level within the SUT 2007, for example all cereals are included in one commodity account while the 2012 Bhutan SAM differentiates between five cereal commodities. Assumptions had to be made for the hotel and restaurant sector for which agricultural commodities are important intermediate inputs. Table 30 shows how the SUT 2007 input shares are disaggregated according to the 2012 Bhutan SAM structure for the hotel and restaurant activity.

Table 30 – Adjustment of agricultural intermediate inputs of hotel and restaurant activity

SUT 2007		2012 Bhutan SAM		
Intermediate input	**% output share**	**Intermediate input**	**Assumed distribution share %**	**% output share**
Cereals	10.99%	Maize	5%	0.6%
		Pulse	10%	1.1%
		Bhutanese Rice	35%	3.9%
		Milled other cereals	10%	1.1%
		Imported Rice	40%	4.4%
Vegetables	4.94%	High-value vegetables	50%	2.5%
		Low-value vegetables	20%	1.0%
		Potato	30%	1.5%
Other products of agriculture	7.5%	Other cereals and oilseeds	20%	1.5%
		Beverages and spices	80%	6.0%
Fruits and nuts	0.14%	Apple	40%	0.1%
		Citrus	40%	0.1%
		Other Nuts and Fruits	20%	0.0%
Live animals and other animal products	6.1%	Milk	40%	2.5%
		Eggs	60%	3.7%
Meat, fish, fruit, vegetables, oils and fats and dairy products	2.6%	Beef	15%	0.4%
		Chicken meat	25%	0.6%
		Other meat	10%	0.3%
		Processed fruits and vegetables	15%	0.4%
		Dairy products	25%	0.6%
		Vegetable oils	10%	0.3%
Beverages and Tobacco	1.8%	Non-alcoholic beverages	50%	0.9%
		Alcoholic beverages and tobacco	40%	0.7%
		Ara	10%	0.2%

Source: Own compilation

Fuels are not explicitly recorded as a commodity within the SUT 2007, but aggregated under the *manufacturing n.e.c.* commodity. This commodity account included all fossil fuels such as coke, diesel, gasoline, kerosene, fuel oil and any other fuels. The 2012 Bhutan SAM disaggregates this commodity into five fuel accounts: 1) Coke, 2) Fuel oil and natural gas, 3) Gasoline and kerosene, 4) Diesel, and 5) Fuels not elsewhere considered. Assumptions are necessary in order to disaggregate the intermediate-input consumption from the SUT 2007 to the 2012 Bhutan SAM structure. Table 31 shows the relative distribution of *manufacturing n.e.c.* as an intermediate-input across service activities and the assumed shares of the disaggregated fuel commodities.

Table 31 – Disaggregation of fossil fuel commodities across activities

	SUT 2007 Intermediate consumption of fossil fuels		Assumed distribution among 2012 Bhutan SAM commodities				
	% output shares	Consumption in Million Nu.	Coke	Fuel oil	Gasoline	Diesel	Fuels n.e.c
Construction	8.80%	3,948	5%	4%	3%	66%	22%
Wholesale and retail trade	0.35%	34	0%	5%	30%	65%	0%
Hotels and restaurants	1.11%	27	0%	5%	30%	65%	0%
Land transportation	17.81%	2,086	0%	5%	50%	45%	0%
Air transport	15.07%	416	0%	5%	75%	15%	5%
Supporting and auxiliary transport activities	1.64%	52	0%	5%	30%	65%	0%
Post and telecommunications	1.79%	25	0%	5%	30%	65%	0%
Financial intermediation	0.00%	-	0%	5%	30%	65%	0%
Insurance and pension funding	0.00%	-	0%	5%	30%	65%	0%
Real estate activities	0.00%	-	0%	5%	30%	65%	0%
Business services n.e.c.	0.00%	-	0%	5%	30%	65%	0%
Public administration	0.62%	74	0%	5%	30%	65%	0%
Education	1.05%	37	0%	5%	30%	65%	0%
Health and social work	0.46%	13	0%	5%	30%	65%	0%
Other services	6.05%	39	0%	5%	30%	65%	0%

Source: Own compilation

5   Trade and Transport Margins

The 2012 Bhutan SAM includes two margin accounts, one for transportation margins and another for trade margins. Data on margins is derived from the SUT 2007, which in turn documents that trade margins "were calculated using the trade margin ratios of India" (ADB, 2012 p. 92), because no trade and transport margin survey exists for Bhutan. The ADB used case studies to adjust trade margin data to the Bhutanese context. Regarding transportation margin data, information from corporate annual reports are used.

For the 2012 Bhutan SAM, some more detailed data on trade and transportation margins are obtained by expert interviews with traders and shop keepers during a field trip to Bhutan in early 2015. Further, since the SUT 2007 included only very aggregate data on agricultural commodities, additional data collection and analysis is required. Farm gate prices are estimated using the ASS 2012 data, while purchaser prices and export prices (in FOB terms) are available from the BLSS 2012 and BTS 2012. The sum of trade and transport margins could be estimated by subtracting mean farm gate prices from mean purchases prices. It needs to be noted, that this is of course only a crude method of estimating margins. Farm gate prices from the ASS 2012 data might be distorted as farmers might not only sell at their farm gate, but also by the roadside or at local markets. In the latter cases, reported farm gate prices would of course include margins for trade and transportation. Also, to further disaggregate margins into trade and transport margins, shares from the SUT 2007 are used. The SUT 2007 reports that 60.6% of total margins is comprised by trade margins, while the remainder (39.4%) accounts for transportation margins. This is certainly not realistic for all commodities. For example, some commodities have higher transportation shares as they are low-value crops with high water content (e.g. potatoes). Due to the lack of better data, this simplified method of estimating margins is used.

Margins are implemented as an expenditure of commodities to margin accounts. The sum of all trade margins is channelled to the wholesale and retail trade service account. The sum of transportation margins is likewise channelled to the land transportation service account. There are certainly transportation margins actually accruing to air transportation services, these are – however – not recorded by the SUT 2007.

6   Factor Returns (Value-added Components)

In addition to intermediate-inputs, activities also require factor inputs, have to pay taxes and might receive production subsidies. There are three factor account categories represented in the 2012 Bhutan SAM: labour, capital and land. These factor account categories are disaggregated into factor accounts by characteristics that describe the limited substitutability between them such as e.g. skill (for labour) or agroecological zone (for land).

6.1   Data Sources and Principle Approach to Disaggregate Factor Returns

Main data sources utilized to disaggregate factor returns per activity are the 2007 SUT, data from corporate annual reports and the BLSS 2012. The 2007 SUT for Bhutan distinguishes between three value added components: (1) taxes less subsidies on production; (2) compensation of employees; and (3) gross operating surplus. Taxes on production is discussed in the section on tax accounts. Compensation of employees is used as an approximation of labour returns even though it might include non-cash benefits such as subsidized transportation. Own-account workers or unpaid family labour are not part of this first component. These types of labour are often part of unincorporated businesses that earn mixed income. The third component – gross operating surplus – includes earnings before subtraction of interest or depreciation. In case of unincorporated businesses this component includes mixed income and thus also returns to labour. Mixed income requires special consideration and will be addressed in section 6.3 (OECD, 2001).

Given Bhutan's small size, certain industrial activities within the 2012 SAM consist of only few companies of which again some make up the majority of economic output. For instance, Karma Feeds is Bhutan's main animal feed producer representing an estimated 90% of total sector output. Another example is Bhutan Calcium Carbide Limited (BCCL), which is producing about 70% of total output of the basic chemical production activity. Consequently, if 2012 data from annual reports is available for a considerable share of an activity, then this data is preferred over value added data from the SUT 2007.

Returns to labour, land and capital are further disaggregated into sub-accounts, such as for example returns to skilled or unskilled labour, irrigated, rain-fed or permanent crop land or private or public capital. The data to disaggregate the value added components on the level of sub-accounts is taken from the BLSS 2012, ASS 2012 and information on ownership of companies.

6.2   Overview on Factor Accounts

The Table 32 provides an overview on all factor accounts included in the SAM. The detailed description of how factor returns are estimated is explained in the later sections of this chapter.

Table 32 – Return to factor accounts from activity categories

	Factor type	Agriculture and forestry	Manu-facturing	Energy and utilities	Construc-tion	Services	Rest of the World	Total	% share of total factors
Labour	Skilled Bhutanese labour	181	424	288	918	6,953	122	8,886	9.7%
	Semi-skilled Bhutanese labour	151	728	506	1,715	6,588	-	9,688	10.6%
	Low-skilled Bhutanese labour	180	539	285	1,189	5,585	-	7,778	8.5%
	Unskilled Bhutanese labour	75	289	67	210	3,019	-	3,659	4.0%
	Skilled Foreign labour	4	99	14	107	314	-	539	0.6%
	Semi-skilled foreign labour	4	88	6	225	50	-	375	0.4%
	Low-skilled foreign labour	2	250	4	2,897	46	-	3,198	3.5%
	Unskilled foreign labour	7	101	1	1,589	48	-	1,746	1.9%
	Family farm labour	5,031	307	-	-	-	-	5,338	5.9%
	Hired farm labour	320	52	-	-	-	-	372	0.4%
	Total labour	**5,955**	**2,877**	**1,170**	**8,851**	**22,604**	**122**	**41,579**	**45.6%**
Land	AEZ1 irrigated land	77	-	-	-	-	-	77	0.1%
	AEZ2 irrigated Land	123	-	-	-	-	-	123	0.1%
	AEZ3 irrigated Land	81	-	-	-	-	-	81	0.1%
	AEZ1 rain-fed land	146	-	-	-	-	-	146	0.2%
	AEZ rain-fed land	297	-	-	-	-	-	297	0.3%
	AEZ3 rain-fed land	814	-	-	-	-	-	814	0.9%
	AEZ1 permanent cropland	834	-	-	-	-	-	834	0.9%
	AEZ2 permanent cropland	496	-	-	-	-	-	496	0.5%
	AEZ3 permanent cropland	316	-	-	-	-	-	316	0.3%
	Improved pasture land	82	-	-	-	-	-	82	0.1%
	Native pasture land	59	-	-	-	-	-	59	0.1%
	Total land	**3,246**	**-**	**-**	**-**	**-**	**-**	**3,246**	**3.6%**
Capital	Powertiller	237	-	-	-	-	-	237	0.3%
	Unincorporated capital	127	-	-	-	-	-	127	0.1%
	Improved female cattle	234	-	-	-	-	-	234	0.3%
	Improved male cattle	25	-	-	-	-	-	25	0.0%
	Local female cattle	290	-	-	-	-	-	290	0.3%
	Local male cattle	172	-	-	-	-	-	172	0.2%
	Poultry	48	-	-	-	-	-	48	0.1%
	Other animals	76	-	-	-	-	-	76	0.1%
	Private owned incorporated capital	1,170	4,332	0	12,283	12,388	777	30,950	33.9%
	Public owned incorporated capital	142	290	10,253	-	3,528	-	14,213	15.6%
	Total capital	**2,521**	**4,621**	**10,253**	**12,283**	**15,916**	**777**	**46,371**	**50.8%**
Total	**Total Factors**	**11,722**	**7,498**	**11,423**	**21,134**	**38,520**	**900**	**91,196**	**100.0%**
	% of total factor	12.9%	8.2%	12.5%	23.2%	42.2%	1.0%	100.0%	

6.3   Treatment of Mixed Income

Mixed income consists of returns to labour, land and capital and concerns primarily agricultural activities and other sectors such as manufacturing of textiles, wholesale and retail-trade as well as other services. Mixed income is earned by unincorporated enterprises run by own-account workers and supported by unpaid family labour. As in such cases there is often no bookkeeping or accounting standards to comply with, disaggregating mixed income according to returns to labour, land and capital is challenging. In case of cropping activities, the labour requirement measured in person-days per hectare is obtained to estimate total labour input. Knowing the share of all production factor inputs except for land, this approach allows to estimate the share of cropland as the residual. In case of livestock activities, the share of pasture land and livestock is known, such that the share of labour is the residual.

The capital share in mixed income from manufacturing of textiles, wholesale and retail-trade and other services is assumed to be negligible. The textile industry in Bhutan, for instance, is dominated by cottage and small-scale industries, which are characterized by simple technologies and absence of large and capital-intensive machinery. Mixed income from these sectors, not including agricultural activities, is thus distributed among the labour accounts as it is done for labour return from all remaining sectors characterized by incorporated enterprises.

6.4   Factor Returns in Agricultural Activities

The return to all factors (value-added) of agricultural activities is computed as a residual of total output value minus total value of intermediate inputs. As previously mentioned, farmers earn mixed income without explicit distinction between the three factor categories labour, capital and land. The following two sections present how the shares of each factor category are estimated for cropping and livestock activities. In case of cropping activities the following order applies: First, the return to agricultural capital is estimated; second, the return to labour and finally, the return to land is computed as a residual. For livestock activities, first the return to agricultural capital in form of livestock is estimated, then the return to pasture land and finally the return to labour is determined as a residual.

6.4.1   Factor Returns of Cropping Activities

Return to Agricultural Capital in Form of Machinery

Using data from the RNR census 2009, it is possible to estimate the return to agricultural capital. Agricultural capital is included in two different accounts: (1) Powertiller and tractors and (2) Unincorporated capital. The Agricultural Machinery Center (AMC) has published information on the acquisition cost of agricultural machinery. Table 33 lists the machinery items included in the 2009 census and the cost as reported by (AMC, 2014). Some items are subsidized and in such cases the selling price is adjusted accordingly. Annualized cost of machinery is computed assuming a 10% discount rate and 10 year average economic lifetime.

