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## **Constructing a regional Social Accounting Matrix using non survey method for CGE Modeling**

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# Constructing a regional Social Accounting Matrix using non survey method for CGE Modeling

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## Abstract

The Government of Indonesia is committed to cut its emissions by 26% by 2020. In forestry sector, this is done through reducing emissions from deforestation and forest degradation (REDD) program. One of several pilot activities of the REDD Program is the Berau Forest Carbon Program (BFCP) which is located in the Berau District East Kalimantan Indonesia. The Program attempts to generate behavioural changes of the forests stakeholders like forest-dependent community, forestry/logging company and oil palm plantation company to contribute to the emissions reduction, which is formulated in the Program's strategies. Changes of these behaviours are reflected in the costs being borne by the relevant forest stakeholders as well as the incentive rewarded for engaging in the programme.

This paper focuses on the dataset preparation i.e. the Berau District Social Accounting Matrix for CGE modeling analysis of the above context. A non survey method was employed to generate the regional accounts and was it combined with available data as well as experts' estimates.

## 1. Introduction

The Government of Indonesia is committed to cut its emissions by 26% by 2020. In forestry sector, this is done through reducing emissions from deforestation and forest degradation (REDD) program. There are several pilot activities of the REDD Program in Indonesia including the Berau Forest Carbon Program (BFCP) which is located in the Berau District East Kalimantan Indonesia. This program attempts to generate behavioural changes of the forests stakeholders like forest-dependent community, forestry /logging and oil palm plantation companies to contribute to the emissions reduction, which is formulated in the Program's strategies<sup>1</sup>. Changes of these behaviours are reflected in the costs being borne by the relevant forest stakeholders as well as the incentive rewarded for engaging the parties in the programme.

Being one of the 10 districts in the East Kalimantan Province, Berau District is 34.127,47 km<sup>2</sup> (more than half of the Canterbury Region area). Total forests area is 2.2 millio hectares (of which are classified as for production, conservation, and other purposes) and 70% of the district area is still forested. With its population of 179.444 in 2010, the GRP growth is 5.2% for the period of 2005 to 2008. In 2007, the District's economic growth is mainly contributed by the (coal) mining, agriculture, and forestry (excluding timber based industry), which reflects nearly 37.72%, 9.61%, and 9.57% of the total GRP of IDR 4.35 trillion (~ NZ\$ 620 million), respectively.

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<sup>1</sup> Current annual emissions of the Berau District is estimated to be 20 million tonnes CO<sub>2</sub> equals.

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It is predicted that the emissions reduction program is expected to impact the future of economic performance of the Berau District. Therefore, this research investigates potential socio-economic impacts of REDD strategies implemented by the BFCP program. A Computable General Equilibrium (CGE) is to be employed to assess the socio economic impacts of the proposed strategies. The impacts will be modelled as the changed behaviour of participants, which will provide input to the CGE. Successive model runs will identify the socio-economic impacts of REDD policies on the Berau economy. For the CGE analysis, a regional account (social accounting matrix) of the Berau District was constructed.

This paper demonstrates the construction of the Berau District datasets by employing a method introduced by Kronenberg (2007, 2009a, 2009b) and combined with available information as well as statistics officer's estimation to construct the initial unbalanced social accounting matrix table. Then, the matrix was balanced using the cross entropy approach (Robinson, Cattaneo, and El-Said, 1998; Robinson & El-Said, 2000); in which during the balancing process, the known information is retained.

## 2. Literature review

For the purpose of carrying out CGE Analysis, one requires input-output (I-O) and/or social accounting matrix (SAM) tables. Being the core of the SAM, the I-O framework describes the flows of value of goods and services between all the individual sectors of the national economy over a certain period (e.g. usually for a year), as depicted in Figure 1. It comprises activities and commodities accounts only. The I-O table can be extended into a SAM by adding information explaining the relationship between production factors and final demands; which shows the amount of income distributed to households and government as well as being transferred abroad and invested.

Output Allocation Input Structure	Intermediate Demand		Total intermediate demand	Domestic Final Demand	Exports	Total Final Demand	Total Demand	Supply		Total Supply
	Sector 1	Sector 2						Domestic Output	Imports	
Intermediate Input										
Sector 1	$z_{1,1}$	$z_{1,2}$	$z_1^D$	$d_1$	$e_1$	$f_1$	$u_1$	$x_1$	$m_1$	$s_1$
Sector 2	$z_{2,1}$	$z_{2,2}$	$z_2^D$	$d_2$	$e_2$	$f_2$	$u_2$	$x_2$	$m_2$	$s_2$
Total intermediate input	$z_1^U$	$z_2^U$								
Value added (Primary Input)	$w_1$	$w_2$								
Total Input/Output	$x_1$	$x_2$								

Source: Department for Economic and Social Affairs Statistic Division (1999), which was further modified to Indonesia type input-output table. The symbol was adapted from Kronenberg (2009).

Figure 1. A Typical Input-Output Table with Two Sectors

Official input-output tables are usually constructed based on a survey of a representative industries (Kronenberg, 2007; West, 1990). However, in developing countries where resources such as funding and expertise are quite scarce, this type of publication is rarely available. In this discourse, input-output researchers attempted to construct a regional input-output table by utilising national data; a process that regionalises a national input-output table. The proposed study location i.e. the Berau District provides a typical situation where a recent input-output table is absent and consequently, an estimate of its input-output and SAM tables will be predicted (constructed). Approaches to construct the regional input-output table range from a full non-survey method to a mix between survey and non-survey methods (Kronenberg, 2009; West, 1990).

Three popular methods of estimating a regional account available in the literature are LQ technique (Round, 1983), Commodity Balance or Supply-Demand Approach (Isard, 1953), and the RAS method (Caipit, 2009; Mínguez, Oosterhaven, & Escobedo, 2009). Researchers developed new techniques based on these methods. Further review of approaches to constructing the non-survey input-output table is available in Lahr (1999) and Richardson (1985).

Lahr (2001) summarised some principles that have been used during the development of regional accounts either by using a small amount of data or pure non-survey methods as follows:

- a. When deriving regional accounts from national accounts, use as much sectoral detail as there is available. This has also been suggested by Morrison and Smith (1974).
- b. Regionalisation requires an assumption that technology is spatially similar within a region  $a_{i,j}^R = a_{i,j}^N$ ; an assumption that has also been widely used by most input-output modellers (Hewings, 1985, p. 40; Richardson, 1985). Lahr (2001) further suggests that some adjustments could be made if considered necessary.
- c. Regionalisation typically should be carried out on domesticated national accounts. Lahr (2001) states that most regionalisation methods fail to account for regional exports and imports, as in the case of supply/demand pool technique. Therefore, he suggests that 'most regionalization methods must be applied on top of the domestication of national technology' (Lahr, 2001).

In addition to the principles, Jackson (1998) recommends that the selected technique should be resulting in an input-output table which can provide a basis for further analysis i.e. for constructing a social accounting matrix table and/or general equilibrium modelling analysis.

