# Chapter 4

## Yunnan Micro SAM 2002

A Micro SAM, based on the Macro SAM which was made previously chapter, will be discussed in this section. For building the Micro SAM, some cells in Macro SAM will be disaggregated to sub-matrices. For distance, intermediate consumption (CA-CA), household final consumption (CA-Household) etc in Macro SAM will be disaggregated as IO matrix (nXn) in Micro SAM. These which can find a specific data source can be used directly. However, for those which cannot, they have to be assumed and estimated technically. In this chapter, whole specific procedure will be introduced step by step in each section.

### 4.1 The Accounts Setting of the Micro SAM for Yunnan, 2002

The Micro SAM has the same structure with the Marco SAM which includes Commodities-Activities, Value-Added, Institutions, Capital and Rest of World.

**Commodity-Activity Accounts (CA, 41)**

Deriving from the official classification of all sectors, the CA account of the Micro SAM contains 41 sectors. Among the 41 sectors, there are 10 agricultural sectors, 18 industrial sectors, 3 energy sectors, 1 construction sector, 9 services sectors. See in Table4.1.

**Table4.1 CA accounts setting of the Micro SAM**

| | No. | Sector | | No. | Sector |
|---|---|---|---|---|---|
| Agriculture | 1 | Grain Crops | Industry | 22 | Other chemicals |
| | 2 | Beans | | 23 | Metal and non-metal manufacturing |
| | 3 | Oil bearing Crops | | 24 | Equipment |
| | 4 | Sugar Crops | | 25 | Machinery |
| | 5 | Tobacco | | 26 | Electronics, instruments, and office equipment |
| | 6 | Other Farming | | 27 | Other manufacturing |
| | 7 | Forestry | | 28 | Waster |
| | 8 | Animal husbandry | | 29 | Electricity and heat |
| | 9 | Fisher | | 30 | Gas |
| | 10 | Extension services | | 31 | Water |
| Industry | 11 | Coal mining and processing | Services | 32 | Construction |
| | 12 | Oil and natural gas extraction | | 33 | Transportation and storage |
| | 13 | Metal and non-metal mining | | 34 | Telecommunication and logistics |
| | 14 | Food and tobacco processing | | 35 | Retail and wholesale |
| | 15 | Textiles and apparel | | 36 | Accommodation and restaurant |
| | 16 | Timber and furniture | | 37 | Finance and insurance |
| | 17 | Papermaking | | 38 | Tourism |
| | 18 | Oil refining | | 39 | Scientific research |
| | 19 | Coking | | 40 | Other services |
| | 20 | Fertilizer | | 41 | Public administration |
| | 21 | Pesticides | | | |

Source: The input and output table for Yunnan 2002

Agriculture sector contains farming sectors in terms of grain crops, beans, oil bearing crops, sugar crops, tobacco, and other farming; and non-farming sectors in

terms of forestry, animal husbandry, fisher, and extension services. The farming sector will be disaggregated referring to a 1500 samples field survey that was carried out by ICRAF in 2008 and 2002 Yunnan IO table. The non-farming sector will get from a 122 sectors Yunnan IO table directly. The non-agriculture sectors were obtained from 42 sectors Yunnan IO table or 122 sectors Yunnan IO table.

**Value-Added accounts (VA,4)**

Value added account has two types in terms of value added labor and value added capital which correspond to compensation of employee, depreciation & operating surplus in IO table.

**1. Value-added labor (3)**

According to the realistic situation for obtaining available data, 3 types labor will be defined in terms of Agriculture labor (Va1), Other rural labor (Va2) and urban labor (Va3). Agriculture labor represents the rural labors who work for agriculture sector. Other rural labor represents the rural labors who work for industry sector or services sector. Urban labors usually were considerate other work for non-agriculture sector.

**2. VA – Capital (1)**

In the Micro SAM, the VA-K account will set only one sector which get from IO table. It is the summation of depreciation and operating surplus which represent the new value creation for the current year.



**Institutions (Institutions, 16)**

**1. Household accounts setting of the Micro SAM (12)**

According to 122 sectors IO table for Yunnan 2002, household is firstly disaggregated as two parts in terms of rural household and urban household. Then,

each of them will be disaggregated as 7 sorts of urban household and 5 sorts of rural household by the levels of income referring to the standard of the Yunnan Statistics Yearbook. See in Table4.2:

**Table4.2 the categories of household of the Micro SAM**

| | | | | | |
|---|---|---|---|---|---|
| **Urban Households** | **Hu1** | **Lowest income** | **Rural Households** | **Hr1** | **Low income** |
| | Hu2 | Low income | | Hr2 | Lower middle income |
| | Hu3 | Lower middle income | | Hr3 | Middle income |
| | Hu4 | Middle income | | Hr4 | Upper middle income |
| | Hu5 | Upper middle income | | Hr5 | High income |
| | Hu6 | High income | | | |
| | Hu7 | Highest income | | | |

Source: China Statistics Yearbook 2003

**2. Enterprise accounts setting in the Micro SAM (1)**

In the Micro SAM, the enterprise account keeps single sector as same as it in the Macro SAM.

**3. Government account setting in the Micro SAM (3)**

Government account will keep the same feature as the Macro SAM in terms of local government, central government and extra-budgetary system.

**Capital account setting in the Micro SAM (CAP, 1)**

The capital accounts will keep one sector as same as in the Macro SAM.

**Rest of the World (ROW, 2)**

In a regional SAM, since there are both international and domestic trades with other nations and the rest part of the same country. Therefore, the rest of the world will keep the two accounts setting as same as in the Macro SAM in terms of ROW &ROMC.

## 4.2 The Framework and Explanations

For clearly understanding on the whole prefecture of the Micro SAM, it is necessary to know the dimension of the Micro SAM. Hence, based on the setting of the accounts, the dimension of the Micro SAM can be clearly described in table4.3

**Table4.3 the dimension of the Micro SAM**

| | CA | VA-L | VA-K | Household | Enterprise | Gov-L | Gov-E | Gov-C | CAP | ROMC | ROW | ROWSUM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CA** | $C_I$ (41X41) | - | - | $C_F$ (41X12) | - | $G_L$ (41X1) | $G_E$ (41X1) | $G_C$ (41X1) | I (41X1) | $X_D$ (41X1) | $X_W$ (41X1) | AD |
| **VA-L** | $W_V$ (3X41) | - | - | - | - | - | - | - | - | - | - | $Y_{FL}$ |
| **VA-K** | RK (1X41) | - | - | - | - | - | - | - | - | - | - | $Y_{FK}$ |
| **Household** | - | $W_H$ (12X3) | $RK_H$ (12X1) | - | | $G_{TLH}$ (12X1) | | $G_{TCH}$ (12X1) | - | - | - | $Y_H$ |
| **Enterprise** | - | - | $RK_E$ (1X1) | - | - | - | | - | - | - | - | $Y_E$ |
| **Gov-L** | $T_{IDL}$ (1X41) | - | - | $T_{HI}$ (1X12) | $T_{EIL}$ (1X1) | | | $G_{TCL}$ (1X1) | - | - | - | $Y_{GL}$ |
| **Gov-E** | $T_{EB}$ (1X41) | | | | | | | | | | | $Y_{GE}$ |
| **Gov-C** | $T_M+T_{IDC}$ (1X41) | - | - | - | $T_{EIC}$ (1X1) | $G_{TLC}$ (1X1) | | | - | $G_{CROMC}$ (1X1) | - | $Y_{GC}$ |
| **CAP** | - | - | - | $S_H$ (1X12) | $S_E$ (1X1) | $S_G$ (1X1) | | | - | $S_D$ (1X1) | $S_W$ (1X1) | S |
| **ROMC** | $M_D$ (1X41) | - | - | - | - | - | | - | - | - | - | $Y_{ROMC}$ |
| **ROW** | $M_W$ (1X41) | - | - | - | - | - | | - | - | - | - | $Y_{ROW}$ |
| **COLSUM** | AS | $E_{FL}$ | $E_{FK}$ | $E_H$ | $E_E$ | $E_{GL}$ | $E_{GE}$ | $E_{GC}$ | I | $E_{ROMC}$ | $E_{ROW}$ | |

Source: designed by the author



Table4.3 clearly presents that the final objective of the paper is going to build a 64X64 Micro SAM and 31 parts without considering row total and column total. The same component and structure will be kept as same as of the Macro SAM with 31 parts with opposite data. Some components or cells will be expended to small

matrices.