Table 33 – Cost of agricultural machinery

Machinery item	Subsidy	Annualized cost	Capital account
Tractor	31.3%	164,065	Powertiller and tractors
Powertiller	50.0%	70,949	
Power Thresher		3,564	Unincorporated capital
Diesel Engine for Thresher		5,257	
Rice Mill Set		1,546	
Oil Mill Set		7,690	
Power Reaper		3,564	
Maize Sheller		2,143	
2Paddy Transplanter		1,204	
Bullock Drawn Plow (Improved)		278	
Rotary Paddy Weeder		1,204	
Power Sprayer		2,000	
P.P. Equipment		20,000	
Water Pump	70.0%	41,065	
Power Chain Saw		10,000	
Hand Operated Winnower		1,000	
Cornflake (tengma) machine		6,043	
Veg.& fruit driers		10,000	
Silo		1,567	

Source: own compilation based on MoAF, 2009 and AMC, 2014

Annualized cost per type of agricultural capital is allocated among different crop producing activities using the share of area harvested. This implicitly assumes that farmers owning agricultural machinery are using it for each crop proportionally to the share of area harvested. In case of specialized machinery (e.g. rotary paddy weeder, vegetable and fruit driers, etc.), the cost is only allocated to the crops for which the machinery is exclusively used for. Total return to agricultural capital is scaled up by 40% to reflect the increasing level of investments made in agricultural machinery between 2008 and 2012. In total, returns to powertiller and tractors are estimated to be Nu. 237 Million, while return of other agricultural machinery summarized within the account of unincorporated capital is Nu. 67 Million.

Return to Agricultural Labour and Land in Crop Producing Activities

The return to family farm and hired farm labour per activity is estimated by multiplying the labour requirement measured in person-days per hectare with total area harvested and an estimated average wage. The rationale behind this approach is that agricultural wages are assumed to be independent of the actual productivity of a crop. Farmers that cultivates e.g. a high-value crop such as spices are assumed to either be able to perform all labour themselves or to hire the required labour at the spot market wage, which in return can be considered their shadow wage. This assumption simplifies reality, as it does not account for supervision cost and differences in skills, however, the benefit of this approach is to isolate the crop productivity and thus the return to land.

The labour requirement per hectare and crop has been estimated by Feuerbacher *et al.* (2017). The estimated average daily wage for an agricultural worker is 210 Nu./person-day. This may seem like a low estimate, as often (adjusted to 2012 levels) spot market wages of up to 350 Nu./person-day are reported. However, one needs to account for seasonal fluctuations and regional differences in wages.

Hired-workers are often employed during peak labour seasons like transplanting and harvesting periods and thus wages reported during these periods cannot be used as an average.[9] Furthermore, wages are lower in Eastern and most parts of Southern Bhutan compared to West and Central-Western Bhutan.

There are three different types of cultivated land considered in the 2012 Bhutan SAM: irrigated land, rain-fed land and permanent cropland (orchards). Each land-type is disaggregated according to the three major agroecological zones (AEZ) in Bhutan, which are classified according to specific altitude ranges as listed in Table 34. Hence, in total there are nine land accounts.

Table 34 – Simplified classification of AEZs

Altitude range (meters above sea level)	AEZ 1 – Wet and humid subtropical	AEZ 2 – Dry subtropical	AEZ 3 – Temperate / alpine
Min	150	1,200	1,800
Max	1,200	1,800	4,600

Source: Own compilation based on Neuhoff *et al.*, 2014

The *humid* and *wet subtropical* AEZ is characterized by high rainfall and temperatures and provides suitable growing conditions for tropical fruit trees. The *dry subtropical* AEZ covers the medium altitude areas within Bhutan. Dependent on water availability, some crops such as maize and vegetables can be harvested two to three times a year in the subtropical zones. The climate in the *temperate / alpine* AEZ is cold and this is where the largest share of temperate crops such as apples, potatoes, wheat and barley are cultivated in Bhutan.

Crop land is classified according to these three AEZs based on Gewog level data. Gewogs are the lowest administrative unit within Bhutan and there are 205 gewogs in total. The predominant AEZ per gewog is determined using data on the altitude of gewog centres (Dukpa and Namgay, 2014), which serves as proxy for the overall altitude. As shown in Table 35, using the procedure as described above total cropland is almost evenly distributed among the three AEZs. Most cropland (37%) is located in the wet and humid subtropical AEZ, where also more than half (56.6%) of permanent cropland is located. Most rain-fed land is found in the temperate / alpine AEZ, while most irrigated land is located in the dry subtropical AEZ.

Table 35 – Distribution of cropland (in hectares) across AEZs

	Total land		Irrigated land		Rain-fed land		Permanent cropland	
AEZ 1 – Wet and humid subtropical AEZ	39,726	37.0%	7,759	37.5%	19,772	34.2%	2,593	56.6%
AEZ 2 – Dry subtropical AEZ	33,004	30.7%	7,803	37.7%	17,170	29.7%	1,286	28.1%
AEZ 3 – Temperate / alpine AEZ	34,680	32.3%	5,131	24.8%	20,838	36.1%	701	15.3%
Total	107,410	100.0%	20,693	100.0%	57,781	100.0%	4,580	100.0%

Source: MoAF, 2013a

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[9]   Spot market wages as high as 350 Nu./person-day would also not be consistent with average monthly income of agricultural workers that are reported to range between 4,000 and 6,000 Nu/month.

The differentiation between the various types of land and the different agro-ecological climates is important to reflect constraints in agricultural production. If crop land is considered one type, it would be theoretically possible to shift rice production in irrigated land to rain-fed land or to shift orange production in subtropical permanent cropland to temperate irrigated land.

Table 36 presents the estimation of labour and land return across all cropping activities. As mentioned previously, wages of agricultural workers are assumed to be constant across agricultural activities. About 6.4% of all agricultural workers are from landless farm households and are thus defined as hired farm workers. It is assumed that each cropping activity has the same share of hired farm labour, due to a lack of more detailed data.

Table 36 – Estimation of agricultural labour and land returns

Crops	Cultivated area	Labour days	Return to labour	Return to land	Land productivity in AEZ 1	Land productivity in AEZ 2	Land productivity in AEZ 3
	In hectares	Per hectare	In Million Nu.	In Million Nu.	In Million Nu. Per hectare	In Million Nu. Per hectare	In Million Nu. Per hectare
Paddy	16,678	265	927	281	13,677	17,871	19,367
Maize	23,866	145	727	64	2,708	2,297	3,360
Other Cereals and Oilseeds	9,204	102	196	78	5,962	7,381	12,069
Pulse	2,464	144	74	53	22,104	16,577	32,012
Low-value vegetables	5,078	139	148	271	32,812	37,818	75,340
High-value vegetables	2,770	180	105	444	95,133	130,877	213,904
Potato	6,181	207	269	347	12,550	16,876	72,411
Beverages and spices	2,652	145	81	459	192,607	181,627	100,392
Other Nuts and Fruits	2,319	122	59	248	74,406	189,589	232,424
Apple	703	174	26	177	295,549	272,898	252,070
Citrus fruits	3,265	144	99	761	195,164	262,454	204,830

Source: Own compilation based on Feuerbacher *et al.*, 2017; MoAF, 2013a

6.4.2 Factor Returns of Livestock Activities

Return to Agricultural Capital in Form of Livestock

Livestock itself is a form of capital, as in contrast to intermediate inputs it is not consumed within a single year. Instead it is considered a production factor that can be utilized over more than one period (i.e. year). To obtain the annual return from livestock capital, the asset value of livestock is capitalized using market prices of livestock, their economic lifetime and a discount rate of 10%. Prices and economic lifetime for cattle and poultry are obtained through personal communication with livestock experts from the MoAF for the year 2015 and adjusted for the year 2012. Livestock prices for goats, sheep and pigs (other animals) are obtained from the agricultural census 2009 and adjusted to 2012 price levels. The economic lifetime for other animals is based on the best knowledge of the authors. Table 37 lists the different livestock capital accounts, their purchasing price, economic lifetime and capitalized annual value.

Table 37 – Livestock capital accounts

	Price (Nu./head)	Economic lifetime	Capitalized annual value (Nu./head)
Female improved cattle	30,000	8	5,623
Male improved cattle	10,000	7	2,054
Female local cattle	15,000	12	2,201
Male local cattle	12,000	10	1,953
Poultry	150	2	86
Goat	2,597	6	596
Sheep	3,060	6	703
Pig	5,862	3	2,357

Source: Own compilation

Return to Pasture Land

Besides feeding livestock with fodder crops (e.g. maize) and compound feed, which is included within the intermediate inputs (use-matrix section), livestock is either grazing on native pasture, in forests or are fed with improved pasture. Fodder crops and fodder plantation are in total estimated to contribute below 5% of total dry matter (Gurung *et al.*, 2015), therefore it is neglected within the following. The forest land in which livestock grazes is virtually all owned by the government. The share in return accruing to forest land is also assumed to be zero, since farmers let their livestock graze there for no cost.

In total, it is estimated that 480,000 hectares are used as pasture land. The majority is native pasture (98%), of which 59% is in private ownership and 26% and 16% is community or government pasture land, respectively (Gurung *et al.*, 2015). Improved pasture makes up only 2% of pasture land, or 8,596 hectares, yet it has much higher yields of dry-matter per hectare (13.25 tons/hectare) compared to native pasture (0.75 tons/hectare). It is assumed that one kg dry-matter of improved and native pasture is worth 0.7 Nu./kg and 0.2 Nu./kg, respectively. In total, returns to improved and native pasture are Nu. 82 and Nu. 59 million, respectively.

Return to Labour in Livestock Activities

Return to labour in livestock activities is computed by subtracting return to livestock capital and pasture land from total value added.

6.4.3   Prior-estimates of Factor Returns in Agricultural Activities

Table 38 on the following page presents the column shares of factors across all cropping and livestock activities. The value added share is overall high ranging from 41.9% in poultry husbandry to 99.1% in citrus cultivation. The value added share in poultry and the other livestock activities is lower than in all cropping activities due to the comparably high share of intermediate inputs. Agriculture in Bhutan is known to be labour intensive, which becomes evident by the high labour shares particularly in cereal production. However, as the column shares are calculated on value basis, high relative labour input measured in physical quantity might appear low in cases of high-yielding or high-priced activities such as potatoes and vegetables. Analysing Table 38, it becomes also clear that capital in form of agricultural machinery has a very low input share in cropping activities, reflecting the low utilization levels of machinery. However, in livestock the capital share is substantial.

6.5   Factor Returns in Remaining Activities

The derivation of total value added as well as the respective shares of labour and capital of activities other than agriculture is predominantly done by using relative shares derived from the SUT 2007 or, if available, from corporate annual reports. For activities that are not incorporated (i.e. cottage and small industries), there is no information available from corporate annual reports as they don't have to file any. Furthermore, they are not represented in the SUT 2007. This concerns the production of milled cereals, dairy, ara (home-made alcohol) and goods from community forestry. In such cases, assumptions based on own expertise are made. Table 39 below lists total output, intermediate inputs, production tax and value added in million Nu. as well as each sector's share of labour and capital.

Table 38 – Column shares of factors in cropping and livestock activities

	Cropping activities											Livestock activities		
	Paddy	Maize	Other cereals and oilseeds	Pulses	Low-value vegetables	High-value vegetables	Potato	Beverages and spices	Other nuts and fruits	Apple	Citrus fruits	Cattle	Poultry	Other animals
Intermediate Inputs	**16.5%**	**16.9%**	**16.0%**	**19.3%**	**11.5%**	**6.5%**	**24.6%**	**8.3%**	**3.7%**	**6.2%**	**1.8%**	**31.8%**	**58.1%**	**27.7%**
Family farm labour	57.1%	69.9%	53.7%	42.2%	28.6%	16.4%	29.7%	12.8%	14.8%	10.4%	10.4%	13.6%	31.0%	30.7%
Hired farm labour	4.0%	4.9%	3.7%	2.9%	2.0%	1.1%	2.1%	0.9%	1.0%	0.7%	0.7%	0.9%	2.2%	2.1%
Total labour	**61.0%**	**74.8%**	**57.4%**	**45.2%**	**30.6%**	**17.6%**	**31.8%**	**13.7%**	**15.9%**	**11.2%**	**11.1%**	**14.5%**	**33.2%**	**32.8%**
AEZ1 irrigated land	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AEZ2 irrigated Land	8.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AEZ3 irrigated Land	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AEZ1 rain-fed land	0.0%	2.6%	4.9%	8.7%	7.7%	7.6%	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AEZ2 rain-fed land	0.0%	2.2%	7.2%	12.5%	13.2%	24.5%	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AEZ3 rain-fed land	0.0%	1.8%	10.7%	11.2%	35.0%	42.4%	37.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
AEZ1 permanent cropland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	47.2%	34.5%	0.3%	47.6%	0.0%	0.0%	0.0%
AEZ2 permanent cropland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	22.2%	20.5%	0.7%	32.1%	0.0%	0.0%	0.0%
AEZ3 permanent cropland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.0%	11.4%	75.9%	5.7%	0.0%	0.0%	0.0%
Improved pasture land	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.1%	0.0%	0.0%
Native pasture land	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.5%	0.0%	0.9%
Total land	**18.5%**	**6.6%**	**22.8%**	**32.4%**	**55.9%**	**74.5%**	**40.9%**	**77.4%**	**66.4%**	**76.9%**	**85.4%**	**8.6%**	**0.0%**	**0.9%**
Powertiller	6.8%	2.2%	2.8%	2.9%	3.1%	1.5%	4.1%	0.5%	2.2%	5.4%	1.9%	0.0%	0.0%	0.0%
Unincorporated capital	0.7%	0.6%	2.3%	1.7%	0.4%	0.7%	0.6%	0.6%	3.0%	3.1%	0.8%	0.0%	0.0%	0.0%
Improved female cattle	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.6%	0.0%	0.0%
Improved male cattle	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%
Local female cattle	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18.1%	0.0%	0.0%
Local male cattle	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.7%	0.0%	0.0%
Poultry	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.7%	0.0%
Other animals	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	38.6%
Total capital	**7.4%**	**2.8%**	**5.1%**	**4.6%**	**3.5%**	**2.2%**	**4.7%**	**1.1%**	**5.2%**	**8.4%**	**2.6%**	**45.0%**	**8.7%**	**38.6%**
Total value added	**86.9%**	**84.2%**	**85.4%**	**82.2%**	**90.0%**	**94.2%**	**77.4%**	**92.1%**	**87.5%**	**96.5%**	**99.1%**	**68.2%**	**41.9%**	**72.3%**

Source: Own compilation based on prior 2012 micro-SA

Table 39 – Total output, production tax and value added components in million Nu.