### ***Concerning the accuracy***

Following the development of ways to construct an input-output table based on a non-survey method, there has been a growing concern regarding the accuracy and reliability of the predicted input-output table. Some modellers attempted to evaluate the accuracy of an input-output table constructed using a non survey base by comparing it with its counterpart produced from a survey base. Bonfiglio (2005), for instance, evaluated the performance of non-survey methods (seven derivatives of location quotient methods and a supply demand pool method) by reproducing a survey-based input-output model in both a partitive and holistic sense. He concluded that the examined non-survey

methods produced better results in estimating multipliers than input-output coefficients.

According to Round (1983), as cited by Kronenberg (2009, p. 42), “nonsurvey regionalization methods do not produce estimates in the statistical sense but rather ‘surrogate’”. This is in line with Morrison and Smith’s (1974, p. 13) statement that “the non-survey can only produce an approximation of a full survey based table”.

Jensen (1980) introduces two types of accuracy i.e. partitive accuracy and holistic accuracy with regard to constructing regional input-output table. The partitive accuracy is described as the accuracy of predicted input-output table which are built upon a compilation of accurately-calculated-information of cells of the input-output table. Hence, the accuracy focuses on the cells of the table and depends on the cell accuracy in the statistical sense. Assuming that each cell records a true and accurate transaction, the table then reflects the true table with a high degree of accuracy (Jensen, 1980).

On the other hand, holistic accuracy is defined as the accuracy of the predicted input-output table in mathematically portraying an economy as a whole. Thus, it does not focus on cells of the tables ‘but on the accuracy with which the table represents the main features of the economy in a descriptive sense’ and retains these features’ importance in an analytical sense (Jensen, 1980, p.142). The table underlines the main features of the economy in terms of size and structure, and less-analytically important features are treated as background. In this sense, partitive accuracy will ensure that the table is holistically accurate, but holistic accuracy does not necessarily come with a high degree of partitive accuracy, particularly with respect to the less significant parts of the table (Jensen, 1980).

Partitive accuracy is considered inappropriate as a general approach to regional input-output tables because it is very expensive to achieve (Jensen, 1980). He suggests that the construction of a non-survey input-output table should be directed to achieve accuracy in the holistic manner, according to his statement:

“The more modest goal of holistic accuracy is appropriate to regional input-output tables. In these terms the accuracy...would be judged, not on the accuracy of its separate parts, but on its ability to represent the size and structure of the economy in general terms” (Jensen, 1980, p.143).

Jensen (1990) further points out that non-survey input-output development can only be legitimised by an acceptable theoretical/logical structure. To increase the accuracy and acceptability of the input-output table, integrating all exogenous available information with the employed methods is advised (Bonfiglio, 2005).

The construction of the input-output table and social accounting matrix for the study location will adhere the holistic type of accuracy in light that it will represent the structure of the regions’ economy. Following Lahr (1993), Kraybil (1986), this to be achieved through:

- identification and collection superior data; required to be inserted into the relevant cells or matrix of the table (Lahr, 1993);
- identification of key sectors (Lahr, 1993); what important sectors generate the economy of the region whether they are natural resources based sector or service sector;

- Comparison and review with national /and neighbouring accounts; This stage is required to estimate cells or information that are not available for in the region. Usually this is done by national/local experts or statistians
- Provision of export judgments; involving consultation process with national and regional statistic office. This to adjust or modify cells or information that are too big or illogical regarding the region.

### **3. Construction of the Berau District SAM**

#### **3.1. The Commodity Balance Approach with Cross Hauling**

Kronenberg (2007a, 2007b, 2009) modifies the Commodity Balance Approach by including the estimation of regional trades figure during the process of constructing a regional IO table. The traditional Commodity Balance (Supply Demand) approach, however, only estimates net exports (exports minus imports); making it an incomplete I-O table due to to the inexistent of trade figures.

Cross-hauling is defined as simultaneous exporting and importing of a given commodity (Kronenbeger, 2009) and it has been noted by Richardson (1985) and Jackson (1998). Richard and Miller (1988) also observed the phenomenon of cross hauling in the timber sector when constructing a non-survey input-output table for a small area. Norcliffe (1983) indicated that cross-hauling happened due to product differentiation and consumer's preferences. Cross hauling occurs because commodity/products are heterogeneous. Ignoring that phenomenon might cause overstated multipliers (Robison & Miller, 1988). Kronenberg (2009), citing from Richardson (1985) insisted that failure to take account of the cross hauling causes an underestimation of regional trade and thereby leads to overestimated regional multipliers.

There are two possible causes of cross hauling: (1) data are not available in sufficient detail in order to prevent cross hauling and (2) proximity to borders where some industries receive supplies from outside. This is more likely to occur in a smaller area, especially where larger parts of the area are close to the border. Avoiding cross hauling by detailing sectors/industries into sufficient levels of detail could never been possible since products from different regions or countries cannot be perfect substitutes(Kronenberg, 2009).

Kronenberg (2007) showed that his method works well with very little data to derive a regional input-output table from a nation-wide input-output table. This approach employs minimum data requirement such as regional employment quotients<sup>2</sup> to derive the regional matrix of inter-industry transactions, utilisation of regional trade, and its independence from subjective educated guesses (Kronenberg, 2007). Furthermore, Lahr (2001) suggested using superior data e.g. information on primary inputs/value added such as labour income or expenditure if available.

#### ***Commodity balance***

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<sup>2</sup> The ratio between employment levels in a region (district) and in the nation (province) as a whole in each sector.

The term commodity balance or net export implies the different between exports and imports, and is defined by:

$$b = e - m \quad 1.$$

Exports ( $e$ ) is demand less intermediate plus domestic final demand (excluding export)  $e = u - (z^D + d)$ . Imports ( $m$ ) is defined as total supply less gross production,  $m = s - x$ . It is also known that supply always equals demand, i.e.  $u = s$ . Inserting  $e$  and  $m$  into the above equation, the regional commodity balance can be estimated (Kronenberg, 2009), as follows:

$$b = u - (z^D + d) - (s - x) \quad (1.)$$

$$b^{di} = x^{di} - (z^{Ddi} + d^{di}) \quad (2.)$$

where  $x$  denotes domestic output,  $z^D$  denotes intermediate demand,  $d$  symbolises final demand excluding export, and the superscript  $di$  denotes the district level.

Thus, equation implies that estimating a regional commodity balance requires an estimation of regional output and total regional demand/use (a sum of intermediate demand and final demand excluding export).

### ***Estimating commodity cross hauling***

The cross hauling  $q_i$  is defined as the difference between trade volume,  $(e_i + m_i)$  and trade balance  $|e_i - m_i|$  or net export (it is referred as absolute value, since the calculation of trade balance may result in negative value). (Kronenberg, 2009):

$$q_i = (e_i + m_i) - |e_i - m_i| \quad (3.)$$

This equation implies that neither export nor import can be negative by definition; either the trade volume can not. On the other hand, trade balance can be negative. The equation also states that the cross hauling will be zero if export or import (or both) equals to zero. Traditional approach of non-survey methods fail to acknowledge the cross hauling since they assume that the sector is export or import oriented and set either  $e$  or  $m$  to zero; therefore, resulting into an assumption that the cross-hauling is zero (Kronenberg, 2009).