There is a specific excel spreadsheet, named the Micro SAM of Yunnnan 2002, with the whole process to make Micro SAM. In this paper, the major procedure and method will be mentioned to help the audit understand how such a regional SAM has been built at all. The section will explain the data sources as well.

**Commodity & Activity (CA)**

In 2002 Yunnan Micro SAM, the mostly data in the CA account will derive from IO table and some of it will be estimated with technology which introduced as next sections. The detail interpretation is listing as bellow:

1. **Intermediate consumption or intermediate input ($C_I$, 41X41):** Actually there are two IO tables in terms of the 42 sectors IO table and the 122 sectors IO table. Both of them will be used to build the Micro SAM, consequently, they will be combined to be a 41 sectors IO table. The detail is introduced in next section that explains the entire process of build the Micro SAM. This part is a 41X41 matrix which completely from the 41 IO table.

2. **Private consumption ($C_F$,41X12):** As well known from accounts setting, the households was aggregated as 12 types which include 7 types of urban household and 5 types of rural household. IO table has 2 types of household in terms of urban household and rural household. The further disaggregation has to be estimated by some techniques. However, a private consumption matrix which contains only 2 types of households can be made by only using the IO table. After a basic Micro SAM was built, the household account will continually disaggregate into 12 types.

**3. Local government consumption ($G_{L,}$ 41X1):** The final consumption of Provincial Government on purchasing goods and services will refer to the IO table but cannot be directly derived from IO table. The author uses the data from the Macro SAM as the total amount to control the final results what are estimated by the method which introduced in next section.

**4. Extra-Budgetary consumption ($G_E$, 41X1):** this account is a residual balance term to indicate the expenditures of government and other public sector. The total amount of this part the equal to the opposite cell in the Macro SAM. Since we need to see the relation between this part to 41 agents, hence, it need to be disaggregated in to 41 times 1 matrix. The important assumption here is Gov-E only input on public administration rather than others. Hence, the Gov-L and Gov-C will be corresponding adjusted by the way that will be introduced in next section.

**5. Central government consumption ($G_C$, 41X1):** Central government's expenditure for purchasing goods and services on Yunnan province. The total of the array was dominated by the opposite cell in the Macro SAM. It will be disaggregated by the share that each level government takes account for the total.

**6. Gross fixed capital formation (I, 41X1):** The capital account derives from IO table. The cell value is equal to the sum of the fixed capital formation and the change in inventories in the IO table.

**7. Outflow to rest of mainland China ($X_D$, 41X1):** Total outflow of goods and services from Yunnan to ROMC was determined by the difference of total outflow and total export. The total outflow can be obtained from IO table directly for specific agents but the export has an only value. Therefore, this part has to be disaggregation by estimation.

**8. Export ($X_W$, 41X1):** The total exports from Yunnan to the rest of the world has an only data from the Macro SAM, consequently, it has to be disaggregated by estimation.

**Factor**

Factor account includes 2 types of value added accounts in terms of value added labor and value added capital. All of them can be obtained from IO table with specific agents.

**9. Compensation of employee ($W_V$, 12X41):** the data of this account, representing the value added labor, was obtained from the compensation of employee of the IO table. According to the categories of the Yunnan Statistics Yearbook, the types of VA-labor were identified as 12 in terms of 7 for urban labor and 5 for rural labor. The method for disaggregating describe as next section.

**10. Depreciation & operating surplus (RK, 1X41):** The data of the account, representing the value added capital, was gotten by the sum of depreciation and the operating surplus which comes from the IO table.

**Institution**



Institution account includes household, enterprise, government which contain 14 parts or 14 sub-matrix in the Micro SAM. They represent all transaction or transfer flow between them and others. This is also a very important and challengeable part because some parts of institution in the Macro SAM has only one array or one value and they have to be disaggregated into a matrix with multi array or a array. The principle for disaggregating the sort of data should, firstly, control the total amount to match the Macro SAM; secondly, disaggregate the data with appropriate proportion to

reflect the essential quantities relation reasonably between economic accounts and agents; thirdly, balance the each row total and column total.

**11. Compensation of employee distributed to household ($W_H$, 12X12):** This is a 12X12 triangle matrix which reflects each type of household gets the compensation from related type of value added labor.

**12. VA- Capital transfer to Household ($R_{KH}$, 12X1):** This is **a** residual balancing term which represents the capital revenue contribution to household. According to the quantitative relation in the Macro SAM, $R_{KH}$ plus $R_{KE}$ should be equal to RK.

**13. Local Government Subsidy and transfer on household ($G_{TLH}$, 12X1):** There are 2 steps to disaggregate the part. First, Using IO table to disaggregate $G_{TLH}$ into 2 cells in terms of urban and rural; Secondly, referring the household income and expenditure data which contain 7 types urban household and 5 types of rural household from the Yunnan Statistics Yearbook and China Statistics Yearbook to disaggregate this part into 12 cells.

**14. Central Governmental Subsidy and transfer on household ($G_{TCH}$, 12X1):** This part has only one value and has to be disaggregated by referring to the share of local government transferring to households.

**15. Capital Income distributed to enterprise ($RK_E$, 1X1):** This cell keep the same with the opposite cell in the Macro SAM.

**16. Local governmental indirect tax ($T_{IDL}$, 1X41):** This part was calculated by using the total input of CA account minus intermediate consumption, compensation of labor, capital revenue, indirect tax, outflow to rest of china and export to the rest of the world.

**17. Household' income taxes ($T_{HI}$ , 1X12):** Using the same method mentioned before to disaggregate household into 12 types.

**18. Enterprise income taxes ($T_{EIL}$, 1X1):** The cell keeps the same with it in the Macro SAM.

**19. Inter-government transfer ($G_{TCL}$, 1X1):** The cell keeps the same with it in the Macro SAM.

**20. Extra-budget Fee ($T_{EB}$, 1X41):** The total amount of this part is dominated by the value of opposite cell in the Macro SAM. The proportion to disaggregate it uses the same one which did in disaggregating local government indirect tax.

**21. Import taxes and central governmental indirect taxes ($T_M$+$T_{IDC}$, 1X41).** The total amount of this part will be dominated by the opposite cell in the Macro SAM. Using the same way, which we disaggregated local government indirect tax and extra-budget fee, to disaggregate it.