Economic activities	Output	Interm. Inputs	Prod. tax	Value Added	% Labour	% Capital	Data used
Paddy Milling	1,631	1,472	-	159	89.3%	10.7%	
Cereal milling	135	111	-	24	94.1%	5.9%	
Dairy production	1,755	1,070	-	685	95.9%	4.1%	
On-farm cereal processing	365	300	-	65	88.4%	11.6%	
Ara production	552	418	-	134	95.0%	5.0%	Assumed labour-capital shares
Grain mill and other food production	548	305	2	241	30.5%	69.5%	SUT 2007
Animal feed production	401	264	-	137	20.5%	79.5%	SUT 2007
Fruits and vegetables processing;	1,834	1,320	3	511	32.7%	67.3%	Company data
Community forestry	1,188	-	-	1,188	95.0%	5.0%	Assumed labour-capital shares
Commercial forestry	516	117	28	372	36.7%	63.3%	Company data
Manufacturing of wood,	1,564	1,016	7	541	64.4%	35.6%	Company data
Mining and quarrying	2,675	873	299	1,502	31.6%	68.4%	SUT 2007
Textile manufacturing	1,656	765	-	891	100.0%	0.0%	SUT 2007
Basic chemicals manufacturing	2,082	1,776	27	278	36.0%	64.0%	Company data
Rubber and plastics manufacturing	1,182	854	1	327	66.9%	33.1%	Company data
Glass product manufacturing	3,117	2,013	41	1,062	20.8%	79.2%	Company data
Basic iron and steel manufacturing	7,180	5,412	18	1,750	18.1%	81.9%	Company data
Casted iron and non-ferrous manufacturing	4,840	3,887	12	942	24.5%	75.5%	Company data
Fabricated metal manufacturing	2,192	1,457	46	689	59.1%	40.9%	Company data
Manufacturing n.e.c.	257	171	3	82	20.9%	79.1%	Company data
Electricity generation	10,291	1,052	12	9,226	5.9%	94.1%	Company data
Electricity transmission and retailing	3,643	1,473	0	2,170	27.8%	72.2%	Company data
Water	39	12	1	26	100.0%	0.0%	SUT 2007
Construction	44,894	23,476	285	21,134	41.9%	58.1%	SUT 2007
Wholesale and retail trade,	9,612	2,098	9	7,505	89.7%	10.3%	SUT 2007
Hotels and restaurants	2,397	1,017	2	1,378	55.0%	45.0%	SUT 2007
Land transportation	11,707	5,761	117	5,829	25.2%	74.8%	SUT 2007
Air transport	2,761	1,292	21	1,448	19.1%	80.9%	SUT 2007
Supporting and auxiliary transport activities;	1,373	549	5	819	21.1%	78.9%	SUT 2007
Post and telecommunications	3,142	595	2	2,545	14.6%	85.4%	SUT 2007
Financial intermediation	4,097	422	34	3,641	18.9%	81.1%	SUT 2007
Insurance and pension funding	1,922	76	3	1,844	12.1%	87.9%	SUT 2007
Real estate activities	2,071	254	18	1,799	11.0%	89.0%	SUT 2007
Business services n.e.c.	187	45	-	142	100.0%	0.0%	SUT 2007
Public administration	12,009	5,132	124	6,753	100.0%	0.0%	SUT 2007
Education	3,483	1,263	40	2,179	100.0%	0.0%	SUT 2007
Health and social work	2,793	1,080	31	1,682	100.0%	0.0%	SUT 2007
Other services	1,627	656	18	953	100.0%	0.0%	SUT 2007

6.5.1 Labour Accounts

Formally employed labour, i.e. labour outside agriculture, is disaggregated according to socio-economic characteristics as recorded by the BLSS 2012 survey. There is a high share of foreign labour in Bhutan, however labour policy does only allow for employment given certain criteria. Hence, nationality is the first criteria differentiating labour. Further, different levels of education are used as criteria to account for difference in skill levels among workers. The tree below (Figure 5) shows the disaggregation structure of non-agricultural labour.

Figure 5 – Disaggregation structure of labour accounts
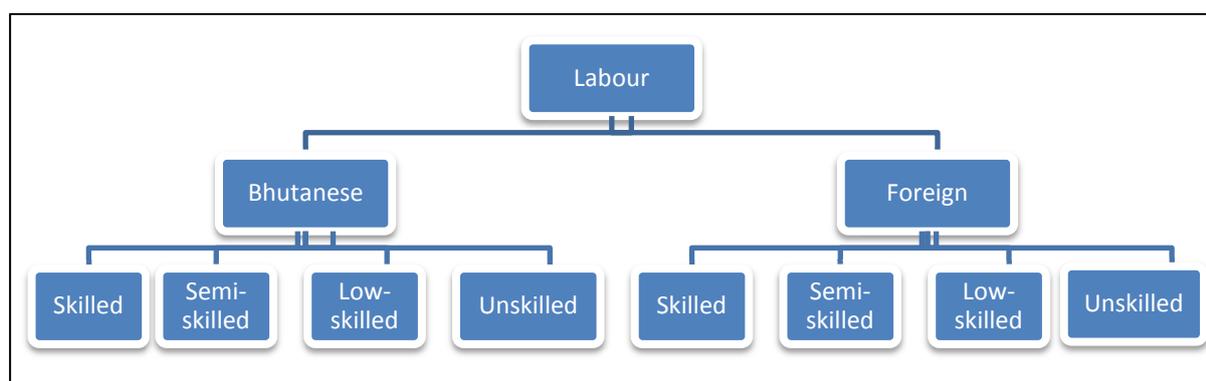
Source: Own compilation

Data on the nationality of workers is provided by the BLSS 2012 data. However, foreign workers seem to be significantly underreported within the BLSS sampling framework, as already documented in Feuerbacher (2014). Still, the BLSS data is deemed to be adequate to determine the relative distribution of skill-levels among foreign and domestic workers. Adjustments to the absolute level of foreign workers per activity are documented in sub-section 6.5.2. Table 40 presents the classification of skill-levels used to disaggregate labour:

Table 40 – Classification of skill-levels

Skill-level	Characteristics
Skilled worker	Workers with tertiary education, i.e. holding an academic degree such as diploma, bachelor, masters or PhD, are classified as skilled workers.
Semi-skilled workers	Workers that have at least passed grade 10 in high-school, but who do not hold an academic degree.
Low-skilled workers	Workers that are literate, i.e. that can read or write in any of the official languages used in Bhutan
Unskilled workers	Illiterate workers

In addition to the above classification, an adjustment is done for workers employed within the occupation group of *Managers* or *Professionals*. These occupations are classified as skill level 3 and 4 by the International Standard Classification of Occupations (ISCO-08) (ILO, 2012). All workers, previously not classified with a skill-level of at least semi-skilled or skilled, are classified skilled if they work in one of these occupation groups. Analogously, workers employed within the occupation

group *Technicians and Associate Professionals* or *Clerical Support Workers* are classified at least with a semi-skilled level, if they have not been classified as skilled previously.

The BLSS 2012 survey includes a question block on income sources per household, asking respondents how much income in cash or in kind they have received from salaries, agricultural activities, construction and own business amongst others. Even though, there is empirical evidence that households are likely to underreport their income when interviewed in surveys (Deaton, 1997), this data is nevertheless used to establish relative differences of income per labour account. Table 41 reports median and mean monthly wage income per wage-earning household.

Table 41 – Income levels per labour account

Labour account	Median	Mean	Standard Deviation	Observations	% ratio of median wage to Bhutanese skilled wage
Bhutanese skilled	15,000	17,778	18,052	1,599	100.0%
Bhutanese semiskilled	10,000	12,856	13,162	2,726	66.7%
Bhutanese low-skilled	6,674	8,822	9,650	2,610	44.5%
Bhutanese unskilled	4,167	6,903	9,614	1,134	27.8%
Foreign skilled	20,000	25,506	22,039	61	133.3%
Foreign semiskilled	10,000	13,235	12,149	61	66.7%
Foreign low-skilled	6,140	6,122	3,557	133	40.9%
Foreign unskilled	6,000	6,865	3,619	27	40.0%
TOTAL	**9,000**	**11,698**	**12,393**	**8,351**	

Source: Own compilation

Applying a one-way ANOVA Bonferroni mean-difference test shows that the difference of all mean wages of Bhutanese labour accounts is statistically significant at the 1% level. The number of observations of foreign labour is low, due to underrepresentation within the sampling framework. Differences of mean-wages of foreign labour are only statistically significant from each other for foreign skilled. Foreign semi-skilled is also statistically significant when compared to foreign skilled or low-skilled, but not when compared to foreign unskilled. The difference in mean wages of foreign low-skilled and unskilled is not statistically significant. However, especially in the case of unskilled foreign labour, the number of observations is low. Despite lacking evidence that wages for foreign low-skilled and unskilled are significantly different, we utilize the same disaggregation structure for foreign labour as for Bhutanese labour due to consistency reasons.

6.5.2   Foreign Labour-Force

Within the BLSS 2012, foreign households make up only 1,555 households or 1.2% of all households (when statistical weights are not applied, 1.7% of households are foreign). Most foreign households have left family members in their home country, which is reflected by a lower mean household size (3.2) compared to Bhutanese households (4.6). Also, dependency ratios of foreign households (20%) are about one third of Bhutanese households (59%).

According to the labour market information system (LMIS) of Bhutan's Ministry of Labour and Human Resources (MoLHR), 55,142 foreign workers have been registered in Bhutan as per 6th of May, 2013 (MoLHR, 2013b). This number is substantially larger than the number of workers

represented in the BLSS 2012 (3,082 workers), which corresponds to 1.3% of employed labour force. The labour force survey reports a similarly low share of foreign workers for the same year of 1.8% (MoLHR, 2013a). Hence, it seems that there is a systematic bias underrepresenting foreign labour in the sampling framework of both household and labour force surveys.

To adequately represent foreign workers in the 2012 Bhutan SAM, we apply the following procedure. We assume that the number of foreign workers (55,142) reported for May, 2013 is an appropriate estimate for 2012. Information of foreign worker's occupation provided by the LMIS is used to determine place of work (economic activity) of the largest share of registered workers (84.6%). For instance, there are 20,361 concrete workers and 9,984 masons registered in 2013. These workers can unequivocally be allocated to the construction sector.

Indirect allocation of occupations is applied when occupations indicate employment within the manufacturing sector, however without precisely specifying in which manufacturing activity. Additional information on employment of foreign workers per industry is used to determine the relative shares of foreign workers in overall employment. This information is obtained from the establishment census 2010 (MoLHR, 2010) and reported data for 2012 on selected medium and large industries provided by the Ministry of Economic Affairs (MoEA, 2015c). Registered occupations of workers employed within services are difficult to allocate to specific service activities, since the classification is too generalistic (e.g. "consultant" or "project manager"). In such cases, the BLSS 2012 relative shares of foreign worker employment within service activities are used for allocation.

Three out of four skill-levels (skilled, semiskilled and low-/unskilled) of foreign workers are determined based on occupations reported in the LMIS, using the ILO's correspondence of skill-levels and major occupation groups of the ISCO-08. The differentiation of low- and unskilled foreign workers is not feasible using the data on occupations. When possible, the relative share of low- and unskilled foreign workers per economic activity derived from the BLSS 2012 data is used. If not possible, the respective share of low- and unskilled domestic workers is used to approximate the distribution among foreign workers. The final estimated absolute number of foreign workers as well as their relative share of total employment per sector is presented in the following section.

6.5.3   Summary Data for Labour Accounts

The total labour return in Million Nu., average monthly wage as well as the satellite account data for all labour accounts is presented in Table 42.

Table 42 – Satellite account data for labour force

Economic activity	Labour return (in Million Nu.)	Total employed	Number of employees per labour account and activity								
			Family farm labour	Hired farm labour	Skilled Bhutanese	Semi-skilled Bhutanese	Low-skilled Bhutanese	Unskilled Bhutanese	Skilled Foreign	Semi-skilled foreign	Low-skilled foreign	Unskilled foreign
Farm activities (Crop + Livestock)	3,191	95,511	89,492	6,018	-	-	-	-	-	-	-	-
Paddy Milling	142	4,248	4,063	184	-	-	-	-	-	-	-	-
Cereal milling	22	672	642	30								
Dairy production	657	19,666	18,837	828	-	-	-	-	-	-	-	-
On-farm cereal processing	58	1,726	1,726						-	-	-	-
Ara production	127	3,815	3,815		-	-	-	-	-	-	-	-
Grain mill and other food production	74	376			29	70	261	16				
Animal feed production	28	166			13	31	115	7	-	-	-	-
Fruits and vegetables processing	167	767			46	111	415	25	9	22	-	139
Community forestry	1,128	33,782	31,817	1,965	-	-	-	-	-	-	-	-
Commercial forestry	137	1,240			243	645	168	74	6	3	-	102
Manufacturing of wood,	348	2,291			429	508	735	463	10	17	47	82
Mining and quarrying	475	2,776			79	474	430	485	50	82	-	1,176
Textile manufacturing	891	13,024	9,210	1,499	22	247	892	1,051	28	26	49	-
Basic chemicals manufacturing	100	468			67	192	134	28	2	21	-	24
Rubber and plastics manufacturing	219	590			78	84	300	63	6	17	10	32
Glass product manufacturing	221	1,218			189	486	281	195	3	6	59	-
Basic iron and steel manufacturing	318	1,644			48	208	173	16	43	82	614	461
Casted iron and non-ferrous manufacturing	230	1,191			35	150	125	12	31	59	445	334
Fabricated metal manufacturing	407	1,930			76	201	39	25	57	100	1,432	-
Manufacturing n.e.c.	17	91			25	11	19	18	2	3	-	13
Electricity generation	540	2,982			342	1,344	1,075	177	12	6	-	26
Electricity transmission and retailing	603	3,266			538	1,377	837	321	47	54	92	-
Water	26	105			-	48	56	-	-	-	-	-

Economic activity	Labour return (in Million Nu.)	Total employed	Number of employees per labour account and activity									
			Family farm labour	Hired farm labour	Skilled Bhutanese	Semi-skilled Bhutanese	Low-skilled Bhutanese	Unskilled Bhutanese	Skilled Foreign	Semi-skilled foreign	Low-skilled foreign	Unskilled foreign
Construction	8,851	52,302			935	3,166	2,785	521	155	687	24,634	19,419
Wholesale and retail trade,	6,733	17,626			1,761	5,271	5,636	4,854	6	14	67	17
Hotels and restaurants	758	5,636			460	1,875	1,794	1,275	13	18	141	61
Land transportation	1,471	8,486			97	1,159	3,987	1,744	64	130	473	832
Air transport	276	719			230	260	202	17	8	0	-	2
Supporting and auxiliary transport activities;	173	1,768			427	847	463	11	5	3	-	11
Post and telecommunications	372	1,400			310	586	155	34	19	54	-	242
Financial intermediation	687	2,502			1,192	982	257	52	7	2	-	9
Insurance and pension funding	223	738			446	246	45	-	-	-	-	-
Real estate activities	198	844			34	262	381	158	3	1	-	6
Business services n.e.c.	142	595			203	213	109	57	4	2	8	-
Public administration	6,753	28,623			5,102	8,085	10,514	4,921	-	-	-	-
Education	2,179	15,324			9,046	3,077	1,801	692	213	120	373	-
Health and social work	1,682	5,750			1,108	2,494	1,154	133	721	44	-	95
Other services	953	8,673			902	3,451	2,864	1,164	67	43	104	79
TOTAL	**41,577**	**344,529**	**159,603**	**10,525**	**24,514**	**38,161**	**38,200**	**18,610**	**1,592**	**1,616**	**28,547**	**23,162**

Source: Own compilation

6.6   Capital

Rather than pooling all capital return in one account, the 2012 SAM for Bhutan disaggregates capital into three capital account types: private capital, public capital and unincorporated capital.