### ***Estimating Products Heterogeneity***

Cross-hauling is considered as a function of product heterogeneity. If cross hauling is observed, the degree of product heterogeneity can be calculated. However, the cross hauling also depends on the fact that a region consumes or produce a certain commodity. If a region does not consume a certain commodity then it has no reason to import the commodity. On the other hand, if the region does not produce a certain commodity, it has no reason to engage in cross hauling of that product because the region will simply import to fulfill its demand for the product. For these reasons, the

cross hauling is assumed as a function of product heterogeneity, domestic production, domestic final and intermediate use (Kronenberg, 2009), and defined as:

$$q_i = h_i(x_i + z_i + d_i) \quad (4.)$$

In which, cross hauling  $q$  is a proportional to the sum of domestic production  $x_i$  and total demand  $z_i + d_i$ , and the factor of product heterogeneity  $h_i$ . This equation is claimed to comply the aforementioned requirements (Kronenberg, 2009).

The following equation represents total volume which is a sum of export and import, and is denoted by:

$$v_i = e_i + m_i \quad (5.)$$

Previously, in equation (1) trade balance is calculated as the difference between export  $e_i$  and import  $m_i$ . Then, using equation (5), export and import are written as a function of trade volume and trade balance:

$$m_i = \frac{v_i - b_i}{2} \quad (6.)$$

$$e_i = \frac{v_i + b_i}{2} \quad (7.)$$

Regarding the equations (1) and (5), the trade volume can also be rewritten as a sum of the absolute value of trade balance  $b_i$  and the amount of cross hauling  $q_i$  as:

$$q_i = (e_i + m_i) - |e_i - m_i| \quad \text{and}$$

$$v_i = e_i + m_i$$

therefore

$$q_i = v_i - |b_i| \quad \text{then,}$$

$$v_i = |b_i| + q_i \quad (8.)$$

Equation (4) is then substituted into equation (8), and  $h_i$  is solved, as the following:

$$v_i = |b_i| + h_i(x_i + z_i + d_i)$$

$$h_i = \frac{v_i - |b_i|}{(x_i + z_i + d_i)} \quad (9.)$$

Finally, the degree of heterogeneity  $h_i$  (of a certain commodity) can be estimated using information from the parent input-output table. Product heterogeneity is specific to different commodity, and it is not characterised by geographical location. Therefore, a commodity of certain region is assumed to have similar product heterogeneity of a different region (Kronenberg, 2009). Therefore, it is assumed that  $h_i^{di} = h_i^{pr}$ .

### ***Estimating District Trades Pattern***

District trade pattern, which is defined the amount of exports and imports, are estimated by utilising the estimation of the district's production (domestic product)  $x_i^{di}$ , intermediate demand  $z_i^{di}$ , and final demand excluding exports  $d_i^{di}$ , as well as the district trade balance of each sector  $b_i^{di}$ .

The District cross hauling of each sector  $i$ ,  $q_i^{di}$ , is estimated using equation (4), by employing information of domestic output, intermediate demand and final demand excluding export of  $x_i^{di}$ ,  $z_i^{di}$ , and  $d_i^{di}$ , respectively. The equation requires information of  $h_i$ , which can be estimated from the parent input-output table, by using equation (9).

The estimated district trade balance  $b_i^{di}$  and cross-hauling  $q_i^{di}$  are then substituted into equation (8) to obtain the trade volume of commodity  $i$   $v_i$ . Finally, the district imports and exports, are then estimated using equation (6) and (7) respectively, by employing the  $v_i$  and the trade balance commodity  $i$   $b_i^{di}$ .

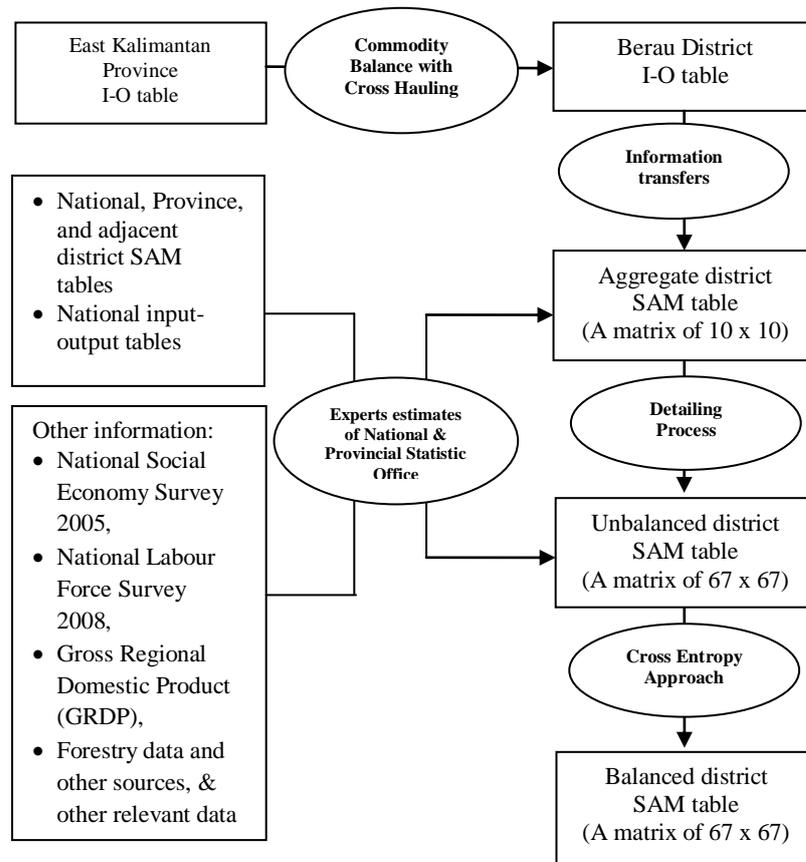
It is important to note that in a regionalised input-output table, most modellers do not differentiate between international trades or intra-national trades (trades within other region in a nation)<sup>3</sup> and is unfortunate that methods to distinguish these trades is barely available. The approach proposed by Kronenberg (2009) does not distinguish between international trade and intranational trade. Jackson (1998) attempts to propose approach to separate between, what he calls, rest-of-world imports (or exports) and rest-of-nation imports (or exports). In this study, however, the import is not differentiated simple because it is lack of information to support the differentiation.

After all information have been calculated, the intermediate transactions  $Z^{di}$ , the estimated primary input  $w^{di}$ , the regional output  $x^{di}$ , the final demand excluding export  $d^{di}$  and the regional trades (exports  $e^{di}$  and imports  $m^{di}$ ) are finally assembled to produce a prediction of district input-output table.

