Chapter 2
Approach of Input–Output Table at Regional Level

Input–output analysis involves all aspects of the national accounts related to goods and services, including expenditure aggregates. Input–output analysis provides the opportunity to reconcile supply and use of goods and services, as well as reconcile GDP and expenditure on GDP. One of the goals of this analysis is to eliminate the statistical discrepancy. This is also a requirement for deriving downstream input–output tables. Compiling regional input–output table, not only identify the quantity of products in inter-regional trade, but also determine the trade flows among departments. Moreover, in the inter-regional trade, it is also necessary to distinguish how much of intermediate inputs used in the production sector and how much used in final consumption. Therefore, compiling inter-regional input–output tables require high quality data, but so far, apart from a small part of developed countries, the vast majority of countries cannot meet the need of basic data requirements compiling inter-regional input–output tables in the existing statistical system, because of a lot of manpower and material resources to carry out surveys and collect data, which makes considerable difficult to compile inter-regional input–output table at present. It requires compiling inter-regional input–output tables when the data resources are relatively low.

2.1 Methods of Commodity Flows Estimation

The key step of compilation of regional input–output table through a regional input–output model is to estimate the flows of commodity. As the statistical system is not perfect, the majority of countries are difficult to obtain the data of commodity flow directly which could compile regional flow matrix. Many studies are focused on how to estimate the flow of commodity according to reliable mathematical models and existing data. At present, the countries who research on this aspect in the world more in-depth include the United States, Japan, Russia, Finland, Spain, etc. Here are three common methods of estimating regional commodity flow, including location quotients, gravity model and regression equation, respectively.

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2.1.1 Location Quotients

The widespread use of the Location Quotients (LQ) approach for constructing regional input–output tables is primarily driven by pragmatic concerns. Generally speaking, detailed data are seldom available at the regional level. It is typically beyond the means of the users to implement more accurate methods and collecting the primary data which is needed. One way to solve this problem is to draw on a published input–output table pertaining to a larger geography and use employment based location quotients to estimate a local sub-section of that table. Implicitly by going down that route, the researcher is accepting some rather bold assumptions. For these, Harris and Liu (1998) refer to Norcliffe (1983), who identifies the main assumptions underlying the use of location quotients, to identify the export base in export base models.

It is clear that in order to let a region's share of national employment accurately represent its share of national production, there must be identical productivity per employee in each region in each industry for employment to be used as a proxy. Also, for similar reasons, there must be identical consumption per employee. However, there must be no cross-hauling between regions of products belonging to the same industrial category, so as not to underestimate inter-regional trade. Because these assumptions rarely hold, a number of researchers have attempted firstly to estimate empirically the extent to which the breakdown of these assumptions will influence estimates for input–output accounts and then come up with modifications of the LQ approaches that might counter some of the biases.

Various LQ methods have been suggested in the literature (Miller and Blair 2009). In general LQ approaches adjust the national technical coefficient to take account of the potential for satisfying input needs locally. A regional Input–Output technical coefficient is a function of the location quotient and the national technical coefficient:

$$a_{ij}^{RR} = a_{ij}^{RR}\left(LQ^R, a_{ij}^N\right) \tag{2.1}$$

where a_{ij}^{RR} is the regional IO technical coefficient, LQ_i^R is the location quotient and a_{ij}^N is the national technical coefficient.

1. Simple location quotient (SLQ)
The simple location quotient for sector i in region R is defined as:

$$SLQ_i^R = \left[\frac{E_i^R/E^R}{E_i^N/E^N}\right] \tag{2.2}$$

where E_i^R and E^R are employment in sector i in region R and total employment in region R respectively, and E_i^N and E^N are employment in sector i and total employment in the nation as a whole.

When the SLQ_i^R is greater than one (less than one), it can be inferred that sector i is more (less) concentrated in region R than in the nation as a whole. Where the location quotient is less than one the region is perceived to be less able to satisfy regional demand for its output, and the national coefficients are adjusted downwards by multiplying them by the location quotient for sector i in region R. Where the sector is more concentrated in the region than the nation at large ($LQ_i > 1$), it is assumed that the regional sector has the same coefficients as the nation as a whole. Therefore for row i of the regional table:

$$a_{ij}^{RR} = \begin{cases} a_{ij}^N SLQ_i^R \ \ if \ \ SLQ_i^R < 1 \\ a_{ij}^N \ \ if \ \ SLQ_i^R \geq 1 \end{cases} \tag{2.3}$$