6.6.1   Private Capital

Private capital represents equity shares in incorporated companies owned by private households, whether these shares are privately hold or traded on the Royal Securities Exchange of Bhutan. Returns to private capital are channeled to the private enterprise account and returns to public capital to the public enterprise account, analogously. Details on the enterprise accounts are presented in section 7.4.

6.6.2   Public Capital

Public capital is defined as equity shares in incorporated companies either wholly or partially owned by the state. State-owned enterprises (SOE) as well as state controlled enterprises (more than 50% owned by the state) play a significant role in Bhutan. Dividends paid to SOEs are an important source of government budget and do not represent income to private households. The Royal Government of Bhutan (RGoB) either owns a company directly (i.e. direct state holding) or indirectly through its investment company, the Druk Holding and Investment (DHI) enterprise. The most relevant SOEs in Bhutan are listed in Table 43. For a few enterprises, especially those that are not administered by DHI, no data is available on their annual revenue and their share of sector output. However, these companies are believed to be small and thus negligible as regards their role in paying dividends to the government.

6.6.3   Unincorporated Capital

Besides returns to incorporated capital, whether hold by private households or the public, there are returns to unincorporated capital, which is referred to informal capital in the following. Informal capital can be understood as a component of mixed income. It consists of returns to machinery used in crop, livestock and post-harvest activities. The procedure of estimating returns to informal capital used in agricultural activities (powertillers; other machinery; livestock types) is already documented in section 6.4. Further activities with returns to informal capital are cereal milling; dairy production; cereal processing and ara production. Returns on informal capital are directly channelled to farm-household accounts.

Table 43 – Overview of State-Owned Enterprises – based on 2012 data

Abbr.	Company name	Sector	Direct state holding	DHI holding	Revenue in (in million Nu.)
DGPC	Druk Green Power Corporation Ltd.	Electricity generation		100%	11,141
BPC	Bhutan Power Corporation Ltd.	Electricity distribution		100%	4,140
NRDCL	Natural Resources Development Corporation Ltd.	Forestry and mining		100%	485
BTL	Bhutan Telecom Ltd.	Telecommunications		100%	2,209
Drukair	Druk Air Ltd.	Air transportation		100%	2,761
BOBL	Bank of Bhutan Ltd.	Financial services		80%	2,136
BNBL	Bhutan National Bank Ltd.	Financial services		12%	2,175
RICBL	Royal Insurance Corporation of Bhutan Ltd.	Insurance services		18%	542
	DHI Infra Ltd.	Real Estate		100%	14
	Thimphu Tech Park Pvt. Ltd	Real Estate		31%	-
STCBL	State trading corporation Bhutan Ltd.	Trading		51%	1,010
DPL	Dungsam Polymers Ltd.	Manufacturing of rubber and plastics		100%	27
PCAL	Penden Cement Authority Ltd.	Manufacturing of glass products		40%	2,080
BFAL	Bhutan Ferro Alloys Ltd.	Manufacturing of basic iron		26%	2,143
BBPL	Bhutan Board Products Ltd.	Manufacturing of wood		48%	328
	Bhutan Postal Corporation	Telecommunications	100%	*	102
BDBL	Bhutan Development Bank Limited	Financial services	96%	*	725
	Bhutan Agro Industries	Food and beverage production	100%		92
KCL	Kuensel Corporation Limited	Manufacturing of wood	51%		184.3
FCB	Food Corporation of Bhutan	Wholesale and Trade	100%	*	982.96
	Wood Craft Center	Wood Manufacturing	100%	*	70
CDCL	Construction Development Corporation limited	Construction	100%	*	589.21
AWP	Army Welfare Project	Food and beverage production	100%		816.737
	National Pension and Provident Fund	Insurance services	100%	NA	NA
	National Housing and Development Corporation	Rental services	100%	NA	NA
BBS	Bhutan Broadcasting Services	Telecommunications	100%	NA	NA

* ownership transferred to DHI in 2014 (DHI, 2014)
Source: Own compilation based on DHI, 2013, 2014; Kharka, 2015

6.6.4 Disaggregation of Capital

Table 44 reports the disaggregation of capital accounts across economic activities. Activities performed on the household level (cereal milling and processing, dairy and ara production) have solely returns to informal capital. Electricity generation and distribution are the only two sectors with a hundred percent share of public capital. Other sectors with significant shares of public capital are post and telecommunications; fruits and vegetable processing and financial intermediation.

Table 44 – Disaggregation of capital

Economic activity	Private capital % share	Public capital % share	Unincorporated capital % share
Paddy Milling	0.0%	0.0%	100.0%
Cereal milling	0.0%	0.0%	100.0%
Dairy production	0.0%	0.0%	100.0%
On-farm cereal processing	0.0%	0.0%	100.0%
Ara production	0.0%	0.0%	100.0%
Grain mill and other food production	100.0%	0.0%	0.0%
Animal feed production	100.0%	0.0%	0.0%
Fruits and vegetables processing;	100.0%	0.0%	0.0%
Community forestry	100.0%	0.0%	0.0%
Commercial forestry	48.6%	51.4%	0.0%
Manufacturing of wood,	91.6%	8.4%	0.0%
Mining and quarrying	100.0%	0.0%	0.0%
Textile manufacturing	0.0%	0.0%	0.0%
Basic chemicals manufacturing	100.0%	0.0%	0.0%
Rubber and plastics manufacturing	100.0%	0.0%	0.0%
Glass product manufacturing	73.6%	26.4%	0.0%
Basic iron and steel manufacturing	95.3%	4.7%	0.0%
Casted iron and non-ferrous manufacturing	100.0%	0.0%	0.0%
Fabricated metal manufacturing	100.0%	0.0%	0.0%
Manufacturing n.e.c.	100.0%	0.0%	0.0%
Electricity generation	0.0%	100.0%	0.0%
Electricity transmission and retailing	0.0%	100.0%	0.0%
Water	100.0%	0.0%	0.0%
Construction	100.0%	0.0%	0.0%
Wholesale and retail trade,	100.0%	0.0%	0.0%
Hotels and restaurants	100.0%	0.0%	0.0%
Land transportation	100.0%	0.0%	0.0%
Air transport	0.0%	100.0%	0.0%
Supporting and auxiliary transport activities;	100.0%	0.0%	0.0%
Post and telecommunications	36.1%	63.9%	0.0%
Financial intermediation	70.3%	29.7%	0.0%
Insurance and pension funding	94.4%	5.6%	0.0%
Real estate activities	100.0%	0.0%	0.0%
Business services n.e.c.	0.0%	0.0%	0.0%
Public administration	0.0%	0.0%	0.0%
Education	0.0%	0.0%	0.0%
Health and social work	0.0%	0.0%	0.0%
Other services	0.0%	0.0%	0.0%

Source: Own compilation

7   Households and Enterprises

This chapter presents the classification and disaggregation of household accounts, the mapping of household factor income, of household consumption and households transfers as well as finally satellite account data. The primary data source used is the BLSS 2012. Two important adjustments had to be made concerning the actual size of population and the share of foreign households. According to the BLSS 2012, there are 127,942 households of which 98.8% are Bhutanese and 1.2% foreign households in 2012 (ADB and NSB, 2013a).

The underlying sample framework of the BLSS 2007, in contrast, estimated that there are 125,491 households already in 2007 (NSB, 2007). Further, the average household size based on BLSS 2007 data is 5.0, which is significantly higher than the household size in 2012 of 4.6. Consequently, based on the statistical weights used in the BLSS 2012 the population of Bhutan would have declined from about 620,261 to 585,974 between 2007 and 2012; which results in an average negative population growth of 1.4% annually.

The last population census has been conducted in 2005, reporting that 634,982 people lived in Bhutan. Based on population projections from 2005 to 2015, the population of Bhutan is expected to reach 757,042 in 2015, growing at 1.77% annually (NSB, 2008). Following the projections, population in 2012 is estimated to be 720,680 people, which is substantially higher than represented in the BLSS 2012. While this number, being a projection, is still uncertain, it nevertheless seems to be more reliable. As a consequence, default statistical weights are scaled up to arrive at the projected population for 2012.

Another adjustment is made to the share of foreigners residing in Bhutan. Foreign households, as previously discussed, seem to be underrepresented within the BLSS sampling framework (the BLSS 2007 also reports a similarly low share of only 2.1% foreign households). The number of foreign households is scaled up matching the number of foreign workers as presented within the satellite account data of labour force. The two adjustments result in a population of 720,680 Bhutanese and 92,112 foreigners, summing up to an estimated total population of 812,792 people in 2012. Households within which at least half of members are foreigners are defined as foreign households. There are an estimated 26,453 foreign households with an average household size of 3.1 representing 82,592 foreigner or 89.7% of total foreigners in Bhutan. There are 160,321 Bhutanese households with an average household size of 4.6, representing the projected Bhutanese population of 720,680 plus the remaining 9,520 foreigners which live among Bhutanese households.

7.1   Classification of Household Accounts

There are different characteristics according to which household accounts can be separated, such as disaggregation according to income classes (e.g. disaggregation by income quantiles), ethnicity, geographic area and source of income. For the 2012 SAM, nationality (Bhutanese versus foreign), area (urban versus rural) and the source of income are characteristics used to separate households. Cicowiez et al. (2017) found that such a strategic disaggregation is more precise in simulating changes in income distribution and poverty levels compared to disaggregation by income deciles. There are four generic household account types, depending on whether households receive most of their income from (1) labour, (2) capital or (3) agriculture or (4) whether they are dependent on transfers such as

pensions, intra-household transfers or remittances. The disaggregation structure is presented in Figure 6 in more detail.

Figure 6 – Disaggregation structure of households
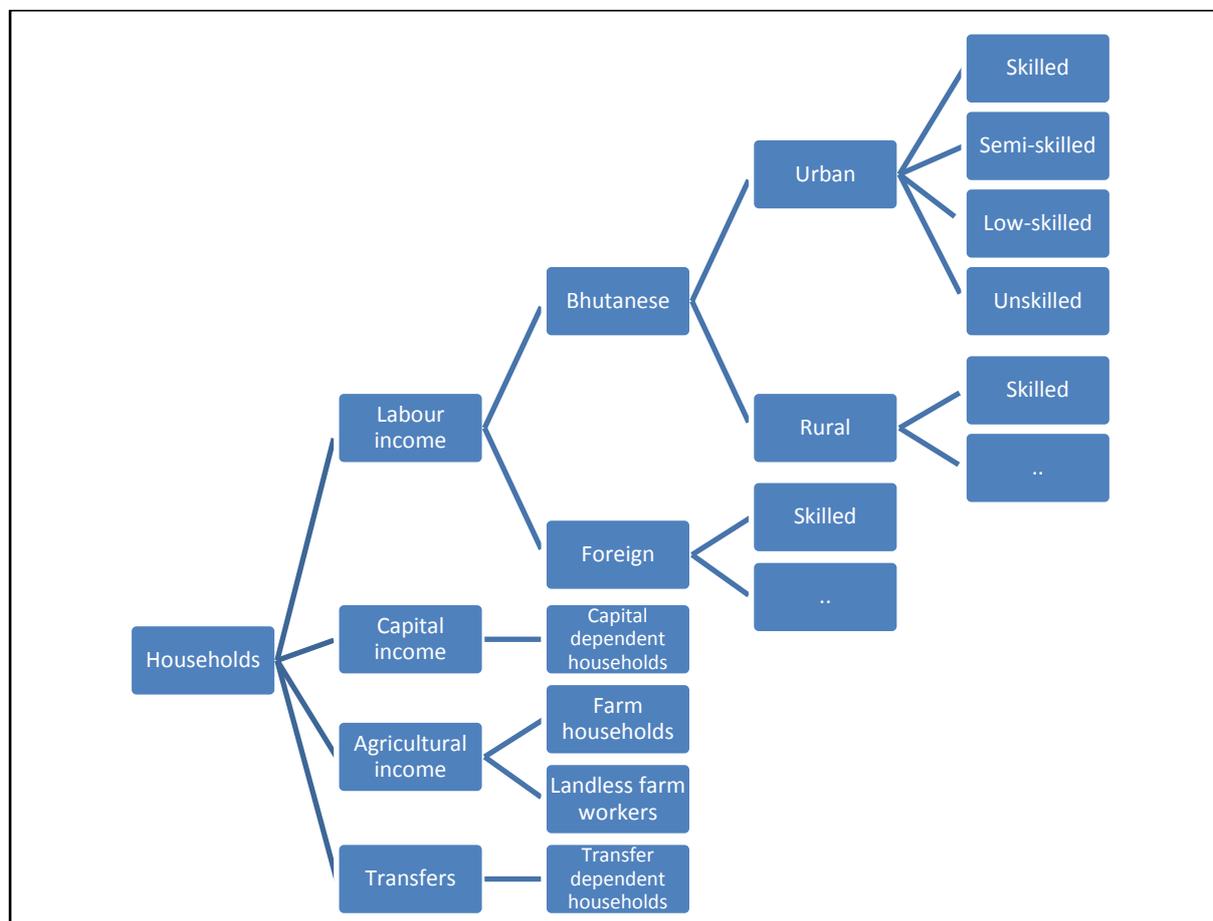
Source: Own compilation

7.1.1   Labour Income Households

Households that receive majority of their income from labour are disaggregated into Bhutanese and foreign households. Bhutanese households are further disaggregated into rural and urban households. Rural and urban households as well as foreign households are then disaggregated according to which labour type households are most dependent on. If two or more labour-types are equally represented within households (e.g. one member works as a skilled and another as a semi-skilled worker) then the household is classified according to the labour-type representing the highest skill-level.