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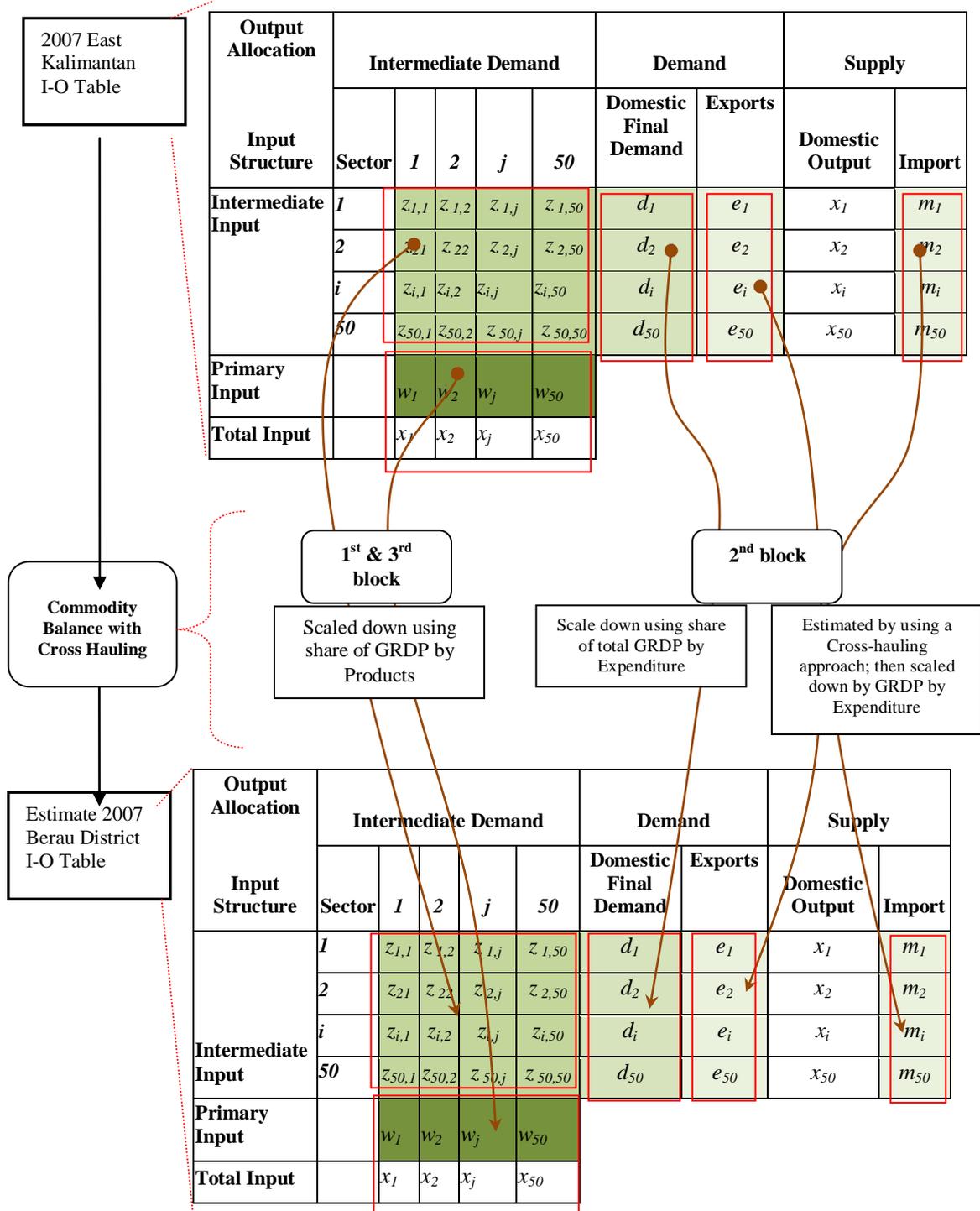
<sup>3</sup> The 2007 East Kalimantan Input-Output Table and other official province and district input-output tables in Indonesia do not differentiate between international and intra-national exports (imports).

In addition, the framework that is used to construct the Berau District SAM is as the following diagram:



**Figure 2. Procedure to construct the Berau District SAM table**

The basis for estimating the Berau District I-O table is a 2007 East Kalimantan Province I-O table, which consists of 50 sectors. The information on the Berau District GRP (both based on sectoral (value added) GRP and by expenditure) was used to scale down the production activities (intermediate inputs and value added), and the final demand excluding export of the East Kalimantan I-O table. The following chart demonstrates this process.



**Figure 3. Deriving Berau District I-O Table using Commodity Balance with Cross Hauling Approach**

### **3.2. The process**

#### **a. Estimating the Berau District Output (Intermediate Transactions and Primary Inputs/Value Added)**

Sectoral domestic products data were considered more superior than employment level data. From East Kalimantan Statistic Office, the 2007 sectoral domestic products data of both Berau District and East Kalimantan Province were obtained and used to estimate sectoral GRP shares between the District and the Province. The shares were utilised to scale down the East Kalimantan Province's production output, in order to obtain estimates of the Berau District's production output (including the intermediate transactions and primary inputs).

Based on our calculation, the sector of marine transportation and the sector of pulp, paper and printing were the highest and second highest shares of 0.341 and 0.259, respectively. The high share of the marine transportation sector was probably due to the Tanjung Jabung Port, the main port linking the district to other regions through water transportation. Meanwhile a high share of the pulp and paper and printing was contributed by the Kiani Nusantara Pulp and Paper Company, which is located in the District. The timber and the timber industry sectors' shares were estimated to only be 0.119 and 0.002 respectively; while in the estate crops group, the shares of pepper plantation, oil palm plantation and other crops sectors were the lowest with only 0.024, 0.050 and 0.073.

#### **b. Estimating the Berau District's Final Demand excluding Exports**

The Berau District's final demand excluding exports consists of both households and government consumptions, capital formation/accumulation, and change in stocks. Share of the total final demand excluding exports was calculated using information on the total Berau District Final Demand and the East Kalimantan Province's counterparts. Those shares were employed to scale down the East Kalimantan Province final demand excluding exports. This process assumes that the structure Berau District's final demand follows that of East Kalimantan Province.

We calculated that the share of the Berau District households' consumption was 0.023 and this value was used to scale down the East Kalimantan Province households consumption. Shares of the Berau District's Government Consumption, Capital Formation/Accumulation, Changes in Stock, Export and Import were estimated to be 0.025, 0.030, 0.0003, 0.02, and 0.012, respectively and were used to scale down those correspond parameters.

#### **c. Estimating the Berau District Trades Pattern (Exports and Imports)**

In order to estimate the Berau District trade figure i.e. exports and imports, we first estimate the product heterogeneity using the East Kalimantan Trade Figures. Subsequently, the product heterogeneity of East Kalimantan was used to estimate the degree of cross hauling of the corresponding commodity for the Berau District. The cross hauling of the Berau District is embedded within the process of calculating the Berau District Trade Volume. Once the District's trade volume, consumption and production have been calculated, an estimation of the Berau District's exports and imports can be carried out. It is important to note that official information on

aggregate exports and imports are available from the Districts statistics office. To compromise the data, the ratio between aggregate exports/imports official information and aggregate exports/imports from the above calculation was used to scale down the estimated exports/imports columns; hence retaining the coefficients of commodities within the exports/imports column.