**22. Enterprise Income tax to Central Government ($T_{EIC}$, 1X1):** The cell keeps the same with it in the Macro SAM.

**23. Inter-government transfer ($G_{TLC}$, 1X1):** The cell keeps the same with it in the Macro SAM.

**24. Central government expenditure($G_{CROMC}$, 1X1):** The cell keeps the same with it in the Macro SAM.



**Capital accounts**

The account has only one row since the land and none land capital are not separated here. There are 5 cells represent the capital inflow from household saving, enterprise saving, government saving, ROMC saving and ROW saving.

**25. Household saving ($S_H$, 1X12):** Household saving here will be firstly disaggregated into 2 parts in terms of urban household and rural household. Then next section will explain how disaggregate it into 12 household types. The total amount of this part is dominated by the value in opposite cell in the Macro SAM.

**26. Enterprise saving ($S_E$, 1X1):** The cell keeps the same with it in the Macro SAM.

**27. Government savings ($S_G$, 1X1):** The cell keeps the same with it in the Macro SAM.

**28. ROMC savings ($S_D$, 1X1):** The cell keeps the same with it in the Macro SAM.

**29. Foreign savings ($S_W$, 1X1):** The cell keeps the same with it in the Macro SAM.

**ROMC & ROW**

**30. Interregional inflow ($M_D$, 1X41):** The total amount of this part is dominated by the value of opposite cell in the Macro SAM. The method to disaggregate it into 41 cells is described in next section.

**31. Import ($M_W$, 1X41):** The total amount of this part is dominated by the value of opposite cell in the Macro SAM. The method to disaggregate it into 41 cells is described in next section.



## 4.3 Transforming IO Table

Since the major data source for building the Micro SAM has to highly rely on the IO table, I will set 2 steps to build the Micro SAM in terms of transforming the IO table, constructing the Micro.

### 4.3.1 Framework of the official IO table

In 2007, A 2002 Yunnan IO table, which includes two tables in terms of the 42 sectors sheet and 122 sectors sheet, has internal issued. IO table include all the inter-sectors transfer, and the transfer between CA and rural households consumption, government consumption, fixed capital formation, change in inventories, outflow and inflow. The basic structure of IO table can be seeing in Table4.4 as below.

**Table4.4 the framework of IO table**

| | Sectors | household consumption | Government consumption | Fixed capital formation | Change in inventories | Outflow | Inflow | Total output |
|---|---|---|---|---|---|---|---|---|
| Sectors | | | | | | | | |
| Labor compensation | | | | | | | | |
| Net production tax | | | | | | | | |
| Fixed capital depreciation | | | | | | | | |
| Operating surplus | | | | | | | | |
| Total input | | | | | | | | |

Source: The input and output table for Yunnan 2002

For applying the IO table to correspond to the Micro SAM, the sectors-sectors part in IO should be complete match the CA-CA in Micro SAM, in other words, IO table and the Micro SAM should have the same sectors or agents.

Considering the final requirement, a 64X64 Micro SAM framework will be set which includes 41 sectors in CA account. Therefore, the IO table will be finally transformed into 41 sectors.

The approach to transform IO into a 41 sector IO table has three steps: 1. Aggregate 42 IO table in to 29 IO table, which means for some sectors that does not

much link to the final analysis, it will be aggregated to make the 29 sectors IO table; 2, Disaggregate 29 sectors IO table into 36 sectors IO table by aggregating 122 sectors IO table, which means for some sector we need more specific categories they will be disaggregated; 3. Make a 41 sector IO table by estimating and disaggregating agriculture sector, which depend on the ICRAF's survey to estimate and disaggregate it.

### 4.3.2 Aggregating 42 Sectors IO Table in to 29 Sectors IO Table

Firstly, I cite the structure of sectors in Official 42 sectors IO table here in table4.5 And the 42 IO matrix , which include production matrix "T", value added matrix "V" , GNP matrix "F" and zero matrix, can be brief described as:

$$\{IO42\} = \begin{Bmatrix} T & F \\ V & 0 \end{Bmatrix} \quad (14)$$

**Table4.5 the sectors structure in the 42 sectors IO table**

| Order | Industry | Sectors |
|---|---|---|
| 1 | Agriculture | Agriculture |
| 2 | Industry | Coal mining and processing |
| 3 | | Oil and natural gas extraction |
| 4 | | Metal mining |
| 5 | | Non-metal mining |
| 6 | | Food and tobacco processing |
| 7 | | Textiles |
| 8 | | Clothing, leather, down, and other fabric products |
| 9 | | Timber and furniture |
| 10 | | Paper |
| 11 | | Oil refining and coking |
| 12 | | Chemicals |
| 13 | | Non-metal minerals processing |
| 14 | | Metal refining and smelting |
| 15 | | Metal products |
| 16 | | General and special equipment |
| 17 | | Transportation equipment |
| 18 | | Electrical machinery |
| 19 | | Communication, computer and other Electronics |
| 20 | | Instruments and office equipment |
| 21 | | Other manufacturing |
| 22 | | Wastes |
| 23 | | Electricity |
| 24 | | Gas |
| 25 | | Water |
| 26 | Services | Construction |
| 27 | | Transportation and storage |
| 28 | | Telecommunication and logistics |
| 29 | | Information transfer, computer services and software |
| 30 | | Retail and wholesale |
| 31 | | Accommodation and Restaurant |
| 32 | | Finance and insurance |
| 33 | | Real estate |
| 34 | | Rental and commercial services |
| 35 | | Tourism |
| 36 | | Scientific research |
| 37 | | Integrated technique services |
| 38 | | Other Social Services |
| 39 | | Education |
| 40 | | Sanitation, social security and welfare |
| 41 | | Culture, physical education and entertainment |
| 42 | | Public administration |

Source: The input and output table for Yunnan 2002

Table4.5 actually present all sectors which are consisted of the whole Yunnan Provincial economy. For agriculture which the author is interest to is too simple, however, there are some sectors in industry and services that are not so important for final analysis which are apparently redundant. Hence, some sectors are not so mach related to the final analysis will be aggregated into some different individual sectors which show in table4.6.

All aggregation here will process as the approach that in new order: 4. the metal mining and non-metal mining will be merged into metal and non-metal mining as one sector; 6. the textiles and clothing, leather, down, and other fabric products will be merged into textiles and apparel as one sector; 11. the non-metal minerals processing, metal refining and smelting and metal products will be merged into the metal and non-metal manufacturing as one sector; 12. the general and special equipment and the transportation equipment will be merged into equipment as one sector;14. the communication, computer and other electronics and instruments and office equipment will be merged into electronics, instruments, and office equipment as one sector; 28. the information transfer, computer services and software, real estate, rental and commercial services, other social services, education, sanitation, social security and welfare will be merged into other services as one sector.