7.1.2   Capital Income Households

Households that receive the majority of their income from capital are grouped in a "capital dependent household" account. The criteria applied is that per adult equivalent households receive at least Nu. 300,000 from capital annually or capital income makes up at least 50% of household income, while

the annual per adult equivalent income from capital exceeds 150,000 NU. In total, capital dependent households represents of 3,120 households or 12,700 people, respectively.

7.1.3   Agricultural Income Households

If there is at least one household member reporting to work in agriculture, then the household may be considered a household dependent on agricultural income. If the household owns less than 0.1 hectare, following the definition of Jayne *et al.* (2003), it is defined as landless, thus belonging to the landless farmer household. The remaining households are defined as farming households. About 6,416 households or 8.4% of total agricultural households in 2012 are classified as landless farmers and 69,858 households (91.6%) are farming households. Further disaggregation of the remaining agricultural households by farming system, market orientation, etc. is possible, yet not pursued within this SAM development procedure.

7.1.4   Transfer-dependent Households

Households that neither fall into one of the above categories, i.e. they do not have household members receiving a wage, they do not classify as capital dependent or agricultural income households, then they are classified as transfer-dependent households. Transfer-dependent households receive their income from pensions, domestic and foreign remittances.

7.1.5   Satellite Account Data on Households

Table 45 presents summary data including satellite account data on the household accounts. Please note that the estimated total population exceeds the official population projections for 2012. This is due to the apparent underestimation of foreigners residing in Bhutan, which we estimate at 92,112 people.

Table 45 – Summary data on household accounts

Household (HH) type	Mean HH-size	# of HHs	% of total HHs	Population	% of pop.
Urban skilled	4.1	12,319	6.6%	51,022	6.3%
Urban semiskilled	4.2	18,507	9.9%	76,990	9.5%
Urban low-skilled	4.4	15,122	8.1%	65,823	8.1%
Urban unskilled	4.5	6,014	3.2%	26,886	3.3%
Foreigners skilled	2.8	1,264	0.7%	3,547	0.4%
Foreigners semiskilled	3.3	964	0.5%	3,188	0.4%
Foreigners low-skilled	3.8	12,578	6.7%	47,600	5.9%
Foreigners unskilled	2.4	11,647	6.2%	28,257	3.5%
Capital dependent	4.1	3,119	1.7%	12,700	1.6%
Rural skilled	3.7	4,931	2.6%	18,284	2.2%
Rural semiskilled	4.2	5,575	3.0%	23,450	2.9%
Rural low-skilled	4.4	6,499	3.5%	28,590	3.5%
Rural unskilled	4.4	2,770	1.5%	12,053	1.5%
Farm households	3.4	9,190	4.9%	31,306	3.9%
Landless-farmer	5.1	69,858	37.4%	355,836	43.8%
Transfer dependents	4.2	6,416	3.4%	27,259	3.4%
TOTAL households	**4.4**	**186,775**	**100.0%**	**812,792**	**100.0%**

Source: Own compilation

7.2   Mapping of Household Income

7.2.1   Factor Income

Households receive factor income from returns of labour, capital and land. The mapping of factor income to households is prepared using data on income per source and household reported by the BLSS 2012 data. The BLSS 2012 dataset includes a separate block of questions asking households on their annual income from various sources, ranging from wages, agricultural activities, own business over to remittances and pensions.

Mapping labour returns to households, we compute the relative distribution of workers within each labour account type across household accounts. Thus the share of e.g. how much skilled workers belong to urban skilled households is determined and labour return can be distributed among the various household accounts.

Capital returns to households are mapped in a similar way. Returns to incorporated capital, both private and public capital, are first channelled to enterprise accounts (see section 7.4 on enterprises for more details). While public enterprises (i.e. SOEs) pay dividends to the government, dividends paid by private enterprises represent income to households. As each households reports its annual income from capital (own business), we can estimate the relative distribution of capital return across households. Given the nature of its classification, the largest share of capital income (47%) is channelled to the capital dependent household account

Returns from agricultural land are distributed among households according to the reported landownership in the BLSS 2012. A substantial amount of agricultural land in Bhutan is owned by the members of the clerical and monarch community. However, no data is available to what extent this land is leased out to farmers and at what land lease rate.

7.2.2   Household Transfers

Besides income from factors, household receive transfers through domestic remittances (intra-household transfers), inward remittances (received from abroad) and the government (e.g. pensions). The distribution of these transfers is estimated using BLSS 2012 data, which includes questions on income received from remittances and pensions. There is, however, no differentiation whether remittances received or sent originate from abroad or from within Bhutan.

Remittances Sent by Households

BLSS 2012 data is used to derive the distribution of both remittances sent abroad and to domestic households. Remittances sent abroad are assumed to originate from all households except farm and landless farmer households. According to the BoP, Nu. 1,535 Million is sent in remittances abroad. For domestic remittances sent, the BLSS 2012 shares are used for all household accounts. While the RMA uses information from bank transfers to estimate remittances send or received from abroad (RMA, 2014), there are no official statistics on domestic remittances. It is assumed that domestic remittances make up 3% of GDP (about Nu. 2,923 Million).

Remittances Received by Households

The BLSS also does not differentiate between remittances received from abroad and from domestic households. In 2012, according to the BoP 2012, about Nu. 692 Million in outward remittances are received from abroad, which are distributed using relative shares derived from BLSS 2012 data. To obtain an estimate for domestic remittances received, the above estimate (3% of GDP) is applied. As there is no data available on estimating which household type sends remittances to another household account, we distribute the amount of domestic remittances sent by each household with equal shares among all households. The shares used to distribute remittances received is also obtained from the BLSS 2012.

Government Transfers Received by Households

Government transfers consist largely of pensions. Income from pensions is also included within the BLSS 2012. In total, about Nu. 1,502 Million of government transfers are paid out to households (MoF, 2013a). These transfers are distributed among households using relative shares derived from BLSS 2012 data.

7.2.3 Household Income Shares

The previous sections have documented the various income sources of households. Table 46 below presents the share of income sources in total household income across all household types.

Table 46 – Income sources of households

Household Type	Factors				Transfers			
	Labour	Incorp. capital	Unincorp. capital	Land	Domestic remittances received	Pensions	Remittances from abroad	TOTAL
Urban skilled	81.4%	15.4%	0.0%	0.1%	0.9%	1.6%	0.7%	100.0%
Urban semiskilled	85.4%	10.3%	0.0%	0.1%	0.2%	3.1%	0.9%	100.0%
Urban low-skilled	84.2%	11.1%	0.0%	0.1%	0.7%	3.8%	0.1%	100.0%
Urban unskilled	80.7%	15.3%	0.0%	0.1%	2.6%	1.0%	0.3%	100.0%
Foreigners skilled	84.2%	13.8%	0.0%	0.0%	0.0%	2.0%	0.0%	100.0%
Foreigners semiskilled	82.6%	13.4%	0.0%	0.0%	0.0%	4.0%	0.0%	100.0%
Foreigners low-skilled	98.5%	1.1%	0.0%	0.0%	0.0%	0.4%	0.0%	100.0%
Foreigners unskilled	99.3%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	100.0%
Capital dependent	23.6%	74.6%	0.0%	0.0%	0.1%	1.3%	0.4%	100.0%
Rural skilled	95.0%	2.2%	0.0%	0.1%	0.5%	0.4%	1.8%	100.0%
Rural semiskilled	86.5%	7.9%	0.0%	0.2%	2.8%	0.4%	2.2%	100.0%
Rural low-skilled	85.8%	10.1%	0.0%	0.3%	2.6%	1.0%	0.3%	100.0%
Rural unskilled	86.5%	11.6%	0.0%	0.2%	0.4%	1.2%	0.0%	100.0%
Farm households	0.0%	10.0%	0.0%	0.5%	56.1%	19.1%	14.3%	100.0%
Landless-farmer	52.5%	6.9%	7.2%	20.9%	9.1%	2.4%	0.9%	100.0%
Transfer dependents	73.6%	11.6%	6.3%	0.0%	5.6%	2.4%	0.6%	100.0%

Source: Own compilation based on prior 2012 micro SAM

7.3   Mapping of Household Consumption

As previously described in the supply-matrix chapter, this SAM differentiates between HPHC commodities valued at basic prices and commodities purchased via markets valued at purchasing prices. The BLSS 2012 survey includes a large block of questions asking households on their expenditure on both food and non-food items. Determining the relative share of each household account's expenditure in total household expenditure per commodity can be done using the BLSS 2012 data. However, the challenge lies in estimating total household expenditure per commodity as there are no official estimates that approximately match the SAM's level of disaggregation. Hence, total household consumption per commodity needs to be estimated. This can be done either by using BLSS 2012 data or computing it as a residual.

While the first option comprises a bottom-up approach based on empirical data, it also faces various limitations. Determining the household's absolute expenditure on all commodities, one would need an almost comprehensive coverage of expenditure items. As mentioned, the BLSS 2012 covers questions on the consumption of a wide range of food items. However, in case of some commodities (e.g. glass products), there are only one or two items included in the BLSS 2012, which certainly leads to underestimation of consumption in absolute terms of these specific commodities. This problem does not affect most food items. For these items, the BLSS 2012 includes very detailed questions, e.g. asking for a wide range of vegetables and fruits. However, estimating absolute expenditure on agricultural goods and food is problematic due to seasonal effects. The BLSS 2012 has been conducted between March and May 2012. Consequently, household expenditure for off-season goods, e.g. citrus or apples, is underrepresented. Last but not least, households have to recall their expenditure over three recall periods (7 days, 30 days and annually). The longer the recall period, the more uncertain household responses are.

Alternatively to using a bottom-up approach in estimating household consumption per commodity, it is possible to compute the residual of expenditures on commodities. This is done by considering the sum of commodity output and imports valued at purchaser prices (sum of commodity columns) and subtracting intermediate consumption of commodities, government consumption, capital expenditure and exports. This approach also bears the risk, that if total demand of industries, government or export markets is over- or understated, then household consumption in turn is under- or overstated. Even if the demand per commodity of other institutions and markets is deemed to be reliable, one still needs to take into account stock changes. For the 2012 SAM estimation, no detailed data on stock changes is available, which needs to be taken into account when applying the top-down approach of estimating household consumption per commodity.

In the national accounts 2013, private final consumption per item category is reported (NSB, 2013). This information is not sufficient to estimate total private final consumption for each commodity account represented in the SAM, however it is useful to compare it to final expenditure per item category estimates computed using BLSS 2012 data and by applying the residual method. As Table 47 shows, the residual estimate of total private final consumption is very close to the national account 2012 figure. Total private final consumption using the BLSS 2012 data is however significantly lower.

Table 47 – Private final consumption per item category (in Million Nu.)

Consumption items	BLSS 2012	Residual	National account 2012
Food and non-alcoholic beverages	13,200	17,401	16,454
Alcoholic Beverages, Tobacco & Narcotics	413	2,652	1,216
Clothing and Footwear	518	2,601	2,868
Housing, water, electricity, gas	5,312	5,344	9,516
Furnishing, Household equipment & Routine Household Maintenance	706	1,526	1,592
Restaurants & Hotel	511	578	1,325
Transport	720	3,109	1,993
Communication	795	1,184	600
Health	256	NA*	1,138
Education	468	NA*	1,267
Recreation & Culture	937	1,942	479
Miscellaneous Goods and Services	1,547	6,365	4,243
Final private expenditure	**25,383**	**42,702**	**42,690**

* It is not possible to calculate a residual for health and education expenditure as the actual share of government expenditure is not explicitly reported.
Source: based on authors own analysis and NSB (2013)

Even though both approaches have their shortcomings, the second approach (residual computation) is believed to be more appropriate and is thus applied. For health and education, total household expenditure is assumed to be equal to the NA 2012 figures. Further challenges arise for specific items for which the residual approach results in unrealistic budget shares (i.e. column shares) in total household expenditure. This is particularly the case for the food budget shares of potatoes, spices, apples and citrus fruits. All four are major export agricultural crops traded in large volumes. Thus, possible explanations could be underestimation of exports, but also stock changes. This is considered later on in the estimation of the stock changes account as well in configuring error bounds of exports within the SAM estimation process.

As previously mentioned, BLSS 2012 data is used to compute relative shares of household consumption. This is not necessary for HPHC goods, which are only consumed by farm households, i.e. their relative share is 100%. A small number of commodities is not represented in the BLSS questionnaire, for example non-wood forest products. In such cases, the relative shares of similar commodities is used as a proxy. Absolute consumption on commodities per household is simply computed by multiplying the relative shares times the estimated total household consumption per commodity.

7.4   Enterprises

All returns to capital, except unincorporated capital, are channelled as income to either the private enterprise or SOE account. Returns from informal capital are directly transferred to the household accounts. Enterprises are defined as commercial legal entities that are registered or incorporated. In the context of Bhutan, these enterprises can also be simply distinguished from unincorporated businesses since the former has to file tax declarations for business or corporate taxes. The distinction between private and SOEs as well as private and public capital is documented in section 6.6.