2. Cross industry location quotient (CILQ)
A criticism of the simple location quotient is that it does not take into account the relative size of the sectors engaged in intermediate transactions. The argument goes that if a sector which is relatively small locally is supplying a sector which is relatively big, this should imply a need for imports to satisfy intermediate demand, and vice versa. This is addressed with cross industry location quotients (CILC). The CILQ for sectors i and j can be defined as:

$$CILQ_{ij}^R = \frac{SLQ_i^R}{SLQ_i^R}\left[\frac{E_i^R / E_i^N}{E_i^N \big/ E_j^N}\right] \tag{2.4}$$

where sector i is assumed to be supplying inputs to sector j. As with the SLQ national coefficients are not adjusted if $CILQ_{ij}^R \geq 1$ as it is assumed that intermediate demand can be met within the economy.

2.1.2 Gravity Model

In the development of regional input–output analysis, gravity model is used to calculate regional trade of industrial products and it is decided by the following formula:

$$t_i^{RS} = \frac{x_i^R d_i^S}{\sum_R x_i^R} Q_i^{RS} \tag{2.5}$$

where t_i^{RS} represents the outflow volume in sector i from region R to region S, x_i^R is gross output (gross supply) in sector i in region R, d_i^S is the gross product demand from region S to sector i, $\sum_R x_i^R$ is the gross output (gross demand) of all sector i,

Q_i^{RS} is the trade coefficients in sector i from region R to region S, or the coefficient of friction.

The key factor of using the gravity model is to estimate the coefficient of friction. Lcontief and Strout put forward the corresponding estimation method on the basis of different data. Ihara (1979) introduced the proportional distribution coefficient of inter-regional commodity flows to calculate the trade friction coefficient of different products. The calculation method of the proportional distribution coefficient of inter-regional commodity flows assumes that there are similarities of the distribution proportion of commodity flows from one region to the other regions and the most important product allocation proportion. Thus the distribution coefficient can be treated as the regional product trade flow parameter, Q_i^{RS}, which can be defined as:

$$Q_i^{RS} = \frac{H_i^{RS}}{H_i^{RO} H_i^{OS} / H_i^{OO}} \tag{2.6}$$

where H_i^{RS} is the trade flow in sector i from region R to region S, H_i^{RO} is the amount of the products in sector i of region R, H_i^{OS} is the gross import in the region S, H_i^{OO} is the gross export of the products in all the sectors i. The larger the coefficient of regional product trade flows is, the closer linkage between the regions is.

2.1.3 Regression Equation

The regression equation has three kinds of common forms.

The cross section data equation:

$$T^{RS} = \alpha^{RS} IND^R + \beta^{RS} GDP^S + \delta^{RS} D^{RS} + e \tag{2.7}$$

Time series equation:

$$T^{RS} = \alpha^{RS} IND^R + \beta^{RS} GDP^S + \theta^{RS} t + e \tag{2.8}$$

Mixed time and space equation:

$$T^{RS} = \alpha^{RS} IND^R + \beta^{RS} GDP^S + \theta^{RS} t + \delta^{RS} D^{RS} + e \tag{2.9}$$

The dependent variables include the industrial gross output (*IND*), the sector output as the start point (region *R*), GDP as the end point (region *S*), *D* is the direct distance between provinces and *t* is the time, and the independent variable is the mixed production flows which are obtained from traffic yearbook. This equation reveals the fact that the regional product flows are decided by the ability of supply and demand of one region.

The main idea of regional flows estimated by regression equations is to measure the elasticity of dependent and independent variables by using the sample data. Thereafter, the gross output IND_i^R of sector i is introduced, then the flows T_i^{RS} in sector i from region R to region S can be obtained finally. The important assumption of the regression equation is that the elastic value is a set of parameters which can reflect the movement of fluid diffusion in a certain period of time. If the parameters of a certain period of time are estimated based on the data of mixed production, then the regional flows of the pure sector can be calculated by the parameters and relevant data. Finally the regional trade flows and the coefficient matrix of the corresponding region can be obtained.