**Table4.6 aggregating from 42 sector to 29 sector**

| Merging (order in table 6) | new order | sector |
|---|---|---|
| 1 | 1 | Agriculture |
| 2 | 2 | Coal mining and processing |
| 3 | 3 | Oil and natural gas extraction |
| 4+5 | 4 | Metal and non-metal mining |
| 6 | 5 | Food and tobacco processing |
| 7+8 | 6 | Textiles and apparel |
| 9 | 7 | Timber and furniture |
| 10 | 8 | Papermaking |
| 11 | 9 | Oil refining and coking |
| 12 | 10 | Chemicals |
| 13+14+15 | 11 | Metal and non-metal manufacturing |
| 16+17 | 12 | Equipment |
| 18 | 13 | Machinery |
| 19+20 | 14 | Electronics, instruments, and office equipment |
| 21 | 15 | Other manufacturing |
| 22 | 16 | Waster |
| 23 | 17 | Electricity and heat |
| 24 | 18 | Gas |
| 25 | 19 | Water |
| 26 | 20 | Construction |
| 27 | 21 | Transportation and storage |
| 28 | 22 | Telecommunication and logistics |
| 30 | 23 | Retail and wholesale |
| 31 | 24 | Accommodation and restaurant |
| 32 | 25 | Finance and insurance |
| 35 | 26 | Tourism |
| 36+37 | 27 | Scientific research |
| 29+33+34+38+39+40+41 | 28 | Other services |
| 42 | 29 | Public administration |

Source: calculated by the author

It's easy to use an addition matrix R or inverse matrix R' to carry out a multiplication to transform the 42 sectors in to 29 sectors in the IO table Assume the original 42 sectors matrix as T, then, R'*T*R will give a 29 matrix which aggregate 42 sectors into 29 sectors.

However, IO table also includes two parts in terms of the value added matrix "V" and the GNP=C+G+I+X matrix "F" which should be also disaggregated in to 29 sectors. Therefore, the new value added matrix "V*" can be got by V*=VXR and new GNP matrix can be got by F*=R'XF. The a new 29 IO matrix can be got as:

$$\{IO29*\} = \begin{Bmatrix} T* & F* \\ V* & 0 \end{Bmatrix} \quad (15)$$

### 4.3.3 Disaggregating 29 Sectors IO Table into 36 Sectors IO Table

There is a complete transformed 29 sectors IO table from last step, then, it will be interesting to disaggregate the agriculture, oil refining and coking, chemicals into more detail. Therefore those sectors need to be disaggregated by aggregating the 122 sectors IO table.

Firstly, the agriculture in table4.5 has only one sector which is too simple and not enough for final analysis. Then the author intends to expend it into 5 sectors by 2 steps seeing in table4.7 as below. Agriculture will be disaggregated into farming, forestry, the timber and bamboo logging and transport, animal husbandry, fisher and extension services. And then the timber and bamboo logging and transport will be aggregated into forestry sector as one sector to finally expend the agriculture sector into five sectors.

**Table4.7 expending agriculture into 5 sectors**

| Original order | Sector | First step | | Second step | |
|---|---|---|---|---|---|
| | | order | sector | order | **sector** |
| 1 | Agriculture | 1 | Farming | 1 | Farming |
| | | 2 | Forestry | 2 | Forestry |
| | | 3 | Timber and bamboo logging and transport | | |
| | | 4 | Animal husbandry | 3 | Animal husbandry |
| | | 5 | Fisher | 4 | Fisher |
| | | 6 | Extension services | 5 | Extension services |

Source: calculated by the author

Secondly, the oil refining and coking will be expended to 2 sectors in terms of the oil refining, and coking by aggregating 122 sectors IO table. Thirdly, the chemical sector will be expended to 3 sectors in terms of fertilizer, pesticide, and other chemicals.

There is one thing have to be noticed that the 122 sectors IO table has only data related the farming, forestry, animal husbandry, fisher, extension services, oil refining, coking, fertilizer, pesticide and other chemicals, and the other parts are empty. Therefore, the 36 IO table have to be made by 2 parts which are one from aggregating 122 sectors IO table and one from 29 sectors IO table. The way to recognize the 122 sectors IO into 36 sectors is listed in table4.8.

**Table4.8 36 sectors obtaining from 122 sectors**

| Order | Sectors | Obtaining from 122 sectors IO |
|---|---|---|
| 1 | Farming | 1 |
| 2 | Forestry | 2-3 |
| 3 | Animal husbandry | 4 |
| 4 | Fisher | 5 |
| 5 | Extension services | 6 |
| 6 | Coal mining and processing | 7 |
| 7 | Oil and natural gas extraction | 8 |
| 8 | Metal and non-metal mining | 9-12 |
| 9 | Food and tobacco processing | 13-22 |
| 10 | Textiles and apparel | 23-29 |
| 11 | Timber and furniture | 30-31 |
| 12 | Papermaking | 32-35 |
| 13 | Oil refining | 36 |
| 14 | Coking | 37 |
| 15 | fertilizer | 39 |
| 16 | pesticides | 40 |
| 17 | other chemicals | 38,41-48 |
| 18 | Metal and non-metal manufacturing | 49-60 |
| 19 | Equipment | 61-70 |
| 20 | Machinery | 71-73 |
| 21 | Electronics, instruments, and office equipment | 74-81 |
| 22 | Other manufacturing | 82-83 |
| 23 | Waster | 84 |
| 24 | Electricity and heat | 85 |
| 25 | Gas | 86 |
| 26 | Water | 87 |
| 27 | Construction | 88 |
| 28 | Transportation and storage | 89-97 |
| 29 | Telecommunication and logistics | 98 |
| 30 | Retail and wholesale | 101 |
| 31 | Accommodation and restaurant | 102-103 |
| 32 | Finance and insurance | 104-105 |
| 33 | Tourism | 109 |
| 34 | Scientific research | 110-113 |
| 35 | Other services | 99-100,106-108,114-115,116-121 |
| 36 | Public administration | 122 |

Source: The input and output table for Yunnan 2002

In this part, firstly the author will consolidate 122 sectors IO into 36. Because of the incomplete 122 sectors IO table, which are related with disaggregated sectors, are typed in. therefore it should be combine with the rest part in the 29 sectors IO table which is not related with the aggregated sectors. Then, the final step will combine 2 tables together. Based on the principle, the addition matrix “R” will be used to aggregate the 122 sectors IO into 36. Assume the 122 sectors IO table is {IO122}then we know,

$$\{IO122\} = \begin{Bmatrix} T & F \\ V & 0 \end{Bmatrix} \quad (16)$$

Firstly, an incomplete 36 sectors matrix can be get from R’×T×R. Step 4, combining the rest part from 29 sectors IO table into T* to get complete 36 sectors matrix T*; Secondly, the same approach, the value added matrix can be gotten by aggregating 122 sector value added matrix and then combine the opposite data in terms of V*=V×R; Thirdly, the GNP F matrix will be disaggregated as F*=R’XF and combine with the data from 29 sectors IO. Then finally we get

$$\{IO36\} = \begin{Bmatrix} T* & F* \\ V* & 0 \end{Bmatrix} \quad (16)$$

Final household consumption here will be separated into 2 parts in terms of rural household consumption and urban household consumption by aggregating 122 sectors IO table in the same way.



**4.3.4 Expending 36 sectors IO to 41 Sectors IO**

At the very beginning of this part, it’s very important to cite an agricultural crops output from the Yunnan Statistics Yearbook 2002. Since in the 29 sectors IO table use agriculture as an overall category and 36 sectors IO table distinctively set farming as an sub-sector for distinguishing the forestry, animal husbandry, fishing etc.

In the part, farming will be further disaggregated into some specific crops in terms of grain crops, bean, oil bearing crops, sugar crops, tobacco and other farming listing as following Table4.9.