Finally all the estimates were then assembled to create a complete Berau District Input-Output Table. A simplified Berau District Input-Output Table is shown in Table 1.



### 3.3. Extending the estimated Berau District I-O table into a Social Accounting Matrix

The estimated Berau District I-O table was extended into a social accounting matrix table by completing with the rest of required information. The National Social Accounting Matrix 2005 and the Social Accounting Matrix of East Kutai District East Kalimantan 2000 were employed as a benchmark.<sup>4</sup> In this regards, the Berau District Social Accounting Matrix Table was constructed by adapting and slightly modifying model of the 2000 East Kutai District East Kalimantan Province Social Accounting Matrix Table. All initial values of cells within the berau District SAM table except those derived from the input-output was estimated by officers of the National Statistics Office<sup>5</sup>. Therefore, this section is more appropriate to be considered as an illustration purposes.

The Berau District Social Accounting Matrix Table was designed to consist of the following accounts:

#### (a) Factors of Production

Two groups of factors of production are available in this account i.e. labour and capital. The labour factor is divided into three groups:

- Forestry labours, which is further grouped into paid workers and non-paid workers categories;
- Agricultural labours, which is further classified into paid workers and non-paid workers categories, and
- Other types of labours, which consists of paid workers and non-paid workers categories.

The 2000 East Kutai District and 2003 East Kalimantan Province SAM Tables (Justianto, 2005) did not separate capital factor of production into land and capital. However, the 2005 Inter-regional Input-Output Table for Indonesia disaggregates the capital factors into land and capital and the shares of the Kalimantan can be used as a proxy to disaggregate land factor from the capital of the Berau District<sup>6</sup>.

#### (b) Institutions

There are three types of institution in the district i.e. households, enterprise and government. The households was categorised into four groups. The enterprise and government institutions were not disaggregated.

- *Household Institutions*

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<sup>4</sup> During a field visit in March 2009, an officer of the East Kalimantan Statistics Office revealed that in 2010, a Social Accounting Matrix of East Kalimantan would be developed. Yet, until November 2010, it was not available.

<sup>5</sup> The Social Accounting Matrix of Berau District was prepared by Mr. Wisnu Winardi, Assistant Deputy Director at the Directorate of National Accounts, Indonesian National Statistics Office and his staffes. Mr. Winardi's extensive experience in working at the South Kalimantan Statistic Office provides an additional advantage.

<sup>6</sup> Resosudarmo, B.P., email communications October 2011.

Households was disaggregated into four groups i.e. Forestry households, Agricultural (excluding Forestry) households, Non-Agricultural households and Other type of households. Each household category, except for the Other type of household, was further divided into worker and self-employed category<sup>7</sup>. Overall, there are seven household types in this institution. Further households disaggregation was not possible because of the limited sample size of the Berau district when the 2005 National Social Economic Survey<sup>8</sup>.

- Enterprise Institution; includes all firms in the Berau District,
- Government Institutions; refers to the Berau District government.

(c) Producing Sectors or Activities

Based on discussion with the National Statistics officer, the Social Accounting Matrix was designed to have 24 sectors. Therefore, those sectors of the similar classification and not on the focus of study were disaggregated. Yet, important sectors such as food crops, estate crops, oil palm plantation, as well as timber sector were retained. This disaggregation is considered more detail than that of the 2000 Social Accounting Matrix Table of East Kutai District, East Kalimantan Province, which comprises only 13 sectors.<sup>9</sup>

The following table shows the distribution of 24 sectors/commodity.

**Table 2. Distribution of 24 sectors/commodity**

No	Sector
1	Food and cash crops
2	Pepper plantation
3	Oil palm plantation
4	Other estate crops
5	Poultry & other livestock
6	Timber/logging
7	Other (non-wood) forest products
8	Marine & inland fishery
9	Coal, oil & natural gas, other non oil & natural gas mining
10	Quarrying
11	Food and beverage industry
12	Textile, leather and foot-based industry
13	Forestry-based industry
14	Pulp and paper including printing industry
15	Fertiliser, chemical and rubber-based industry
16	Other products industries, oil refinery, LNG industry, cement & its associations industry, steel industry, transport, machinery & tool industry
17	Electricity & water
18	Construction
19	Trade, hotel & restaurant
20	Transportation
21	Communication
22	Banks & other financial services

<sup>7</sup> Specified according to the head of the household's job occupation.

<sup>8</sup> As was suggested by National Statistic officers.

<sup>9</sup> The National Statistics officer suggested that to have higher number of sectors would be unreasonable because, at the district level, data were lacking to support such high level sectoral distribution.

23	Rentals & company services
24	Other services

Source: Author

(d) Commodities

The number of commodities is similar to the number of sectors, assuming one sector produces only one commodity.

(e) Capital Accounts; also referred to as Saving and Investments

(f) Net Indirect Taxes

(g) Rest of the World (Berau)

The rest of the world represents regions out of the Berau District, such as the rest of East Kalimantan, Indonesia, and out of Indonesia). This follows a single region social accounting matrix model of the East Kutai District 2000 and the Sumatra Island Social Accounting Matrix/CGE Model of Nu Nu San et al. (2000).

**a. Specifying the Social Accounting contents**

Before a detail social accounting matrix table was constructed, an initial social accounting matrix table of 10 x 10 was developed to provide a basis for detailing process (see Table 3 and Table 4). Table 3 informs the meaning of each cell, while Table 4 shows initial value of each cell of the matrix. In both table, highlighted cells indicates that those information were obtained from the input-output table. The rests of the matrix were derived from variety of sources.

This is explained as follow:

- *Cells of the Social Accounting Matrix Table that are derived from the 24 sectors Berau Input-Output Table are:*

a. Intermediate demand/input (T7.6)

Intermediate demand (or intermediate input) includes purchases and uses of both domestic and imported good and services. This also includes trade and transportation margin values (BPS, 2008). Information of the intermediate demand was taken the intermediate demand of the aggregated version of the Berau District Input-Output Table containing 24 sectors. Hence, in the Berau District Social Accounting Matrix Table, they form a sub matrix of 24 x 24.