The 2012 SAM includes one private enterprise and one SOE account. Income to the enterprise account is equal to the sum of either private or public capital returns. Enterprise accounts record no consumption of intermediate inputs, as this is already captured in the use-matrix of activities. The after-tax income from returns of capital is either paid out as dividends to the respective shareholders, paid as interest expenses or saved as retained earnings. Depreciation of capital is already captured as a transaction of capital accounts to the savings account.

The dividend ratio, calculated as the share of dividends in net profit, is used to obtain the share of retained earnings and dividends paid to capital owners. For both private enterprise and SOE account, the dividend ratio is derived from available annual corporate reports and from DHI (DHI, 2013; RMA, 2014). Income taxes paid, whether corporate or business taxes, is first calculated for the SOE account, as most information is available. Afterwards, tax payments of private enterprises is derived as a residual by subtracting tax payments of SOEs from total corporate and business tax income to the government as recorded in the macro SAM. Using the same procedure, the transfer of capital returns to the rest of the world account is computed.

8 Government, Capital and Rest of the World Accounts

8.1 Government

8.1.1 Government Expenditure and Savings

Government expenditure on public administration, education and health

There is only one government account in the 2012 SAM, thus the transactions of the government account are mostly identical to the transfers recorded in the macro-SAM. Government expenditure consists of only three commodities (or rather services): public administration, education and health. Information on total current and capital expenditure for 2012 by the RGoB is reported within the financial statements for the fiscal years 2011-12 and 2012-13 (MoF, 2013a, 2012a). However, there is no explicit data on government expenditure on public administration, education and health. Instead, we calculate government expenditure for these items as a residual after subtracting activity and household expenditure (which is based on the NA estimates) from the total output value. Doing so, we arrive at Nu. 15,150 million, which is a significantly lower prior estimate for total government consumption as the official estimate (Nu. 18,691 million).

Our lower estimate for government expenditure is in line with levels of total current expenditure reported in the financial statements which are Nu. 13,901 million. The potential discrepancy with the national accounts statistics might derive from the SUT 2007 structure, which assumes that the government consumes all public administration, education and health services. This would explain why the reported output of these services in the national accounts 2012 of Nu. 18,229 million are almost as high as the official estimate of aggregate government consumption. However, there are good reasons to justify to use a lower level of government expenditure as reflected by the residual. First, as mentioned, the disaggregated schedule of the government's current expenditure only amounts to Nu. 13,901 million. Second, the 2012 national accounts also report household consumption of health and education services, which in sum amounts to 2,405 million Nu and needs to be subtracted from the total output.

Government transfers

There are no public safety net programs in Bhutan and the only component within Bhutan's social protection system in 2012 Bhutan is a civil service pension system (World Bank, 2010; RMA, 2013, 2014). As also reported in the macro-SAM, there is a total transfer between the government and households of Nu. 1,502 Million. Data from the BLSS 2012 is used to determine the relative distribution of government-households transfer among household accounts.

Government savings

We impute government savings by subtracting total government expenditure from government income.

8.1.2   Government Income

Government income is derived from various channels. Tax revenue makes up about 42% of government income and from a policy analysis perspective, information on taxes is of special interest. In the following, it is briefly described on how the transactions between tax accounts and respective tax payers (commodities, activities, etc.) is derived.

Customs Duty

There is no explicit information available on how much custom duties are received per commodity. Bhutan and India have a free trade agreement, so custom duties are only levied on imports from countries other than India (COTI). The tariff rates for commodities classified by six-digit HS code have been made available by the Ministry of Finance (MoF, 2012b). As the import value in 2012 from COTI reported by HS six-digit codes is also available (UN, 2015a), custom duty levied per reported import item is estimated and aggregated according to the commodity account structure of the 2012 SAM. One factor complicating this procedure is, that during the global financial crisis a fiscal incentive policy has been passed that included various sales tax and custom duty exemption for the manufacturing and service sector (MoF, 2010). Therefore, adjustments are necessary to scale down the estimated custom duty of Nu. 1,535 Million to the officially reported 372 Million Nu. A similar procedure is also necessary for the estimation of sales tax.

Excise Duty

There are two types of excise duties that are levied on goods consumed in Bhutan: Excise duty levied on alcoholic beverages produced in Bhutan and excise duty levied on goods produced in India and exported to Bhutan. The former is regulated by Bhutanese laws, while the latter is subject to legislation in India. Instead of refunding the Indian excise duty to Bhutanese importers, there are annual bilateral meetings between the government of India and Bhutan in which the refund of excise duty paid by Bhutanese importers is negotiated. This excise duty refund is then refunded by the Indian government to the Bhutanese government. Hence, in practice the excise duty can be considered a tax on imports from India, which is not regulated by Bhutan, but which nevertheless is a source of government revenue to the Bhutanese government. Within the 2012 SAM, both excise duties are represented as separate tax accounts.

The Bhutanese excise duty on alcoholic beverages ranges between 30% and 75% (MoF, 2016) and directly corresponds to the Alcohol and Tobacco products commodity account. According to the government revenue report, the excise duty on alcoholic products is Nu. 482 Million in 2012 (MoF, 2013a).

There is no data on refunded Indian excise duty on the commodity level, instead there is only information on the annual excise duty refund, which is Nu. 2,673 Million for 2012 (MoF, 2013a). Breaking the Indian excise duty down on the commodity level is estimated using the excise duty rates levied in India and multiplying them with Bhutanese import data. Further, there are various exceptions in which no Indian excise duty is levied since products are declared as goods exported to Bhutan. For instance, goods imported from India used for the construction of hydropower projects are net of Indian excise duty. These exceptions had to be taken into account when estimating the excise duty on the

commodity level. Due to a lack of data, assumptions are made on the share of imports relating to hydropower projects.

Sales Tax

Sales tax are levied either on the time of import regardless of country of origin or are levied at the point of sale if the good is produced domestically. In 2012, revenue from sales tax is Nu. 2,281 Million. Sales tax rates are published for each good classified by the HS six-digit code (MoF, 2012b), however, again no disaggregated data on sales tax revenue per commodity is available. Further, the fiscal incentive policy also included sales tax exemptions, for example for raw materials and packaging used by manufacturing industries. A simple mean sales tax is computed for each account category, as no detailed data on domestic production based on the HS six-digit level is available. The sales tax base sales per commodity is approximated by the value of domestic supply measured in basic prices plus value of imports (in CIF terms) minus the export value. The tax base is then multiplied by the simple mean tax rate to arrive at the estimated sales tax revenue per commodity. For some specific commodities or group of commodities sales tax revenue is reported, in this case the officially reported tax revenue is used. For all remaining commodities, the estimated sales tax revenue is adjusted tax exemptions and uniformly downscaled to match the reported total sales tax.

Direct Tax

Direct taxes include corporate income tax, business income tax and personal income tax. Also, while not technically a direct tax, 25% of motor vehicle tax revenue is included within the 2012 SAM direct tax account. This is based on the assumption, that 25% of motor vehicle tax is paid by private households. In total, direct tax revenue equals Nu. 7,592 million in 2012 according to the financial statement figures reported for 2011-12 and 2012-13 (MoF, 2012a, 2013a). Of this, households paid Nu. 1,072 million, direct taxes paid by private enterprises and SOEs amounted to Nu. 3,021 and Nu. 3,499 million. BLSS 2012 data is used to determine the relative distribution of direct tax payment by the various household accounts.

Production Tax

Taxes on production include various taxes, lump sum fees (e.g. license fees) and royalties paid by activities. It also includes the remaining 75% of the motor vehicle tax. In total, Nu. 1,211 million of production tax has been collected in 2012 (MoF, 2013d). Of this, a considerable share (28%) is made up by royalties paid by commercial forestry, mining and hydropower generation activities. The remaining share of production tax revenue is allocated among activities using relative shares derived from the SUT 2007.

8.2   Capital Accounts

The capital account captures savings on the income side (row) and investments on the expenditure side. Savings originate from enterprises, households, government, stock changes and rest of the world. Enterprise savings are retained earnings computed as a residual by subtracting tax and dividend payments from total enterprise income. Household and government savings are also computed as a residual. Stock changes records positive entries if a good or service imported or produced in the current year is used in following year. Analogously, it records negative entries if goods or services

imported or produced in an earlier year are used within the current year (ADB, 2012, p. 7). There is no explicit information on stock changes available and stock changes are therefore determined within the cross-entropy balancing procedure providing prior-estimates. Savings from rest of the world can be interpreted as the capital account deficit (or surplus, if negative) which ensures that all components of the balance of payment (BOP) sum to zero.

Investments are capital expenditure on commodities which are not entirely consumed within the same accounting period. This concerns commodities such as machinery, vehicles and construction service, but also seedlings used by permanent cropping activities or live animals demanded by livestock activities. The largest share of investment is made up by construction services (67%) and in total investments amount to Nu. 65,563 million.

8.3   Rest of the World

Transactions with the rest of the world account consist of import and export of goods and services, factor payments, household transfers, government transfers and the balance with the rest of the world. Imports and exports have already been described in detail in sections 3.4 and 3.5. The factor payments account consists of factor payments to abroad through foreign day labour and capital. For capital, private and public enterprises pay capital returns in form of dividends and interest to foreign capital owners. Return to foreign capital owners from public enterprises is approximated by the interest paid by DGPC (Nu. 1,274 Million). Private enterprises pay Nu. 7,017 Million, which is the remaining payment to abroad capital as presented in the macro-SAM. Return to capital invested abroad is Nu. 777 million in 2012 (RMA, 2014, p. 92) and accrues to the private capital account.

Total payment to foreign labour, i.e. payments to workers that do not reside in Bhutan, is equal to Nu. 2,098 million (RMA, 2014). As most foreign day labour is employed in manufacturing sectors located along the Southern border to India, the relative shares of foreign labour accounts in these sectors is used to break up the payment of foreign labour accounts to the rest of the world account. Returns from labour abroad are only Nu. 122 million in 2012 (RMA, 2014) and are assumed to accrue only to the skilled labour account. Household transfers to the rest of the world consist of remittances received and sent, which are discussed in the household section. Government transfers are adopted from the macro-SAM and consist of development aid in form of budget grants. Finally, the balance with the rest of the world account is used to balance the surplus resulting from investments, trade of goods and factor payments and the deficit resulting from trade of services, government and household transfers.

9   Estimation of Final Micro-SAM

Naturally, the prior SAM's underlying different data sources do not result into a consistent framework in which recorded expenditure of agents equals recorded income. Due to measurement errors, data gaps and other challenges, the prior SAM is thus unbalanced, i.e. the sum of columns (expenditure) does not equal the sum of the corresponding row. As a remedy, there are various estimation methodologies that allow to arrive at an estimated final Micro-SAM, with balanced row and column totals. Like the balanced prior macro-SAM, the final micro-SAM is estimated using the *SAM Estimation Program, Version 3.3* developed by Scott McDonald and Sherman Robinson (2006).

9.1   Treatment of Stock Changes

The aggregate stock changes recorded in national accounts 2012 are known to be Nu. -72 million, but not data is reported for individual commodity accounts (NSB, 2013). In the SUT 2007, changes in inventory made up Nu. 1,959 million, or 4% of GDP. For the compilation of the prior SAM we assumed that total stock changes make up 2% of total GDP. Due to missing data, a random number between 0 and 1 million Nu. is generated for stock changes of each commodity (except services). This allows the consideration of stock changes within the estimation procedure, as the SAM estimation program can only work with prior information (zero cell entries do not enter the estimation procedure), The random generated prior values for stock changes are either forced to be negative or positive depending on the deviation of column and row totals.[10] As the column total exceeds the row total, the randomly produced cell entry for the stock changes cell is positive. 50% of the column and row total difference is added to the randomly generated stock change cell entry.

9.2   Final 2012 Bhutan SAM

The final micro 2012 SAM cannot be displayed due to its size, instead we present the final 2012 macro SAM in Table 48.

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[10]   For example, in case of paddy production the prior micro-SAM records a difference of 0.9 million Nu. (0.1% of the column total).

Table 48 – Final 2012 macro-SAM for Bhutan

		A	B	C	D	E	F	G	H	I	J	
		Commodities	Margins	Activities	Factors	House-holds	Enter-prises	Govt.	Taxes	Invest-ments	Rest of the world	Total
1	Commodities		14,501	71,613		42,562		15,396		65,158	35,675	244,906
2	Margins	14,501										14,501
3	Activities	162,936										162,936
4	Factors			90,232							900	91,132
5	Households				44,168		9,179	1,502			692	55,541
6	Enterprises				37,877							37,877
7	Govt.						5,278		14,518		9,733	29,528
8	Taxes	5,834		1,091		1,072	6,520					14,518
9	Savings				7,037	10,371	8,579	12,630		2,152	26,542	67,310
10	Rest of the world (RoW)	61,634			2,050	1,535	8,322					73,542
11	Total	244,906	14,501	162,936	91,132	55,541	37,877	29,528	14,518	67,310	73,542	-

Source: Own compilation based on final 2012 micro SAM

Deriving Bhutan's GDP from the final 2012 macro SAM amounts to Nu. 99,309 million or Nu. 97,157 million depending on whether the expenditure or production approach is applied (Table 49). The deviation between both approaches is 2.2%. The deviation from the official GDP estimates is 4.4% using the expenditure approach, but only 0.3% if the production approach is used. The deviation between both approaches and between the official estimates are defendable, as the official estimates have an even higher discrepancy of 6.6%.

Table 49 – Comparison of GDP estimates (in Million Nu.) of prior and final 2012 macro SAM

	Expenditure approach			Production approach	
Item	Balanced prior-macro SAM	Final macro SAM	Item	Balanced prior-macro SAM	Final macro SAM
Consumption	42,650	42,562	Output of activities	165,712	162,936
Gov. expenditure	18,660	15,396	Intermediate Inputs	73,706	71,613
Net exports	-27,825	-25,960	Taxes on products less subsidies	5,817	5,834
Investments	66,286	67,310			
GDP	**99,771**	**99,309**	**GDP**	**97,823**	**97,157**
National Accounts 2012 estimate		103,868	**National accounts 2012 estimate**		97,453

Source: Own compilation based on prior macro SAM and final 2012 macro SAM

There are some notable deviations between the prior and final 2012 macro SAM reported in Table 50. Applying the bottom-up approach, we estimate total government consumption to be about 17.5% lower as reported in the national accounts. The issue of using a lower estimated government

expenditure is already addressed in section 8.1.1. We use the national account 2012 estimates for household consumption of health and education services, which in turn results in a lower residual value of government consumption. This discrepancy explains 74% of the reported deviation of government consumption.