**Table4.9 disaggregated sectors setting and total output and share**

| Original sector | Disaggregated Sectors | Total output (100 million yuan) | share |
|---|---|---|---|
| Farming | Grain crops | 169.46 | 0.38 |
| | Beans | 17.66 | 0.04 |
| | Oil bearing crops | 6.65 | 0.01 |
| | Sugar crops | 25.54 | 0.06 |
| | Tobacco | 65.83 | 0.15 |
| | Other farming | 160.21 | 0.36 |
| ***Farming total output*** | | ***445.35*** | ***1.00*** |

Source: A social and economic survey by The World Agroforestry Centre China (ICRAF) 2007

Table4.9 actually indicated 6 specific sectors that the author intends to disaggregate. The approach of aggregation is to use the share of total output which each specific sectors take account for in terms of grain crops, beans, oil bearing crops, sugar crops, tobacco and other farming. Separate out the SAM *ROWS* using gross output data list in table4.9. The use the share to build The Column Expansion matrix (CE,44X49) and The Row Expansion matrix(RE,46X41) and we have 36 sectors matrix(IO36, 41X44) and easy to calculate a new 41 IO table by:

$$\{\mathrm{IO41, 46X49}\} = \{\mathrm{RE, 46X41}\}\mathrm{X}\{\mathrm{IO36, 41X44}\}\mathrm{X} \quad \{\mathrm{CE, 44X49}\} \qquad (17)$$

The 41 sectors IO matrix with 46X49 can be obtained and the disaggregated related farming sectors will be presented in table4.10.

**Table4.10 aggregated farming matrix in 41 sectors IO matrix**

| | Grain Crops | Beans | Oil bearing Crops | Sugar Crops | Tobacco | Other Farming |
|---|---|---|---|---|---|---|
| **Grain Crops** | 49,046.5 | 5,111.3 | 1,924.7 | 7,392.0 | 19,053.1 | 46,369.3 |
| **Beans** | 5,111.3 | 532.7 | 200.6 | 770.3 | 1,985.6 | 4,832.3 |
| **Oil bearing Crops** | 1,924.7 | 200.6 | 75.5 | 290.1 | 747.7 | 1,819.6 |
| **Sugar Crops** | 7,392.0 | 770.3 | 290.1 | 1,114.1 | 2,871.6 | 6,988.5 |
| **Tobacco** | 19,053.1 | 1,985.6 | 747.7 | 2,871.6 | 7,401.5 | 18,013.1 |
| **Other Farming** | 46,369.3 | 4,832.3 | 1,819.6 | 6,988.5 | 18,013.1 | 43,838.2 |

Source: calculated by the author

However, there is something in the table4.10 abnormal and unreasonable that each sub-sectors of farming will purchase other farming sectors. Therefore, I assume that each sub-sectors only purchase from itself as an input. The assumption here can be explained as that each sectors purchase seeds and some services to themselves. By checking the data of the production cost for buying seeds for US and China, it shows that the values are varied. However, around 7% for purchasing seeds stay in an acceptable arrange here. Therefore, it's better to keep a diagonal matrix rather than arbitrary put some value in. Then, a new diagonal matrix will replace original one by summing up the total column inner of the farming matrix which shoes in table4.11.

**Table4.11 adjusted farming matrix in the 41 sectors IO table***

| | Grain Crops | Beans | Oil bearing Crops | Sugar Crops | Tobacco | Other Farming |
|---|---|---|---|---|---|---|
| Grain Crops | 128,896.9 | - | - | - | - | - |
| Beans | - | 13,432.8 | - | - | - | - |
| Oil bearing Crops | - | - | 5,058.2 | - | - | - |
| Sugar Crops | - | - | - | 19,426.6 | - | - |
| Tobacco | - | - | - | - | 50,072.5 | - |
| Other Farming | - | - | - | - | - | 121,861.0 |

Source: calculated by the author

*By the adjustment, the part can be explain reasonable, for example, grain crops buy rice seed, wheat seeds and maize seed from grain crop sector and the same to others.

But for the different crops, the input level of fertilizer and pesticide are different, therefore, for it is necessary to adjust the fertilizer and pesticide inputs for each sector which belong to the farming sector. So, an estimated share of fertilizer and pesticide use has been calculated here by the primary data from a field survey which was carried out by World Agro-forestry Centre (ICRAF) 2008. It also allows me to adjust the fertilizer and pesticide input for each sector in farming.

However, this step causes an unbalanced Micro SAM on the sub sectors of farming. For balance it the first 6 rows will be used to balance it. The new column named diff will be made to represent and calculate the different between total columns and total rows. It can be observed that there are 23 non empty cells shared the different in each row with a non agriculture input proportion for each sector. Therefore it brings a balanced 41 sectors IO table with 46 rows and 49 columns.

## 4.4 Building the Micro SAM

In this section, there are actually 3 types of approach to build the Micro SAM. (1) using corresponding data from the 41 sectors IO table;(2) directly use some data from the Macro SAM; (3) estimating some cells as residual, or estimating technically by some assumption or primary data from a survey that carried out by ICRAF.

The whole process contains SAM1, SAM2, SAM3, SAM4 and SAM5. The final one, SAM5, is a balanced SAM which has completely information. Since there are some specific spreadsheet in Excel format in the real work which can't completely share here, consequently, the method of building Micro SAM is still a briefly introduction to help audit to understand how the Micro SAM has been built.

### 4.4.1 A Basic and Unbalanced Micro SAM (SAM1)

The accounts of the first unbalanced Micro SAM will be set in Table4.12 that showed as below. It is actually a matrix with 52 rows and 52 columns without disaggregating VA-L and Household yet. In the unbalanced Micro SAM, during all the process, the 41 sectors in CA-CA matrix will be fixed and no any change and all accounts are listed in table4.12.

Then table4.13 shows how to use the data from the IO table and the Macro SAM for putting into the Micro SAM.

**Table4.12 account setting in the first unbalanced Micro SAM**

| | | | |
|---|---|---|---|
| Commodity-Active | 1 | Agricultural | Grain Crops |
| | 2 | | Beans |
| | 3 | | Oil bearing Crops |
| | 4 | | Sugar Crops |
| | 5 | | Tobacco |
| | 6 | | Other Farming |
| | 7 | | Forestry |
| | 8 | | Animal husbandry |
| | 9 | | Fisher |
| | 10 | | Extension services |
| | 11 | Industry | Coal mining and processing |
| | 12 | | Petroleum and natural gas extraction |
| | 13 | | Metal and non-metal mining |
| | 14 | | Food and tobacco processing |
| | 15 | | Textiles and apparel |
| | 16 | | Timber and furniture |
| | 17 | | Papermaking |
| | 18 | | Oil refining |
| | 19 | | Coking |
| | 20 | | Fertilizer |
| | 21 | | Pesticides |
| | 22 | | Other chemicals |
| | 23 | | Metal and non-metal manufacturing |
| | 24 | | Equipment |
| | 25 | | Machinery |
| | 26 | | Electronics, instruments, and office equipment |
| | 27 | | Other manufacturing |
| | 28 | | Waster |
| | 29 | | Electricity and heat |
| | 30 | | Gas |
| | 31 | | Water |
| | 32 | Services | Construction |
| | 33 | | Transportation and storage |
| | 34 | | Telecommunication and logistics |
| | 35 | | Retail and wholesale |
| | 36 | | Accommodation and restaurant |
| | 37 | | Finance and insurance |
| | 38 | | Tourism |
| | 39 | | Scientific research |
| | 40 | | Other services |
| | 41 | | Public administration |