2.2 Methods of Input–Output Table Compilation

In this work, the methods of constructing a regional input–output table can be roughly divided into two categories including survey-based method and non-survey-based method. One of the key problems of input–output tables is that the survey-based method is extremely time consuming and therefore expensive. Therefore high level input–output tables are compiled by the specific authorities. For example, the major job of Bureau of Economic Analysis is to compile the Benchmark input–output table for the U.S. The production cycle is now generally surveyed every five years, for years ending in ‘2’ and ‘7’, which is dictated by the schedule of the Economic Census. However, with the development of economy, sectors and industries are increasingly becoming more complex. This is illustrated by the history of input–output table of Japan. The first compilation of the input–output table for Japan could date back to 1955 as the reference year. Thereafter compiling input–output tables came to be a joint work by related ministries and agencies every five years. The 1951 input–output table is compiled by the Environmental Protection Agency (EPA) and by the Ministry of International Trade and Industry (MITI). From the experimentation phase to the stage of practical use, the 1955 input–output table has a higher accuracy than that in 1951. Moreover, there were remarkable changes in 1960 input–output table because of technical innovation from which they had to seek materials for reviewing input–output table as of doubling national income. The 1965 input–output table consisting of 456 rows and 339 columns is established and published as the standard of System of National Accounts (SNA). The major improvement of the 1970 input–output table is handling of sector classification. The industries in 1975 input–output table are expanded from 7 to 11, and the characteristic of 1975 input–output table is that endogenous sectors were divided into three groups including industry, producers of government services and producers of the private nonprofit services to household. By comparison, the manufacturing sector was substantially revised in 1980 and a new method of estimation of service sector is introduced in 1990. Furthermore, the 1995 input–output table expanded the service sectors and enhanced the basic materials for estimation. To reflect the changes of Japanese socioeconomic structure, some new sectors were embedded in the 2000 input–output table, such as “Reuse and recycling” and “Nursing care”.

According to the annual report of International Input–Output Association in 2000, there are over 80 countries often constructing the input–output tables, including the Japan, Nederland, U.S. and other countries. As known, the main methods to construct the input–output tables include the survey-based method and non-survey-based method. Generally, each different method has outstanding characteristics. Survey-based method can guarantee the accuracy of the available data but at the expense of huge investment in terms of labor, time and financial resources. Most Chinese input–output tables are compiled with this method in the past. The counterpart, non-survey-based method, may spend much less. Currently certain countries construct the tables by using the hybrid method to reach the dual goals of both two previous methods. Theoretically, the hybrid method is somewhat a non-survey-based method.

2.2.1 Survey-Based Regional Input–Output Methods

In this section, firstly, the survey-based methods will be briefly introduced, such as cyclic census (complete survey), typical survey. Then a guideline with consecutive steps will be introduced to describe how to compile the input–output tables with the survey data.

2.2.1.1 Types of Survey-Based Methods

(1) Census (Complete survey)

A census is a complete enumeration of entire population as statistical units in a field of interest. For example, the population census canvases every household in a country to count the number of permanent residents and other characteristics, or a census of manufacturing may canvas all establishments engaging in manufacturing activities. The census of population (and households) is commonly carried out every ten years. The censuses of agriculture, fishery, forestry, construction, manufacturing, trade and other services are commonly carried out every five years. Similarly, a consumer income and expenditure survey is carried out every 5 years.

Data from the censuses serve as the base-year or benchmark data. A complete and up-to-date register of all statistical units in the field of inquiry is required. The advantages are that census provides the most reliable statistics if done professionally and with integrity, and the disadvantage is it is very costly to enumerate and to process data by means of a census. Timeliness is not high: data is available for use only many months, even years after it is collected. A census is normally carried every 5 or 10 years.

(2) Non-complete survey

Non-complete survey only focuses on some typical or key industries and sectors rather than all of the industries. There are three major types of this method including the sampling survey, key-point survey and typical survey.

Sampling survey is a method to randomly choose samples and estimate the total samples. It is used when there is no need or not able to adopt the complete survey. The sampling error may be controlled before implementation to ensure the data quality and every sample has the same probability to be selected. It is also used to evaluate the data quality collected by complete survey. This method can be divided into several types, such as simple sampling survey, stratified sampling survey, cluster sampling survey, systematic sampling survey and probability proportional to size sampling survey.

Key-point survey is a non-complete survey method to investigate the key industries, sectors or firms to get the information of the total sample. This method can be used in some areas in which some sectors overwhelmingly beat other sectors. This method can also be used to collect the data with quite low cost. This is much similar to the typical survey, which is to select some representative industries or sectors to project the situations and trends of these industries or sectors.