Total exports are 4.1% higher than in the prior SAM, which is largely due to potential underreporting of exports of cash crops (predominantly spices and citrus fruits) and ferro-alloys. The higher estimate of exports results in a decrease of foreign savings (6.6%). Due to lower expenditure, government savings decrease by 33.4%. The remaining deviations are rather of lower magnitude.

Table 50 – Percentage deviations between final and balanced prior 2012 macro SAM

		A	B	C	D	E	F	G	H	I	J	
		Commodities	Margins	Activities	Factors	House-holds	Enter-prises	Govt.	Taxes	Invest-ments	Rest of the world	Total
1	Commodities		8.4%	-2.8%		-0.2%		-17.5%		1.3%	4.1%	-0.8%
2	Margins	8.4%										8.4%
3	Activities	-1.7%										-1.7%
4	Factors			-0.6%							0.0%	-0.6%
5	Households				-0.2%		2.7%	0.0%			0.0%	0.3%
6	Enterprises				-0.3%							-0.3%
7	Govt.						0.0%		-0.7%		0.0%	-0.3%
8	Taxes	0.3%		-9.9%		0.0%	0.0%					-0.7%
9	Savings				-4.3%	2.4%	-4.4%	33.4%		10.5%	-6.6%	1.5%
10	Rest of the world (RoW)	-0.7%			-2.3%	0.0%	0.4%					-0.6%
11	Total	-0.8%	8.4%	-1.7%	-0.6%	0.3%	-0.3%	-0.3%	-0.7%	1.5%	-0.6%	

References

ADB (2012), *Supply and use tables for selected economies in Asia and the Pacific: A research study*, Mandaluyonng City, Philippines.

ADB and NSB (2013a), *Bhutan Living Standard Survey (BLSS) 2012*, Thimphu, Bhutan.

ADB and NSB (2013b), *2007 32-sector and 51-commodity Supply-Use-Table for Bhutan as excel-sheet*, Email, Thimphu, Bhutan.

AMC (2014), *Machinery Price List*, Paro, Bhutan.

BCCL (2014), *Annual Report 2013*, Phuentsholing, Bhutan.

BFAL (2014), *Annual Report 2013*, Phuentsholing, Bhutan.

BPC (2013), *Annual Report 2012*, Thimphu, Bhutan.

Chettri, G.B., Ghimiray, M. and Floyd, C.N. (2003), "Effects of farmyard manure, fertilizers and green manuring in rice-wheat systems in Bhutan: results from a long-term experiment", *Experimental Agriculture*, Vol. 39 No. 02, pp. 129–144.

Cicowiez, M., Lofgren, H. and Escobar, P. (2017), *How many households does a CGE model need and how should they be disaggregated?, 5308 Conference Paper - 20th Global Economic Analysis Conference*, Purdue, USA.

Deaton, A. (1997), *The analysis of household surveys: A microeconometric approach to development policy,* 1. print, Johns Hopkins Univ. Press, Baltimore Md. u.a.

Dervis, K., Melo, J. de and Robinson, S. (1982), *General equilibrium models for policy development*, Cambridge University Press, Cambridge.

DGPC (2013), *Annual Report 2012*, Thimphu, Bhutan.

DGPC (2014), *Annual Report 2013*, Thimphu, Bhutan.

DHI (2013), *Annual Report 2012*, Thimphu, Bhutan.

DHI (2014), *Annual Report 2013*, Thimphu, Bhutan.

Dukpa, C. (2015a), *Questions on Ara production*, Email, Stuttgart, Germany.

Dukpa, C. and Namgay, T. (2014), *Gewog centre altitude data*, Email, Stuttgart, Germany.

Dukpa, K. (2015b), *Interview at MoAF-PPD on food balance in Bhutan and underlying coefficients*, Oral, Thimphu, Bhutan.

Feuerbacher, A., Luckmann, J., Boysen, O. and Grethe, H. (2017), *The 100% Organic Agriculture Policy in Bhutan – A gift or a curse?, 8722 Conference Paper - 19th Global Economic Analysis Conference*, Washington D.C., USA.

Feuerbacher, A., Siebold, M., Chhetri, A., Lippert, C. and Sander, K. (2016), "Increasing forest utilization within Bhutan's forest conservation framework: The economic benefits of charcoal production", *Forest Policy and Economics*, Vol. 73, pp. 99–111.

Feuerbacher, A. (2014), "Development of a 2007 Social Accounting Matrix (SAM) for Bhutan and Multiplier-Based Policy Experiments", Master Thesis, Agricultural and Food Policy Group, University of Hohenheim, Stuttgart, 2014.

Gurung, J.B., Tamang, N., Dorji, T., Gyeltshen, J., Wangdi, J. and Maya Rizal, G. (2015), *Optimizing Feed and Fodder Production and Utilization*, Jakar, Bhutan.

ILO (2012), *International Standard Classifciation of Occupations (ISCO-08) Volume 1.*, Geneva, Switzerland.

Jayne, T.S., Yamano, T., Weber, M.T., Tschirley, D., Benfica, R., Chapoto, A. and Zulu, B. (2003), "Smallholder income and land distribution in Africa: implications for poverty reduction strategies", *Food Policy*, Vol. 28 No. 3, pp. 253–275.

Joshi, S.R. and Gurung, B.R. (2009), *Value Chain Analysis of Dairy in Merak and Sakteng*, Thimphu, Bhutan

Karma Feeds (2015a), *Data inquiry for production in 2012*, Email, Phuentsholing, Bhutan.

Karma Feeds (2015b), *Input costs for production*, Email, Phuentsholing, Bhutan.

Kharka, D.S. (2015), *Institutionalizing Performance Management among DHI SOEs in Bhutan*, Hanoi, Vietnam.

King, B.B. (1985), "What is a SAM? A layman's guide to social accounting matrices", in Pyatt, G. and Round, J.I. (Eds.), *Social Accounting Matrices, A Basis for Planning: A World Bank Symposium*, A World Bank Symposium, Washington DC, pp. 12–29.

McDonald, S. and Robinson, S. (2006), *User Guide for Version 3.3 of SAM Estimation Program*, Sussex, UK.

MoAF (2009), *Renewable Natural Resource (RNR) Census 2009 - Microdata*, Thimphu, Bhutan.

MoAF (2013a), *Agricultural Sample Survey 2012 - Dataset*, Thimphu, Bhutan.

MoAF (2013b), *Livestock Census 2012 micro-data*, Thimphu, Bhutan.

MoAF (2014), *Agricultural Sample Survey 2013 - Dataset*, Thimphu, Bhutan.

MoAF (2015), *Bhutan RNR statistics 2015*, Thimphu, Bhutan.

MoEA (2015a), *Corporate annual reports - visible inspection at Chamber of Commerce*, personal inspection, Thimphu, Bhutan.

MoEA (2015b), *Cottage and Small-Industry 2013 - Dataset*, Thimphu, Bhutan.

MoEA (2015c), *Medium and Large Industries*, Excel sheet, Thimphu, Bhutan.

MoF (2010), *Fiscal Incentives 2010*, Thimphu, Bhutan.

MoF (2012a), *Annual Financial Statements 2011/2012*, Thimphu, Bhutan.

MoF (2012b), *Bhutan Trade Classification: Custom Tariff and Sales Tax Schedul*, Fifth Edition: January 2012, 5th ed., Thimphu, Bhutan.

MoF (2013a), *Annual Financial Statements 2012/2013*, Thimphu, Bhutan.

MoF (2013b), *Bhutan Trade Statistics 2012*, Thimphu.

MoF (2013c), *Bhutan Trade Statistics 2012*, Thimphu, Bhutan.

MoF (2013d), *National Revenue Report 2012-2013*, Thimphu, Bhutan.

MoF (2016), "About Customs and Excise Division:", available at: http://www.drc.gov.bt/drc/customs-excise (accessed 26 August 2016).

MoLHR (2010), *Establishment Census 2010.*, Thimphu, Bhutan.

MoLHR (2013a), *Labor Force Survey 2012*, Thimphu, Bhutan.

MoLHR (2013b), *Extract of the labor market information system (LMIS)*, Personal meeting, Thimphu, Bhutan.

Moore, J.A. and Gamroth, M.J. (1982), "Calculating the fertilizer value of manure form livestock operations", *Agricultural Communications Oregon State University Administrative Service A442 EC*, Vol. 1094, pp. 1–7.

Neuhoff, D., Tashi, S., Rahmann, G. and Denich, M. (2014), "Organic agriculture in Bhutan: potential and challenges", *Organic Agriculture*, Vol. 4 No. 3, pp. 209–221.

NRDCL (2013), *Annual Report 2012*, Thimphu, Bhutan.

NSB (2007), *Bhutan Living Standard Survey (BLSS) 2007 Report*, Thimphu, Bhutan.

NSB (2008), *DZONGKHAG POPULATION PROJECTIONS 2006-2015*, Thimphu, Bhutan.

NSB (2011), *National Account Statistics 2011*, Thimphu, Bhutan.

NSB (2013), *National Account Statistics 2013*, Thimphu, Bhutan.

NSB (2014), *National Account Statistics 2014*, Thimphu, Bhutan.

NSB (2015a), *Statistical Yearbook 2014*, Thimphu, Bhutan.

NSB (2015b), *Quarterly observed commodity prices per district*, email, Thimphu, Bhutan.

OECD (2001), *Definition Mixed Income., Glossary of statistical terms*. available at: https://stats.oecd.org/glossary/detail.asp?ID=1668 (accessed 26 November 2016).

PCAL (2014), *Annual Report 2013*, Thimphu, Bhutan.

Pradhan, B.K., Saluja, M.R. and Sharma, A.K. (2013), *A Social Accounting Matrix for India 2007-08, IEG Working Paper*, Delhi.

Pyatt, G. (1988), "A SAM approach to modeling", *Journal of Policy Modeling*, Vol. 10 No. 3, pp. 327–352.

Pyatt, G. and Round, J.I. (1985), "Social Accounting Matrices for Development Planning", in Pyatt, G. and Round, J.I. (Eds.), *Social Accounting Matrices, A Basis for Planning: A World Bank Symposium*, A World Bank Symposium, Washington DC, pp. 52–69.

RGoB (2006), *Forest and Nature Conservation Rules of Bhutan*, Thimphu, Bhutan.

Rinzin, C. (2015), *Cost of Production for Rice and Maize*, Email, Thimphu, Bhutan.

RMA (2013), *Annual Report 2011/12*, Thimphu, Bhutan.

RMA (2014), *Annual Report 2012/13*, Thimphu, Bhutan.

Robinson, S., Cattaneo, A. and El-Said, M. (2001), "Updating and estimating a social accounting matrix using cross entropy methods", *Economic Systems Research*, Vol. 13 No. 1, pp. 47–64.

Roder, W., Gratzer, G. and Wangdi, K. (2002), "Cattle grazing in the conifer forests of Bhutan", *Mountain Research and Development*, Vol. 22 No. 4, pp. 368–374.

Roder, W., Wangdi, K., Gyamtsho, P. and Dorji, K. (2001), *Feeding the Herds: Improving Fodder Resources in Bhutan*, Kathmandu, Nepal.

Samdup, T., Udo, H.M., Eilers, C., Ibrahim, M.N. and van der Zijpp, A.J. (2010), "Crossbreeding and intensification of smallholder crop–cattle farming systems in Bhutan", *Livestock Science*, Vol. 132 No. 1, pp. 126–134.

Stone, R. (1962), *A social accounting matrix for 1960*, Department of Applied Economics. University of Cambridge.UK.

Thinley, K. (2015), *Interview at MoAF on utilization of machinery in Bhutan*, Oral, Thimphu, Bhutan.

UN (2002), *International Standard Industrial Classification of All Economic Activities (ISIC) Revision 3.1*, New York, USA.

UN (2008), *Central Product Classification (CPC) Ver.2*, New York, USA.

UN (2009), *System of National Accounts 2008*, New York, USA.

UN (2010), *Extended Balance of Payments Services classification (EBOPS) 2010*, New York, USA.

UN (2012), *Manual on Statistics of International Trade in Services 2010 (MSITS 2010)*, Geneva, Luxembourg, Madrid, New York, Paris and Washington D.C.

UN (2015a), *UN comtrade database*, New York, USA.

UN (2015b), *UN ServiceTrade database*, New York, USA.

UNCTAD (2016), *UNCTADstat: Data on economic trends - national accounts*, Geneva, Switzerland.

van Noord, H. (2010), *Feasibility of REDD+ in Bhutan: A scoping study*, Thimphu, Bhutan.

Wangchuk, K. and Dorji, T. (2008), *Animal feed production and management in Bhutan*, Dhaka, Bangladesh.

World Bank (2010), *Social Protection in Bhutan: Overview*, Washington DC, USA.