Source: The input and output table for Yunnan 2002

**Table4.13 the data source of the unbalanced Micro SAM**

| order | Accounts transfer | row | column | value range | Data Sources |
|---|---|---|---|---|---|
| 1 | CA-- CA | 41 | 41 | C2:AQ42 | 16.IO-41 |
| 2 | CA-- Households | 41 | 2 | AR2:AS42 | 16.IO-41 |
| 3 | CA-- Gov-L | 41 | 1 | 4,513,386 | 5.Macro SAM |
| 4 | CA-- Gov-E | 41 | 1 | 503,115 | 5.Macro SAM |
| 5 | CA-- Gov-C | 41 | 1 | 2,118,015 | 5.Macro SAM |
| 6 | CA-- CAP | 41 | 1 | sum(AU2:AV2):sum(AU42AV42) | 16.IO-41 |
| 7 | CA-- ROMC | 41 | 1 | 7,630,510 | 5.Macro SAM |
| 8 | CA-- ROW | 41 | 1 | 1,183,750 | 5.Macro SAM |
| 9 | VA-L-- CA | 1 | 41 | C43:AQ43 | 16.IO-41 |
| 10 | Va-capital --CA | 1 | 41 | sum(C45:C46):sum(AQ45:AQ46) | 16.IO-41 |
| 11 | Household -- VA-L | 2 | 1 | 10,204,912 | 5.Macro SAM |
| 12 | Household -- VA-K | 2 | 1 | 1,606,143 | 5.Macro SAM |
| 13 | Household – Gov-L | 2 | 1 | 755,520 | 5.Macro SAM |
| 14 | Household – Gov-C | 2 | 1 | 19,730 | 5.Macro SAM |
| 15 | Enterprise -- VA-K | 1 | 1 | 5,647,964 | 5.Macro SAM |
| 16 | Gov-L -- CA | 1 | 41 | 1,715,504 | 5.Macro SAM |
| 17 | Gov-L -- Households | 1 | 2 | 94,454 | 5.Macro SAM |
| 18 | Gov-L -- Enterprises | 1 | 1 | 257,636 | 5.Macro SAM |
| 19 | Gov-L -- Gov-C | 1 | 1 | 3,352,949 | 5.Macro SAM |
| 20 | Gov-E -- CA | 1 | 41 | 503,115 | 5.Macro SAM |
| 21 | Gov-C -- CA | 1 | 41 | 4,949,409 | 5.Macro SAM |
| 22 | Gov-C -- Enterprises | 1 | 1 | 310,900 | 5.Macro SAM |
| 23 | Gov-C -- Gov-L | 1 | 1 | 144,970 | 5.Macro SAM |
| 24 | Gov-C -- ROMC | 1 | 1 | 85,415 | 5.Macro SAM |
| 25 | CAP -- Household | 1 | 2 | 2,245,820 | 5.Macro SAM |
| 26 | CAP -- Enterprises | 1 | 1 | 5,079,428 | 5.Macro SAM |
| 27 | CAP -- Gov-L | 1 | 1 | 6,667 | 5.Macro SAM |
| 28 | CAP -- ROMC | 1 | 1 | 2,067,062 | 5.Macro SAM |
| 29 | CAP -- ROW | 1 | 1 | (524,083) | 5.Macro SAM |
| 30 | ROMC -- CA | 1 | 41 | 9,782,986 | 5.Macro SAM |
| 31 | ROW -- CA | 1 | 41 | 659,668 | 5.Macro SAM |

Source: calculated or collected by the author

The data sources for the Micro SAM actually derive from 2 approaches such as the Macro SAM and the 41 sectors IO table. The different part of the Micro SAM which were indicated data sources in table4.13: Firstly, the cells from IO41 and the1×1 cells from the Macro SAM are the first step to do that represent they doesn't need to be disaggregated and can be put into opposite cells directly; Then 1×2 and 2×1 cells will be simply disaggregated for separating household into 2 columns or rows in terms of rural and urban; Thirdly, the rest of cells out of CA-CA matrix but related CA in column or row will be disaggregated into 41. The following part will step to step to explain how to figure it out.

**Step 1 directly data get from corresponding data**

Identify and conduct the cells which mentions in table4.13 to put into opposite cells in the sheet of SAM1.

**Step 2 disaggregating the households saving**

According to the paper, "How China achieved worlds highest household savings?", which published in the Journal of Money to estimate household saving rate for Yunnan province. It gives an average saving rate 10% to rural household and 19% to urban household among the 1995-2004. Since we have:

(1) Gross net income = disposable income per capita X population

(2) Approximately Saving = Gross net income X saving rate

(3) Share of Saving $= \frac{Si}{\sum Si}$

The use the share to calculate the real total household saving can disaggregate into the urban saving and rural saving.

**Step 3 disaggregating household income tax**

In this section, the basic idea is following the equation as below:

(1) $Y = C + S + T$

$(Household\ Income = Consumption + Saving + Income\ tax\ )$

(2) $T = rY$

(3) $Y = C + S + rY$

(4) $Y = (C + S)/(1 - r)$

Note: r denotes the income tax ratio.

Assuming rural is 1 and urban is 2, the data we have at the beginning is C1, C2, C, S1, S2, S, T. They can get from 41 sectors IO table. By using the equations above to calculate Y, Y1, Y2, T1, T2 and r., Y can be gotten from equation 1, and r from equation 2. Then Y1 and Y2 get from equation 4 and T1 and T2 from equation 2 again.

**Step 4 disaggregate the compensation of urban/rural household**

Assume compensation as W, W1 and W2. The basic idea to disaggregate the compensation for rural and urban household is to assume compensation share between rural and urban is actually equally to share of tax, in other words:

$$\frac{W1}{W} = \frac{T1}{T} \quad or \ \frac{W2}{W} = \frac{T2}{T} \tag{18}$$

Since W can be gotten from Macro SAM, T1, T2, T can get from last step, therefore, it gives W1 and W2.

**Step 5 Calculate the VA-K, Gov-L, Gov-C**

**1. Disaggregate VA-K**

In the part, the author assumes that capital value added can get from a share of so called VA-K* as below:

$$\text{VA-K*} = Total\ income - compensation - income\ tax \tag{19}$$

Then, a share can be calculated with a coefficient $\frac{\text{VAK *i}}{\sum \text{VAK *i}}$. Then using the share times the real VA-K which get from the Macro SAM to disaggregate it into the capital value added of rural and urban as VA-K1 and VA-K2

**2. Disaggregate Gov-L and Gov-C**

The basic assumption and relations here are:

(1) $\text{G} = \text{Gov} - \text{L} + \text{Gov} - \text{C}$

(2) $G_i = Y_i - W_i - VAK_i$

(3) Share of G = $\frac{G_i}{\sum G_i}$

Then use the Share of G to time the Gov-L and Gov-C transfer to household which get from the Macro SAM to disaggregate them for rural and urban household.

**Step 6 Government consumption, export and import**

**1. Disaggregate the final government consumption**

Since the final government consumption will be owned with Gov-L, Gov-E and Gov-C with a fixed share like:

(1) $share = \frac{G_i}{\sum G_i} \quad where\ (G = L, E, C)$

(2) From IO table, we get the government consumption matrix as $[\boldsymbol{G_j}]$ where j=1 to 41 with 41X1 matrix.