The differences of these three non-complete survey methods can be grouped into three parts. Firstly, the ways to choose the survey objectives are different. The sampling survey method should randomly choose the samples and everyone has the same probability to be chosen as a sample, no matter the potential survey objective is willing to or not. In point survey, choosing the samples is also objective. The indicators' value of the key industries should account for absolute proportion of the total value. However, in a typical survey, investigators have the own principles and criteria to choose the representative industries. Secondly, the purpose or the representativeness is different. As to the sampling survey method, there are certain rigorous and scientific calculation methods to project the total samples. Thus it can replace the complete survey method to some extent. The data collected by the point survey can only reflect the developing trends rather than the comprehensive information. The typical survey is frequently used to learn lessons from the sun-rise or sun-set industries. The data is hardly used to project the total samples due to lacking of robust scientific supports. Thirdly, according to the characteristics of survey objectives, specific survey method should be selected to collect the data.

2.2.1.2 Compilation Steps with Survey-Based Method

Both methodologies are still developmental to some extent as survey data gradually replaces non-survey data. Internationally, researches have started on constructing regional input–output tables in several countries including the Netherlands, Denmark, Italy, Canada and Finland. The regional input–output tables are based on the supply and use framework and are not derived square input–output tables. The regional supply and use tables are developed simultaneously with the national level ones. Because the national level input–output tables set the control totals for the regional level tables. This survey-based method is followed the constructing method implemented in China Statistic 2007. The general constructing processes of inter-regional input–output tables can be summarized to several steps.

(1) Regional tables of supply at basic prices
Where survey data can be used in this part and with undoubtedly these data can be subject to some potential problems. Specifically, the survey data may only cover certain industries rather than all the commodities. Further, the sum of the survey data collected from different survey methods may not be equal to the calculated national one. Nevertheless, if a good quality survey dataset does not exist, these can be obtained from those corresponding national tables, from which allocating the total value to specific regions based on some indicator variables, such as employment. Thereafter, the RAS technique and linear programming can be used to minimize the gap between regional and national proportions.

(2) Regional intermediate use tables at purchasers' prices
This is done the same as for supply.

(3) Regional final use tables at purchasers' prices
This is done the same as for supply but only for some considerations. The household consumption is estimated by using the disposable income of households by region. Consecutive yearly survey of the household expenditure can be used to reduce sampling error. In addition, the central government and local government final consumption is available from publications on state expenditure by region.

(4) Regional margins tables
Before calculating these tables, it is needed to assume that the margin can be divided into several regions based on the shares of total use of a particular good. So the researchers can thus allocate the national level tables into regions.

(5) Regional intermediate use tables at basic prices
Subtract the table of margins for each region from the regional intermediate use tables at purchasers' prices.

(6) Regional final use tables at basic prices
Subtract the table of margins for each region from the regional final use tables at purchasers' prices.

(7) Sort data by commodity to derive commodity account imbalances

(8) Trade flows for each commodity
A comprehensive multi-region targeted survey approach is taken in this step. Goods producing industries are surveyed for their sales and service industries are

surveyed for their purchases by region, which can be split into commodities considering that what commodities are export commodities and how these are allocated. The data is used to derive export and import flows by region for each commodity, among which the foreign imports are obtained as a residual.

(9) Balance of each commodity account
Each commodity account is balanced by calculating foreign imports as a residual.

(10) Finalization of regional industry-by-industry input–output tables.

2.2.2 Non-Survey-Based Regional Input–Output Methods

Non-survey techniques can derive elements of a regional input–output table from other (usually national) tables by various modification techniques, which use hybrid approach to combine non-survey techniques with superior data that obtained from experts, surveys and other reliable sources. Internationally, researches have contracted on regional input–output tables in several countries by using the non-survey-based methods, in which use the national level symmetrical input–output tables to derive regional tables. Specifically, the high level tables are adjusted by using indicators to calculate a region's contribution to the total industry aggregates.

At present the widely used non-survey-based methods include the RAS approaches and hybrid methods. The RAS technique requires less information than that of survey-based input–output tables. It is often regarded as a partial-survey or a non-survey method, in which some kinds of superior information (from small, focused surveys, expert opinion, etc.) are incorporated into an additional non-survey procedure. On the other hand, the hybrid methods often embed the regional table estimation problem in a large multi-region system. The regional input–output tables based on the hybrid methods mainly include Generation of Regional Input–Output Tables (GRIT).