Appendix

Appendix A - Commodity correspondence table according to CPC Ver. 2

Commodity Name	Activity:	CPC Ver. 2 Code
Paddy	Paddy production	113
Maize	Maize production	112
Other cereals and oilseeds	Other cereals and oilseeds production	111, 115, 116, 119, 141-145;149; 180; 191-192;194-199
Pulses	Pulses production	124; 170
Crop residues	Paddy, maize, other cereals, pulses	1913
Fodder crops	Maize, other cereals, low-value vegetable, potato, other nuts and fruits production	NA
Low value vegetables	Low value vegetables production	1212-1213;1233; 1235;1251;1259;
High value vegetables	High value vegetables production	1211; 1214 – 1229; 1232; 1234; 1253 - 1290; 1591-1599
Potato	Potato production	1510
Beverages and spices	Beverages and spices production	161-164; 1231;1252; 1651-1653; 1654-1690;
Other nuts and fruits	Other nuts and fruits production	131; 133; 134;1352-1359; 136, 137; 139
Apples	Apple production	1351
Citrus fruits	Citrus production	132
Milk		221
Beef	Cattle herding (husbandry)	21111-21112;21131-21132;21151-21152;21172
Manure	Cattle, poultry and other animal husbandry	34654
Live animals	Cattle, poultry and other animal husbandry	21
Bullock draught power	Cattle husbandry	NA
Chicken meat	Poultry farms (husbandry)	2112;2114;21160
Eggs		231
Other meat and animal products	Other animal husbandry	2113-21119;21133-21139; 21153-21159;21171;21173-21190
Milled rice	Paddy milling	2316
Milled Other cereals	Other cereals milling	2311-2314
Dairy products	Dairy production	221 – 222;
Processed rice	On-farm cereal processing	N.A.
Processed maize	On-farm cereal processing	N.A.
Other grain mill products	Other grain mill and other food production	216, 217, 232, 234-238, 391
Vegetable oils	Other grain mill and other food production	2153 - 2155
Ara	Ara production	2413
Animal feed	Animal feed production	233
Processed fruits and vegetables		239; 23170;
Alcoholic beverages and tobacco	Fruits and vegetables processing and beverage production	241,250
Non-alcoholic beverages		244
Firewood	Community forestry, commercial forestry	313

Commodity Name	Activity:	CPC Ver. 2 Code
Logs	Community forestry, commercial forestry	311,312
Non-Wood Forest Products	Community forestry	193; 321-325
Products of wood and cork	Manufacturing of wood, paper and furniture	311-319
Paper products	Manufacturing of wood, paper and furniture	321 -328
Furniture	Manufacturing of wood, paper and furniture	381
Coal Mining	Mining and quarrying	110
Other Mining	Mining and quarrying	120-163
Clothing and wearing	Textile manufacturing	261-296
Basic Chemicals	Basic chemical manufacturing	341-344;34520-34570; 347 – 348; 351 – 355;
Rubber and plastics	Rubber and plastics manufacturing	361 - 369
Glass and glass products	Glass product manufacturing	371 - 379
Basic iron and steel	Basic iron and steel manufacturing	411
Casted iron and steel, and non-ferrous metals	Casted iron, steel and non-ferrous manufacturing	412 - 416
Fabricated metal products, except machinery and equipment;	Fabricated metal manufacturing	421 - 429
Casted iron and steel, and non-ferrous metals	Casted iron, steel and non-ferrous manufacturing	412 - 416
Fabricated metal products, except machinery and equipment;	Fabricated metal manufacturing	421 - 429
Electrical machinery and apparatus	Coal	461 - 469
Manufactured goods n.e.c.	Manufacturing n.e.c.	335; 392; 3936-3938; 399;
Wholesale Electricity	Electricity generation	1710
Low-Voltage electricity;	Basic chemicals manufacturing	1710
High-Voltage electricity	Rubber and plastics manufacturing	1710
Transmission of electricity	Electricity transmission and retailing	691
Water	Collection, purification and distribution of water	692
Commodities that are not produced domestically and which are only imported		
Imported rice	-	
Processed milk	-	221 – 222;
Fish	-	411-493;212
Other transportable goods		382 - 389
Fertilizer		3461-3465
Pesticide		3466
Charcoal		34510
Basic metals (sponge and pig iron; iron scrap)		3931 - 3935
Office, accounting and computing machinery		451 - 452
Radio, television and communication equipment and apparatus		471 - 479

Commodity Name	Activity:	CPC Ver. 2 Code
Medical appliances, precision and optical instruments, watches and clocks		481 - 484
Transport equipment		491 - 499
General purpose machinery		431 - 449
Coke		331
Fuel oils and gases n.e.c.		33360;33370-33380;334
Gasoline		3331-3334
Diesel		33350
Services		
Construction services	Construction	531 - 532; 541 - 547;
Wholesale and retail trade services	Wholesale and retail trade, repair of motor vehicles and other goods	611-612; 621-625
Lodging, food and beverages	Hotels and restaurants	631 - 634
Land transport services	Land transportation	641 - 642; 651; 6601
Air transport services	Air transport	653; 6603
Supporting and auxiliary transport services	Supporting and auxiliary transport activities; activities of travel agencies	671-679
Post and telecomm. services	Post and telecommunications	681; 841-846
Financial intermediation services	Financial intermediation	711-712;717
Insurance and pension services	Insurance and pension funding; Activities auxiliary to financial intermediation	713-716
Real estate services	Real estate activities	721-722
Business services	Business services n.e.c.; Wholesale and retail trade, repair of motor vehicles and other goods	731-733; 811-839; 851-894
Public administration and other services to the community	Public administration	911-913
Education services	Education	921-929
Health and social services	Health and social work	931-935
Other services	Other services	941-990

Source: Own compilation

Appendix B – Activities correspondence table according to ISIC 3.1 rev

Activity Name	Output:	ISIC (3.1. rev) activity
Paddy production	Paddy, crop residues	111
Maize production	Maize; crop residues	111
Other cereals and oilseeds production	Other cereals and oilseeds; crop residues	111
Pulses production	Pulses	111
Low-value vegetable production	Low value vegetables	111, 112
High-value vegetable production	High value vegetables	112
Potato production	Potato	111
Beverages and spices production	Beverages and spices	112, 113
Other nuts and fruits	Other nuts and fruits	113
Apple production	Citrus fruits	113
Citrus production	Apple	113
Cattle herding	Milk; Beef; Bullock draught power; live animals; manure;	121, 1511
Poultry farms	Eggs and chicken meat; live animals; manure	122, 1511
Other Animal husbandry	Other meat and animal products; live animals; manure	122, 1511
Paddy milling	Milled rice	1531
Cereals milling	Milled other cereals	1531
Dairy production	Dairy products	1512;1520
On-farm cereal processing	Processed rice; processed maize;	1531;1532;
Ara production	Ara	1551
Grain mill and other food production	Other grain mill products; vegetable oils	1541-1549
Animal feed production	Animal feed	1533
Fruits and vegetables processing; beverage and tobacco production	Processed fruits and vegetables; non-alcoholic beverages; alc. beverages and tobacco	1513-1514; 1551-1554
Community forestry	NWFP; firewood; logs	200
Commercial forestry	Firewood; logs	200
Manufacturing of wood, paper and furniture products	Products of wood and cork; furniture; paper products	2010-2029; 3610
Mining and quarrying	Coal; other minerals	1010; 1020 - 1030;1110 - 1429
Textile manufacturing	Clothing and wearing	1711-1920
Basic chemicals manufacturing	Basic chemicals	2411-2430
Rubber and plastics manufacturing	Rubber and plastics	2511-2520
Glass product manufacturing	Glass and glass products	2610-2699
Basic iron and steel manufacturing	Basic iron and steel	2710-2720
Casted iron, steel and non-ferrous manufacturing	Casted iron and steel, and non-ferrous metals	2731-2732
Fabricated metal manufacturing	Fabricated metal products, except machinery and equipment; electrical machinery and apparatus	2811-3330
Manufacturing n.e.c.	Manufactured goods n.e.c.	3410;3599;3691;3720
Electricity generation	Wholesale Electricity	4010
Electricity transmission and retailing	LV electricity; HV electricity; transmission of electricity	4010
Collection, purification and distribution of water	Water	4100
Construction	Construction services	451-455

Activity Name	Output:	ISIC (3.1. rev) activity
Wholesale and retail trade, repair of motor vehicles and other goods	Wholesale and retail trade services; Business services	501-526
Hotels and restaurants	Lodging, food and beverages	551-552
Land transportation	Land transport services	601-603
Air transport	Air transport services	621-622
Supporting and auxiliary transport activities; activities of travel agencies	Supporting and auxiliary transport services	630
Post and telecommunications	Post and telecommunication services	641-642
Financial intermediation	Financial intermediation services	651-659
Insurance and pension funding; Activities auxiliary to financial intermediation	Insurance and pension services	660; 671-672
Real estate activities	Real estate services	701-702
Business services n.e.c.	Business services	711-749
Public administration	Public administration and other services to the community as a whole	751-753
Education	Education services	801-809
Health and social work	Health and social services	851-853
Other services	Other services	900-990

Source: Own compilation

Appendix C - Correspondence and statistics of agricultural crops

Crop Name	Production (in tons)	Area Harvested (in hectares)	Price (in NU/kg)	Value (in Million Nu.)	SAM crop commodity account
Asparagus	132	112	86.72	11	High-value vegetables
Barley	1,845	1,225	30.74	57	Other cereals and oilseeds
Beans	2,285	1,042	29.78	68	Pulses
Broccoli	304	135	41.24	13	High-value vegetables
Buckwheat	2,778	2,372	26.10	73	Other cereals
Cabbage	3,460	725	17.06	59	Low-value vegetables
Cardamom	618	1,911	663.99	410	Beverage and spices
Carrot	546	150	27.02	15	Low-value vegetables
Cauliflower	715	246	26.81	19	Low-value vegetables
Chilli	7,222	1,777	58.06	419	High-value vegetables
Collocacia	213	89	32.36	7	Beverage and spices
Corainder	2	2	30.00	0	Beverage and spices
Cucumber	2,325	N.A.	19.75	46	Low-value vegetables
Cultivated mushrooms	3	N.A.	152.29	0	High-value vegetable
Dal	172	244	56.61	10	Pulses
Dolay Chilli	123	23	115.96	14	High-value vegetables
Egg Plant	324	115	22.51	7	Low-value vegetables
Garlic	562	461	85.19	48	High-value vegetables
Ginger	4,427	719	32.74	145	Beverage and spices
Gourds	132	N.A.	18.70	2	Low-value vegetable
Green Leaves	2,246	769	15.24	34	Low-value vegetable
Ground nut	113	57	32.94	4	Other cereals and oilseeds
Lady Finger	12	11	18.24	0	Low-value vegetable
Lentil	14	16	52.26	1	Pulses
Maize	60,810	23,866	14.77	898	Maize
Millet	2,593	2,233	18.09	47	Other cereals and oilseeds
Mung bean	150	125	48.18	7	Pulses
Mustard	776	1,132	24.71	19	Other cereals and oilseeds
Onion bulb	249	183	40.44	10	High-value vegetable
Paddy	54,505	16,676	26.32	1435	Paddy
Peas	645	269	28.97	19	Pulses
Perilla (Naam)	21	79	157.56	3	Other cereals and oilseeds
Potato	59,351	5,972	14.35	851	Potato
Pumpkin	4,166	N.A.	12.21	51	Low-value vegetables
Radish	7,931	1,230	12.12	96	Low-value vegetables
Rajma bean	552	425	36.72	20	Pulses
Soya bean	250	337	33.21	8	Other cereals and oilseeds
Squash	1,792	N.A.	12.12	22	Low-value vegetables
Sunflower	11	14	100.00	1	Other cereals and oilseeds
Sweet potato	73	39	30.35	2	Potato
Tapioca	310	151	15.09	5	Potato
Tomato	304	102	21.39	6	Low-value vegetables
Turnip	6,950	623	20.10	140	Low-value vegetables
Wheat	3,357	2,092	32.05	108	Other cereals and oilseeds

Tree-Crop Name	Production (in tons)	Area Harvested (in hectares)	Price (in NU/kg)	Value (in Million Nu.)	SAM crop commodity account
Apple	6,052	709	33.78	204	Apple
Areca Nut	5,832	1,961	14.2	83	Other fruit and nuts
Avocado	4	1	150	1	Other fruit and nuts
Banana	1,332	213	20.41	27	Other fruit and nuts
Guava	693	190	18.66	13	Other fruit and nuts
Jack fruit	251	56	14.08	4	Other fruit and nuts
Litchi	161	48	23.97	4	Other fruit and nuts
Mandarin	41,809	3,545	21.46	897	Citrus fruits
Mango	636	154	31.18	20	Other fruit and nuts
Papaya	90	40	14.99	1	Other fruit and nuts
Passion fruit	136	64	26.31	4	Other fruit and nuts
Peach	1,451	345	21.31	31	Other fruit and nuts
Pear	2,337	262	23.06	54	Other fruit and nuts
Persimmon	228	95	25.02	6	Other fruit and nuts
Pineapple	46	26	23.46	1	Other fruit and nuts
Plum	696	161	16.23	11	Other fruit and nuts
Pomegranate	90	80	50.85	5	Other fruit and nuts
Sugarcane	213	80	19.75	4	Other fruit and nuts
Tree tomato	540	311	25.64	14	Other fruit and nuts
Walnut	377	148	61.53	23	Other fruit and nuts

*Note: For paddy, we used the imputed farm-gate price as within the Agricultural Sample Survey 2012 respondents seem to have reported both farm gate price for paddy or milled rice.
Source: Own compilation based on MoAF, 2013

Appendix D – Mapping of traded services from EBOPS 2010 to CPC v2 (UN, 2012a)

EBOPS 2010	CPC Code v2	Description of service	Import	Export	Correspondence to SAM account
			In Million Nu.		
200		1 Transportation	2,163	1,817	
210	64134; 6424; 66031; 6531; 66032; 6761; 6762; 6763	1.2 Air transport	454	1,817	Air transport services
214	64112-64119; 64132; 6422; 66011; 6511; 66012; 674	1.3 Other transport	1,710	-	Land transport services
236		2 Travel	3,483	4,636	
237		2.1 Business travel	583	724	* See note below*
240		2.2 Personal travel	2,900	3,911	
241		2.2.1 Health-related expenditure	228		Health Services
242		2.2.2 Education-related expenditure	1,716		Education Services
243		2.2.3 Other	957	-	same as for business travel
245	841; 842; 846	3 Communications services	138	49	Post and telecommunication services
249	53-54	4 Construction services	2,806	-	Construction and pension services
253		5 Insurance services	219	214	Insurance and pension services
260	711-712; 715; 717	6 Financial services	18	5	Financial and pension services
262	831; 843; 871	7 Computer and information services	23	-	Business Services
268		9 Other business services	943	-	
271	612	of which trade-related services	172	-	Wholesale and retail trade services
280	832	of which architectural, engineering and other technical services	763	-	Business Services
291	990	11 Government services	335	116	Other Services

* distributed according to the following shares: 30% Lodging; food and beverage serving services; 40% land transport services; 10% supporting and auxiliary transport services; 20% public administration services

Source: Own compilation