(3) To disaggregate the government consumption into Gov-L, Gov-E and Gov-C by:

$$[GL_j \quad GE_j \quad GC_j] = \left[\frac{G_i}{\sum G_i}\right] * [G_j]$$

However, this is not realistic that Gov-E has any other purchase on any active sector except investing to public administration. Hence, the author force the all

purchase from Gov-E move into public administration. For maintain the balance of this government consumption matrix, the author reduce the input that the Gov-L and Gov-C pay to public administration and increase the input that the Gov-L and Gov-C input to extension services of faming, scientific research and other services.

**2. Disaggregating export**

The major idea of this part is based on:

$$[Outflow] = [Export\ to\ ROW] + [outflow\ to\ ROMC] \quad (20)$$

IO table actually gives the [Outflow] matrix with 41 sectors. Since the total amount of export from Macro SAM can control the [Export to ROW] matrix, therefore, using the official data attach to make a sheet that has 2002 Yunnan provincial export terms over 5 million dollars to classified into 41 sectors by referring to 2007 China IO table explanation and codes. The rest part of export will be proportional allocated to 41 sectors to get [Export to ROW]

There are something need to notice that the export for some terms even over total outflow of it such like textile and apparel, pesticide. It could be an interesting thing for further research, however, the author will force the two term export equal to its outflow. Then the outflow trade that Yunnan with rest part of mainland China can be gotten as:

$$[outflow\ to\ ROMC] = [Outflow] - [Export\ to\ ROW] \quad (21)$$

**3. Disaggregating import**

The major idea of this part is based on:

$$[inflow] = [import\ from\ ROW] + [inflow\ from\ ROMC] \quad (22)$$

IO table also gives the [inflow] matrix with 41 sectors. Since the total amount of import from Macro SAM can control the [Export to ROW] matrix, therefore, using

the official data to make a sheet that has 2002 Yunnan provincial import terms over 5 million dollars to classified into 41 sectors by referring to 2007 China IO table explanation and codes. The rest part of export will be proportional allocated to 41 sectors to get [Import to ROW]

Then, the inflow trade that Yunnan with rest part of mainland China can be gotten as:

$$[Inflow\ to\ ROMC] = [Inflow] - [Import\ to\ ROW] \quad (23)$$

All the process above made SAM1, an unbalanced Micro SAM, with almost necessary information except the production tax.

**4.4.2 A Basic and Balanced Micro SAM (SAM2)**

The accounts setting of SAM2 keeps the same with SAM1.In this section, direct tax or production tax [$T_j$] will be calculated as a residual following equation below:

(1) $[Production\ tax]$

$$= [Total\ income] - [Intermedia\ input] - [Value\ added] - [inflow\ and\ import]$$

(2) $Share\ of\ production\ tax = \frac{T_i}{\sum T_i}$

(3) $[T_{ij}] = \frac{T_i}{\sum T_i} * [Production\ tax]$ Where i=1 to3 and j= 1 to 41

Since there is already the total income matrix, intermediate input matrix, value added matrix and inflow and import matrix in SAM1, Then we can get a 1X41 production tax matrix. The use the data from the Macro SAM to calculate the tax share of Gov-L, Gov-E and Gov-C. Equation 3 will give a 3X41 production

matrix$[T_{ij}]$. Then it gives a complete and balanced SAM2.

### 4.4.3 The Micro SAM with 3 Types of VA-L (SAM3)

The accounts setting of SAM3 keeps almost same with SAM2 except increase the VA-L into VA-L.AG, VA-L.OR and VA-L.U. So SAM3 matrix has 54 rows and 54 columns.

**Step 1 assumption**

The detail data of value added labor is very hard to get from NSB Yearbooks. Based the realistic condition, the author assume 3 types of labor in terms of agriculture labor, other rural labor and urban labor. Agriculture labor means the rural residents who carry out the agricultural production; the other rural labor means rural resident but working in non-agriculture industries; the urban labor means urban resident and works in non-agriculture industry. The 3 types of labor will be abbreviated as VA-L.AG, VA-L.OR and VA-L.U.

**Step 2 to disaggregate value added labor to VA-L.AG, VA-L.OR and VA-L.U**

It's easy to identify the CA accounts pay to VA-L.AG, because all the agricultural sectors of total will pay to VA-L.AG and there are 10 of 41 sectors. The same way, VA-L.AG will pay to rural household by sum VA-L.AG up.

Then the author will start to disaggregate CA accounts pay to VA-L.OR and VA-L.U. Firstly, the total VA-L pay to rural household and urban household was known in last part. It easy to know the total amount that CA account pays to VA-L.U should be equal to the VA-L pay to urban household. Then the total amount of VA-L.OR get from CA accounts should be equal to the VA-L pay to rural household

minus the total amount of VA-L.AG get from CA accounts. Then the compensation of VA-L.OR and VA-L.U can be used to get a share and then using the share to disaggregate the row and column of VA-L in SAM 2 to the VA-L.AG, VA-L.OR and VA-L.U to get a 54X54 matrix.

**4.4.4 Disaggregating the Urban Household (SAM4)**

The accounts setting of SAM4 is different with SAM3 because the urban household from 1 type increase into 7 types. Hence, SAM4 matrix has 60 rows and 60 columns.

**Step 1 estimating the urban people living expenditure and disaggregating the final consumption**

There is two way in this section to disaggregate urban people living expenditure: (1) disaggregated by specific items expenditure by different group; (2) disaggregated by total expenditure by different group.

**1. Disaggregated by specific items (type a)**

**1.1 Population for each group & Total expenditure for each group**

In Yunnan Statistic Yearbook, the urban households were classified as 7 category which named U1, U2, U3, U4, U5, U6 and U7 here. The amount of household of U1, U2, U6 and U7 take separately account for 10% of total samples. The amount of household of U3, U4 and U5 take separately account for 20% of total samples. By timing the average population per household for each type of household can get total of each types of household. Using total population of each types of household times average expenditure for each can get total expenditure for each group.

**1.2 Average Expenditure for each group**

This part gets from the Yunnan Statistic Yearbook of NSB to get the specific expenditure for each group. NBS survey gives 8 kinds terms which spend household's living expenditure in terms of 1.Food; 2.Clothing; 3.Households facilities, articles and services; 4.Medicines and medical services; 5.Transport, telecommunication and logistics services; 6.Recreation, education and cultural services; 7.Residence; 8.Miscellaneous commodities and services.

**1.3 Total expenditure for each group**

By multiplied the population of each group and average expenditure for each group, it will gives the total expenditure for each group

**1.4 The proportion of total expenditure for each group**

Using every type of household's expenditure on specific goods divided by total expenditure on this kind of goods, it will gives a share of each group on the specific term with a coefficient determinant.

**2 Disaggregated by total expenditure for each group (type b)**

This part will use total living expenditure for each group which obtained from the Yunnan Statistics Yearbook to get a share that each type of household takes account for total. Using the share to time the household final consumption that from SAM3, it will disaggregates the household into 7 types as total amount controlling.

**Identify and classify sectors into items**

This part is to build a share matrix to show how many percent that each type of household consumption takes account for the total household consuming on each good. Here services sector to be set as a residual to keep the matrix balance. Then using transposed 41X1 household consumption determinant left multiply the

coefficient determinant in iv, it will gives a 7 types of urban household final consumption matrix. Finally, adding services in to make it complete.

**Step 2 Urban households saving and income tax**

Firstly, I will assume the different group of household has different saving rate and tax rate. Therefore in this part the Engle coefficient will be used to disaggregate the saving rate and tax rate.