The non-survey-based method is followed the constructing method of the Generation of Regional Input–output Tables (GRIT) implemented by the steps in Fig. 2.1. The general constructing processes of regional input–output tables can be summarized as the following steps:

(1) Update of the national input–output tables
In order to construct the regional input–output table, the national table must be updated for volume and price changes, which requires the combination of data from several sources. The international trade data is often used to update international imports and exports. Similarly, primary input and final demand figures are aligned to figures released by National Statistics Bureau. When the table is updated, table quadrants are balanced using the RAS technique. The updated

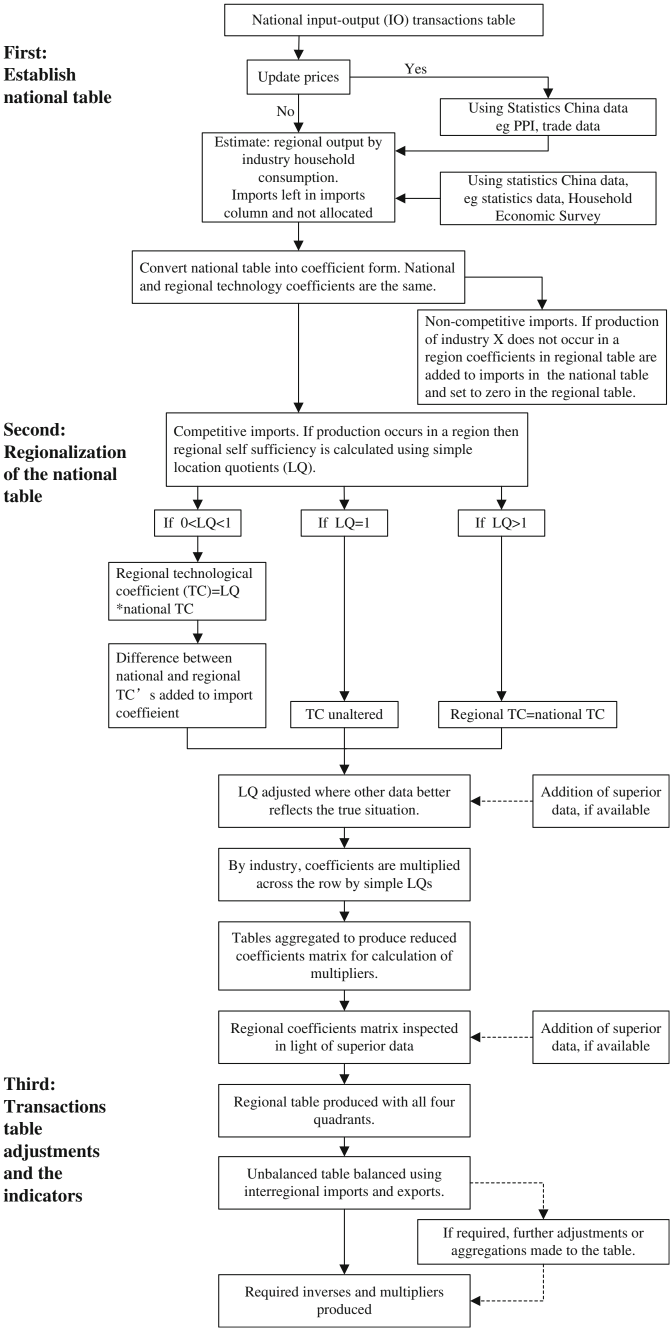

Fig. 2.1 Summary of non-survey-based regional input–output methods

national table is converted into technical coefficient format with the assumption that the national and regional technologies applied in production are the same.

(2) Calculation of non-competitive imports
It is assumed that if the production in industry X does not occur in the region, then any inputs from industry X into industry Y are treated as regional imports. Thus, the technical coefficient in the relevant industry row is set to zero in the regional table, and the difference is added to the regional import coefficient.

(3) Calculation of competitive imports
This requires the estimation of self-supply in each regional industry, which is undertaken by using simple and cross industry location quotients. If the local supply cannot satisfy the demand in an industry then the imports are assumed to be required. The competitive imports are modeled by multiplying technical coefficients in the relevant industry row with the corresponding location quotient, and allocating the difference to the regional import coefficient. If local supply is able to satisfy local demand in an industry then the regional technical coefficient is set equal to its national equivalent.