**Table 3. Structure of the Aggregate SAM (a matrix of 10 x 10)**

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1						Salary & Wages (Labour payment by industries) <b>T1.6</b>				Labour receipt from RoW <b>T1.10</b>	Labour Demand
	Capital	2						Non labour (Gross operating surplus) <b>T2.6</b>				Capital receipt from RoW <b>T2.10</b>	Capital Demand
II. Institution	Households	3	Labours Income <b>T3.1</b>	Households Capital Income <b>T3.2</b>	Inter Household Transfer <b>T3.3</b>	Government Transfer to Household <b>T3.4</b>	Government Transfer to Household <b>T3.5</b>					Household receipt from RoW <b>T3.10</b>	Household Income
	Enterprise	4		Enterprise Capital Income <b>T4.2</b>	Household Transfer to Enterprise <b>T4.2</b>	Inter Enterprise Transfer <b>T4.2</b>						Enterprise receipt from RoW <b>T4.10</b>	Enterprise Income
	Government	5			Direct Tax from Household <b>T4.3</b>	Direct Tax from Enterprise <b>T4.4</b>	Inter Government Transfer <b>T4.5</b>				Government receipt from Indirect Tax <b>T5.9</b>	Government receipt from RoW <b>T5.10</b>	Government Revenue
III. Producing Sector		6							MAKE Matrix <b>T6.7</b>				Industry Sales
IV. Commodity		7			Household Consumption <b>T7.3</b>		Government Consumption <b>T7.5</b>	Intermediate Input <b>T7.6</b>		Investment <b>T7.8</b>		Exports <b>T7.10</b>	Total Demand
V. Capital Account		8			Household Saving <b>T8.3</b>	Enterprise Saving <b>T8.4</b>	Government Saving <b>T8.5</b>						Capital Formation
VI. Net Indirect Tax		9							Indirect Tax <b>T9.7</b>				Sum of Indirect Tax
VII. Rest of the World		10	Labours income transfers to RoW <b>T10.1</b>	Capital income transfers to RoW <b>T10.2</b>	Households transfers to RoW <b>T10.2</b>	Enterprise transfers to RoW <b>T10.4</b>	Government transfers to RoW <b>T10.5</b>		Imports <b>T10.7</b>				Foreign Exchange Outflow
Sum			Labour Supply	Capital Supply	Household Spending	Enterprise Spending	Government Spending	Industry Cost	Total Supply	Total Investment	Indirect Tax Revenue	Foreign Exchange Inflow	

Sources: Wisnu Winardi (2010), personal communication, modified from *Pusat Rencana Kehutanan Departemen Kehutanan & Direktorat Neraca Konsumsi Badan Pusat Statistik* (2001)

Notes:

- Values in the highlighted cells were derived from I-O table. Others were derived from variety of sources.
- E.g. T3.1 refers to an intersection of Row 3 and Column 1.

**Table 4. Initial Estimates of the Aggregate Berau District SAM (in million)**

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
<b>I. Factors of Production</b>	<b>Labour</b>	<b>1</b>	-					2,179,943.71				2,591.57	2,182,535.29
	<b>Capital</b>	<b>2</b>						1,985,373.36				2,609.02	1,987,982.38
<b>II. Institution</b>	<b>Households</b>	<b>3</b>	1,593,972.69	345,740.63	128,900.45	49,683.26	36,434.39					2,998.91	2,157,730.33
	<b>Enterprise</b>	<b>4</b>		1,395,824.29		26,731.99						1,059.70	1,423,615.99
	<b>Government</b>	<b>5</b>			172,099.36	216,333.80	48,644.79				179,437.24	29,569.51	646,084.70
<b>III. Producing Sector</b>		<b>6</b>							7,247,981.04				7,247,981.04
<b>IV. Commodity</b>		<b>7</b>			733,432.10		353,089.35	3,082,663.97		1,040,070.79		3,027,025.39	8,236,281.60
<b>V. Capital Account</b>		<b>8</b>			160,419.26	489,698.23	100,818.70						750,936.19
<b>VI. Net Indirect Tax</b>		<b>9</b>							179,410.46				179,410.46
<b>VII. Rest of the World</b>		<b>10</b>	588,646.35	246,490.15	22,927.17	610,544.84	166,001.01		808,890.10	67,421.22			2,510,920.83
<b>Sum</b>			2,182,619.04	1,988,055.07	1,217,778.34	1,392,992.12	704,988.23	7,247,981.04	8,236,281.60	1,107,492.01	179,437.24	3,061,320.44	

Sources: Author, and Wisnu Winardi (2010), personal communication.

Note that values in the highlighted cells were derived from I-O table. Others were derived from variety of sources.

b. Labour payment by industries (T1.6)

This cell represents value added allocated to factors of production (labour and capital), which was taken from wage and salary, gross operating surplus and depreciation<sup>10</sup> of the input-output table. This transaction reflects returns for service paid by the producing sector and indicates the source of income for the factors of production and institutions (especially households).

In the Indonesian Social Accounting Matrix System, the labour factor of production consists of wages and salaries, i.e. actually represents formal paid workers. The informal workers e.g. unpaid family worker and self employee are still accumulated in the gross operating surplus. For this reason, the value of the informal workers should be excluded and taken out of the operating surplus<sup>11</sup>. Included in the informal workers are unpaid family workers and the self employee (Badan Pusat Statistik, 2008).

In the Berau District Social Accounting Matrix Table, this labour factor of production was expanded into a sub matrix of 6 x 24.

c. Gross operating surplus or non-labour payment by industries (T2.6)

The capital factor of production is estimated from net operating surplus (the gross operating surplus less the portion that has been taken out as imputed wages and salary). This forms a matrix of 1 x 24.

d. Net indirect taxes/taxes minus subsidy (T9.7)

Net indirect tax represents income to government, beside transfers from RoW to the government. In the SAM table, each net indirect tax forms a sub matrix of 1 X 24.

e. Final Demand (T7.3, T7.5, T7.8, T7.10)

Final demand (consumption) includes goods and services purchased for capital government and households' consumption, capital formation (investment), and exports. Data for this final demand comes from the relevant sub matrices of the input-output table. In the Berau District Social Accounting Matrix Table, the households' consumption, government expenditure, capital formation (investment), and exports form sub matrices of 24 x 7, 24 1, 24 x 1 and 24 x 1, respectively.

f. Rest of the World (Berau District (T10.7)

This is a total of imported commodities required by both intermediate and final demanders. This forms a matrix of 1x24 and is derived imports sub matrix of the input-output table.

g. Make Matrix (T6.7);

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<sup>10</sup> Depreciation is assumed to be compensation from the capital factor of production.

<sup>11</sup> The return of service for informal worker was calculated in the form of imputed wage and salary.

Make Matrix is a diagonal matrix that reveals how industries supply commodities to the market. It is assumed that the matrix is diagonal meaning that every industry produces a single commodity.

- *Other cells that to be filled from other sources:*

Sources of these cells are:

- 2005 National Social Economic Survey (*Survey Sosial Ekonomi Nasional* or *SUSENAS* 2005)
- 2007 National Labour Force Survey (*Survey Angkatan Kerja Nasional/ SAKERNAS* 2007)
- Reports of the Berau District Government Expenditure of the year 2007
- Records of the East Kalimantan exports and imports of the year 2007
- Other information (Cash flow accounts, Indonesia National Bank, etc.)