The author assumes that the share of household's payment on food and the rest payment will be vary among different types households. The richer group will use small proportion expenditure on good and the poorer household will consume a large share on food. Based on the assumption, the method gives a percentage distance to mean. Using it to time urban saving rate and tax rate which get and calculated from SAM, it will easily disaggregate the saving rate and tax rate into 7 types of urban household.

**Step 3 Disaggregating urban household compensation from value added account**

In the part, There are an important assumption to get start in terms of the equation as below:

$$Y_j = C_j + S_j + T_j \text{ where j= 1 to 7} \quad (24)$$

or

$$The\ total\ income = Final\ consumption + saving + tax \quad (25)$$

All the data on the right side of equation can be gotten from last step. Consequently, it gives the total income for each group. Assuming the share of the compensation for each group is as same as it of the tax such like:

$$\frac{W_i}{\sum W_i} = \frac{T_i}{\sum T_i} \quad (26)$$

Since $\frac{T_i}{\sum T_i}$ Can get from last step, the share can be used to multiply the urban household compensation W to get $W_i$.The basic assumption here is the compensation of each household have same share with tax.

Let's assume the household income is:

$$Y_j = W_j + VAK_j + T_j \quad (27)$$

Since $Y_j, W_j, T_j$ are all known, then:

$$VAK*_j = W_j + Y_j + T_j \quad (28)$$

$VAK*_j$ here is not real value for capital value added and it's only used to calculate a share, $\frac{VAK*_j}{\sum VAK*_j}$, to multiply the real VA-K value from SAM3 to get the real $VAK_j$ like:

$$VAK*_j = VAK * \frac{VAK*_j}{\sum VAK*_j} \quad (29)$$

There is still a relation in the SAM that:

$$Y_j = W_j + VAK_j + G_j \quad \text{where} \quad G_j = Gl_j + Gc_j \quad (30)$$

Since $Y_j$, $W_j$, $VAK_j$ are known, then

$$G_j = Y_j - W_j - VAK_j \quad (31)$$

And a share of government transfer to household can be gotten as

$$\text{Share} = \frac{G_j}{\sum G_j} \quad (32)$$

Use the share to time the Gov-L and Gov-C transfer to household value from SAM3, we can get $Gl_j$ and $Gc_j$. Consequently, we finished all the works to disaggregate the household in to 7 types to get SAM4.

### 4.4.5 Disaggregating the rural household (SAM5)

In fact, the method to disaggregate rural household is completely as same as to disaggregate the urban. It makes SAM5 matrix increase into 64 rows and 64 columns by increasing 1 rural household into 5 types.

**Step 1 estimating the rural people living expenditure and disaggregating the final consumption**

There is two way in this section to disaggregate rural people living expenditure: (1) disaggregated by specific items expenditure by different group; (2) disaggregated by total expenditure by different group

**1 Disaggregated by specific items (type a)**

**1.1 Population for each group & Total expenditure for each group**

In Yunnan Statistic Yearbook, the rural households were classified as 5 category which named R1, R2, R3, R4 and R5 here. The amount of each type of household take separately account for 20% of total samples. By timing the average population per household for each type of household can get total of each types of household. Using total population of each types of household times average expenditure for each can get total expenditure for each group.

**1.2 Average Expenditure for each group**

This part gets from the Yunnan Statistic Yearbook of NSB to get the specific expenditure for each group. NBS survey gives 8 kinds terms which spend household's living expenditure in terms of 1.Food; 2.Clothing; 3.Households facilities, articles and services; 4.Medicines and medical services; 5.Transport, telecommunication and logistics services; 6.Recreation, education and cultural services; 7.Residence; 8.Miscellaneous commodities and services.

**1.3 Total expenditure for each group**

By multiplied the population of each group and average expenditure for each group we can get total expenditure for each group

**1.4 The proportion of total expenditure for each group**

Using every type of household's expenditure on specific goods divided by total expenditure on this kind of goods, it will gives a share of each group on the specific term with a coefficient determinant.

**2 Disaggregated by total expenditure for each group (type b)**

This part will use total living expenditure for each group which obtained from the Yunnan Statistics Yearbook to get a share that each type of household takes account for total. Using the share to time the rural household final consumption that gets from SAM3, it will disaggregate the rural household into 5 types as total amount controlling.

**3 Identify and classify sectors into items**

This part is to build a share matrix to show how many percent that each type of household consumes take account for the total household consuming on each good. Here services sector to be set as a residual to keep the matrix balance. The use transposed 41X1 household consumption determinant left multiply the coefficient determinant in iv. Then we get a 5 types of urban household final consumption matrix. Finally, adding services in to make it complete.



**Step 2 rural households saving and income tax**

Firstly, the author assumes the different group of household has different saving rate and tax rate. Therefore in this part the Engle coefficient will be used to disaggregate the saving rate and tax rate.

The author assumes that the share of household's payment on food and the rest payment will be vary among different types households. The richer group will use small proportion expenditure on good and the poorer household will consume a large share on food. Based on the assumption, the method give a percentage distance to mean. Using it to time rural saving rate and tax rate which get and calculated from SAM, it will easily disaggregate the saving rate and tax rate into 5 types of urban household.

**Step 3 disaggregate rural household compensation from value added account**

In the part, we can start from the important equations that:

$$Y_j = C_j + S_j + T_j \quad \text{where j=1 to 5} \tag{33}$$

or

$$The\ total\ income = Final\ consumption + saving + tax \tag{34}$$

All the data on the right side of equation can be gotten from last step. Consequently, we get the total income for each group. Assuming the share of the compensation for each group is as same as it of the tax such like:

$$\frac{W_i}{\sum W_i} = \frac{T_i}{\sum T_i} \tag{35}$$

Since $\frac{T_i}{\sum T_i}$ Can get from last step, we can use the share to multiply the rural household compensation W to get $W_i$.The basic assumption here is the compensation of each household have same share with tax.

Let's assume the household income is:

$$Y_j = W_j + VAK_j + T_j \tag{36}$$

Since $Y_j, W_j, T_j$ are all known, then:

$$VAK*_j = W_j + Y_j + T_j \quad (37)$$

$\mathrm{VAK}*_j$ here is not real value for capital value added and it's only used to calculate a share, $\frac{\mathrm{VAK}*_j}{\sum \mathrm{VAK}*_j}$, to multiply the real VA-K value from SAM3 to get the real $\mathrm{VAK}_j$ like:

$$VAK*_j = VAK * \frac{VAK*_j}{\sum VAK*_j} \quad (38)$$

There is still a relation in the SAM that:

$$Y_j = W_j + VAK_j + G_j \quad \text{where} \quad G_j = Gl_j + Gc_j \quad (39)$$

Since $\mathrm{Y_j}, \mathrm{W_j}, \mathrm{VAK_j}$ are known, then

$$G_j = Y_j - W_j - VAK_j \quad (40)$$

And a share of government transfer to household can be gotten as

$$\text{Share} = \frac{G_j}{\sum G_j} \quad (41)$$

Use the share to time the Gov-L and Gov-C transfer to rural household value from SAM3, we can get $\mathrm{Gl_j}$ and $\mathrm{Gc_j}$. Consequently, we finished all the works to disaggregate the rural household in to 5 types to get SAM5.

For the further research, the author put the A matrix for the Micro SAM in the appendices. It can be expected that only for the thesis but also for being used by other researches.