Sometimes some accounts are left as balancing items between accounts because such information is rarely available (Hosoe, Gasawa, & Hashimoto, 2010).

Rest of the social accounting matrix table cells are briefly explained as follow:

**Table 5. Estimating the rest of Berau SAM accounts**

Referred cells	Remarks
T1.10	Data were estimated using a share of the East Kalimantan exports and imports (intra-national and international) to the total East Kalimantan's GRDP, multiplied by salary and wage received by labour factor of production (of the producing sector/activities).
T2.10	Data were estimated using shares of the East Kalimantan Exports and Imports (intra-national and international) to total East Kalimantan's GRDP, and multiplied by capital income of the capital factor of production (of the producing sector/activities).
T3.1	Data were estimated from salary and wages received by the households using <i>SUSENAS</i> 2007.
T3.2	Data were estimated from capital income (from both agriculture and non agriculture) received by households using <i>SUSENAS</i> 2007.
T3.3	Data were estimated from transfers between households from <i>SUSENAS</i> 2007.
T3.4	As a balancing item
T3.5	Data were estimated using the 2007 Berau District expenditure reports. Central government accounts were used to detail this matrix using the District's account for social transfers timed by household consumption (of the input-output table).
T3.10	Data was estimated using share of the East Kalimantan imports and exports to the East Kalimantan's GRDP, multiplied by households consumption component of the Berau District's GRDP.
T4.3	Data were estimated using households' expenditure for insurance. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to extend this District sub matrix.
T4.4	As a balancing item
T4.10	As a balancing item
T5.3	Data were derived from household expenditure for taxes (direct tax income). The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to extend the District sub matrix.
T5.4	As a balancing item
T5.5	Data were obtained from the Berau District government Expenditure 2007. The

Referred cells	Remarks
	corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to extend the District sub matrix.
T5.10	Data were estimated from share of the East Kalimantan exports and imports (intra-national and international) to the total East Kalimantan's GRDP, and multiplied by government consumption.
	As a balancing item
	Data on savings were obtained from the Indonesian National Bank of East Kalimantan Branch 2007. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to form district the sub matrix.
	Data were derived from the Berau District, East Kalimantan and Central Government's Budget and Expenditure in 2007. The corresponding sub matrix of the 2005 Indonesian Social Accounting Matrix Table was used as a proxy to form the sub matrix.

Source:  
Wisnu Winardi, personal communication, 2010.

#### *d. Balancing the Social Accounting Matrix*

The initial social accounting matrix (SAM) table of the Berau District constructed by a National Statistics officer was inconsistent and unbalance (characterised by the sum of some rows are unequal to the sum the corresponding columns) due to a variety of data sources and estimation techniques used to derive information of the SAM accounts. The matrix was adjusted to obtain its balance condition (i.e. sum of each row equals to the sum of each corresponding column) (Robinson, Cattaneo, & El-Said, 1998; Robinson & El-Said, 2000).

A cross entropy method (Robinson, Cattaneo, and El-Said, 1998; Robinson & El-Said, 2000) was utilised. The method basically is an optimisation approach (i.e. minimisation) of relative 'entropy' distance between two probability distributions (prior and posterior) using all information available at the problem at hand. In this context, the idea is to find a new set of (SAM) coefficients which minimise the relative entropy distance between prior and the new estimated matrix coefficients. The process retains some prior known information (i.e. data that have higher reliability such as the value of exports, imports, and private and government consumptions obtained from the District Statistics Office).

Result of balancing process is presented in Table 6. Table 7 presents the percentage change of each cell matrix from its initial values.

**Table 6. the Berau District SAM – final (in million)**

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1	-					1,801,469.55				1,106.08	1,802,575.63
	Capital	2						2,363,847.52				2,842.05	2,366,689.57
II. Institution	Households	3	1,097,240.42	143,016.90	132,533.51	19,165.35	25,409.67					377.25	1,417,743.10
	Enterprise	4		1,870,090.60		37,230.05						1,281.96	1,908,602.61
	Government	5			217,302.72	266,892.66	53,980.86				179,410.46	28,680.70	746,267.41
III. Producing Sector		6							6,221,822.98				6,221,822.98
IV. Commodity		7			733,432.10		353,089.35	2,056,505.91		1,040,070.79		3,027,025.39	7,210,123.54
V. Capital Account		8			303,119.91	740,336.66	121,126.49						1,164,583.05
VI. Net Indirect Tax		9							179,410.46				179,410.46
VII. Rest of the World		10	705,335.21	353,582.07	31,354.86	844,977.89	192,661.04		808,890.10	124,512.26			3,061,313.44
Sum			1,802,575.63	2,366,689.57	1,417,743.10	1,908,602.61	746,267.41	6,221,822.98	7,210,123.54	1,164,583.05	179,410.46	3,061,313.44	

**Table 7. The Berau District SAM –initial & unbalance (in million)**

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
I. Factors of Production	Labour	1	-					2,179,943.71				2,591.57	2,182,535.29
	Capital	2						1,985,373.36				2,609.02	1,987,982.38
II. Institution	Households	3	1,593,972.69	345,740.63	128,900.45	49,683.26	36,434.39					2,998.91	2,157,730.33
	Enterprise	4		1,395,824.29		26,731.99						1,059.70	1,423,615.99
	Government	5			172,099.36	216,333.80	48,644.79				179,437.24	29,569.51	646,084.70
III. Producing Sector		6							7,247,981.04				7,247,981.04
IV. Commodity		7			733,432.10		353,089.35	3,082,663.97		1,040,070.79		3,027,025.39	8,236,281.60
V. Capital Account		8			160,419.26	489,698.23	100,818.70						750,936.19
VI. Net Indirect Tax		9							179,410.46				179,410.46
VII. Rest of the World		10	588,646.35	246,490.15	22,927.17	610,544.84	166,001.01		808,890.10	67,421.22			2,510,920.83
Sum			2,182,619.04	1,988,055.07	1,217,778.34	1,392,992.12	704,988.23	7,247,981.04	8,236,281.60	1,107,492.01	179,437.24	3,061,320.44	

**Table 8. Percentage change of the balance SAM from the initial estimate**

Classifications		No	1	2	3	4	5	6	7	8	9	10	Sum
<b>I. Factors of Production</b>	<b>Labour</b>	<b>1</b>						- 17.36				- 57.32	
	<b>Capital</b>	<b>2</b>						19.06				8.93	
<b>II. Institution</b>	<b>Households</b>	<b>3</b>	- 31.16	- 58.63	2.82	- 61.42	- 30.26					- 87.42	
	<b>Enterprise</b>	<b>4</b>		33.98		39.27						20.97	
	<b>Government</b>	<b>5</b>			26.27	23.37	10.97				- 0.01	- 3.01	
<b>III. Producing Sector</b>		<b>6</b>							14.16				
<b>IV. Commodity</b>		<b>7</b>			0.00		-	- 33.29		-		- 0.00	
<b>V. Capital Account</b>		<b>8</b>			88.95	51.18	20.14						
<b>VI. Net Indirect Tax</b>		<b>9</b>							0				
<b>VII. Rest of the World</b>		<b>10</b>	19.82	43.45	36.76	38.40	16.06		0.00	84.68			
<b>Sum</b>													

Sources: Author's calculation

#### 4. Discussion

**Table 9. Comparison of Output Multiplier**

No	Sector	Output Multiplier of IO Table 5)			% (OM-CH/OM-Berau 4)
		East Kalimantan Province 1)	Berau District (adjusted CH) 2)	Berau District-Pure Cross Hauling 3)	
1	Food crops (FCRO)	1.38	1.22	1.30	6.32
2	Pepper plantations (PEPP)	2.10	1.56	1.60	2.78
3	Oil Palm plantation (OILP)	2.10	1.69	1.78	4.88
4	Other estate crops (OESC)	2.79	1.40	1.44	3.03
5	Livestock (LIVS)	3.25	1.71	1.74	1.81
6	Timber/Logging (TIMB)	2.35	1.18	1.37	15.96
7	Other forest products; non timber forest products (OFOP)	2.48	1.24	1.26	1.60
8	Fisheries (FISH)	2.57	1.30	1.43	10.60
9	Coal mining (COAL)	2.48	1.24	1.50	21.21
10	Quarrying and other mining (QUAR)	2.88	1.44	1.46	1.02
11	Food based industries (FBIN)	3.71	2.18	2.22	1.91
12	Textile industries (TEXL)	4.38	2.20	2.29	3.92
13	Forest/Timber based industries (FOIN)	3.99	2.00	2.07	3.41
14	Pulp, paper and printing industries (PAPR)	3.74	1.87	2.14	14.35
15	Oil refinery (OILR)	4.44	2.22	2.30	3.54
16	Fertiliser & chemical industries (FERC)	4.16	2.09	2.16	3.28
17	Electricity & water (ELWT)	4.30	2.16	2.25	4.52
18	Construction (CONS)	4.59	2.30	2.21	(4.00)
19	Trading (TRAD)	2.80	1.41	1.64	16.52
20	Transportation (TRAN)	3.67	1.85	2.46	32.57
21	COMM	2.85	1.43	1.47	3.01
22	FINA	3.03	1.51	1.53	1.17
23	SERV	2.67	1.34	1.35	0.57
24	PUBO	2.16	1.08	1.09	0.99
		74.88	39.64	42.07	6.14

Note:

- 1) Aggregated East Kalimantan IO Table
- 2) Aggregated Berau District IO Table; derived from the balanced SAM. Note that the export (import) was adjusted at two stages (a) scaled down by the share of total export (import) of official figure between total of that of CH results, and (b) adjusted further to reflect the Indonesia typical IO e.g. no export (import) on Construction sector.
- 3) Aggregated Berau District IO Table; using directly export (import) estimation from CH results.
- 4) Percentage different between Output Multiplier of 3) and 2).
- 5) Output Multiplier is the sum of Leontief Inverse. Leontief Inverse is calculated:  $(I - A)^{-1}$  where A is the coefficient matrix of the IO table. Output multiplier is the sum of Leontief Inverse for each column (sector) and reflect the potential increase of all sector when there is an increase of demand on j sector of one unit.

Thus, for example, there is an increase demand of Livestock sector by one unit, there will be increase of production by 1.71 unit in the Berau District.

An estimate of the Berau District IO table was derived from the final Berau District SAM. Output multiplier of this IO table was calculated with Leontief Inverse technique and was compared with that of the East Kalimantan IO table, as column 1 and 2 of Table 9. In addition, an estimate Berau District IO table whose its trade figure was not adjusted was also produced (hence called 'unadjusted IO table'). Its output multiplier was also calculated, as in the column 3 of the above table.

The the unadjusted IO table produce higher volume of exports and imports, compared to those of the adjusted IO table. However, there have been small difference between output multiplier of the IO derived from SAM table and those derived from the cross hauling approach (between column 2 and column 3). This probably is due to the fact output multiplier is calculated based on the coefficient inputs (make matrix), and the matrix derived from SAM table was slightly adjusted during the balancing process.

Table 9 also suggests that the output multiplier of the Berau District is lower than that of East Kalimantan Province. For example, if there is an increase of demand by 1 unit in Food crops sector (commodity), there will be an increase of production (output) by 1.38 units for East Kalimantan and only 1.22 for the Berau District. This is possible as the increase demand can be supplied from other districts within East Kalimantan.

The sum of output multiplier for East Kalimantan Province is 74.88, much higher than that of the Berau District, which only account for 39.64. This suggests that if there is an increase of final demand by 24 units, the output will increase by 74.88 for the East Kalimantan and by 39.64 units for the Berau District. Therefore, total multiplier for the East Kalimantan is 3.12, while for the Berau District is 1.68. According to Kronenberg (2007), this is consistent; as the regional output multiplier tend to be smaller than national (higher level of region).

Table 6 demonstrates the aggregate version of the final SAM table of the Berau District. The percentage change of cells' value of the transfers between Berau and Rest of World are unsurprisingly high. This seems to correspond to lower level of accuracy in estimating those cells. While for the cells representing receipts of households from factors of production, their changes are moderate. This seems to reflect the moderate level of accuracy of initial estimate, which were utilising insufficient data of National Socio Economic Survey of the Berau District.

The Berau District SAM table serves as the dataset for CGE model. Currently, a single region type of Computable General Equilibrium (CGE) model for the Berau District is developed and planned to be employed to assess the potential socio economic impacts of program for reducing emissions from deforestation and degradation. For example, the contribution of logging companies in the program is formulated as the application of reduced-impact logging (RIL) technique/forest certification. Based on our experts survey result, this would increase logging cost by around 8%. The survey also estimates that required incentive to compensate for maintaining the application of the RIL and forest certification is estimated to be US\$ 35 and US\$ 500 per hectare per year, respectively. For oil plantation sector, expert survey results suggest that in order to engage into the reduce emissions, the sector

would experience an increase of production cost by US\$ 800 per ha for better management.

The development of the CGE framework employs the GAMS programme (Rosenthal, 2008; T. Rutherford, 1998; T. F. Rutherford, 1999) with the MPSGE as subsystem in it. Some of the problems encountered during the process are such as inclusion of appropriate factors supplies particularly land supply and land use change (conversion) into the model.

## **5. Conclusion**

This paper demonstrates the construction of the Berau District SAM by combining the estimate of the District IO table and statistics officers' estimate. During the process, official information such as sectoral GRP and GRP by expenditure which was obtained from the district statistics office was employed. Available raw data at the district level were used but cautioned was put because of the insufficient sample size of data (the Berau district' sample for National Socio Economic Survey and National Survey Labour Force were limited). This fact restricted for making higher level of disaggregation i.e creating higher level of households or sectoral disaggregation. As suggested by Jensen (1980), the holistic accuracy type was pursued so as the estimated SAM/IO table represents the Berau District economy.

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