(4) Calculation of industry aggregation
It is necessary to convert the regional technical coefficients into transaction values by using regional output estimates derived by multiplying national output figures by ratios of regional to national full-time equivalents (FTEs). The tables are aggregated to provide a reduced coefficients matrix for calculation. The coefficients are converted back to transactions values and sum the transactions. This is computationally easier than weighting the coefficients by output data and summing the weighted coefficients. Once expressed in transaction values industries may be aggregated as desired. Tables used for multiplier calculation are generally kept as disaggregated as possible to avoid aggregation bias from affecting multiplier estimates.

(5) Tables balancing
The tables are balanced using inter-regional exports based on a supply-demand pool approach, which is a commodity balancing approach commonly used in input–output table construction. Balancing is however not required if the table is being produced purely for the generation of multipliers.

(6) The insert of superior data and knowledge
The insert of superior data and knowledge can be undertaken at almost any point in the above process. If the developer believes that a mechanically produced LQ is not reflective of the degree of self-sufficiency in an industry, say, because of productivity differences, then adjustments could be made. Similarly, if survey data is available then this could be included.

Table 2.1 Theoretical GRFT transactions table (million CNY)

Industry	Industry A	Industry B	Industry C	Final demand	Total output
Industry A	25	20	15	40	100
Industry B	14	6	10	20	50
Industry C	20	12	43	25	100
Primary input	41	12	32	12	97
Total Output	100	50	100	97	347

(7) Calculation of regional transactions matrix and inverse matrices
The regional transactions matrix is developed using linear optimization and constrained using quality data (Table 2.1).

2.3 The Water and Land Resources Integrated Input–Output Table

The water resource issues are influenced by various factors in terms of climate change, land use and land cover change and socioeconomic development. To sustain the holistic natural and human health, numerous researches attempt to address these issues from different study areas (Deng 2011a, b). The simple conventional input–output tables ignore the interrelationship between the economic activities and the resources depletion, it is therefore necessary to build the resource integrated input–output tables for small scale researches to reveal the impacts of economic development on the natural resources such as water and land. Though a number of respectable researches have been conducted on the high level and international researches to meet the national demand of natural resource negotiations, there are few studies on the low levels, such as the regional level especially the county level, to support the inter-regional and intra-regional analysis among the basic prefectures.

The most concerned natural resources are the water and land resources around the world. In this research, both these two resources, which are regarded as the production factors in the input–output tables, are embedded in the integrated input–output tables at the county level.

The main descriptions to embed the water and land resources into the input–output tables can be divided into two parts. Firstly, the amount of water and land resources consumed in the key sectors should be estimated. Generally, to sustain development of a particular industry needs certain water resource (amount) and this industry will occupy some land resource (area). This is the base of the calculation and estimation of resource consumption of each sector. Secondly, the prices of both two resources are used to calculate their economic values, which are regarded as the economic input on the natural resources related to the water and land.

2.3.1 The Water Resource Integrated Input–Output Table

The water resource consumption in an integrated input–output table can be divided into three parts including the consumption of the primary industry, the secondary industry, and the tertiary industry.

As to the water consumption in the primary industry, it is necessary to find out real water of each sector, which means that the water used in a specific sector is from natural supply or anthropogenic activities. For example, the crop farming industry needs extrinsic investment to get water, while most water consumed in forestry industry is assumed that the water is directly obtained from precipitation and surface runoff.

Additionally, in order to construct a value input–output table, the water price has to be identified for estimating economic input of multiple sectors. For this purpose, the land use in crop farming industry is divided into two categories including irrigated land and non-irrigated land. Therefore, the irrigation coefficients can estimate the water consumption in different land use types. It is difficult to estimate water price in the crop farming industry. Thus, a new method is developed to calculate the water prices. Firstly, the difference of water consumption in both two land use types can be calculated. Then the difference of gross economic output between these two types of land uses can be obtained in order to calculate the economic output per unit water resource. This is regarded as the water price of crop farming industry, which can be applied to calculate the economic water input of the crop farming industry. When considering the water resource consumption in the forestry sector, animal husbandry sector and fishery, it is difficult and necessary to distinguish whether these sectors need "water resource" to industrial sustainable development. Since most forest ecosystem and aquatic ecosystem depend on natural water resource such as precipitation and surface runoff to a large extend to sustainable development without much human intervention, these sectors thus are regarded that there is no water resource consumption. It means that the water resource has no economic value (price = 0) though these sectors consumed certain water resource. This can explain that the ecological water consumption can be considered as the water resource input of these particular sectors that related to corresponding ecosystems, such as forest ecosystems, grassland ecosystems and the aquatic ecosystem. But there are no robust methods to estimate the economic value of natural water resource.

$$WI_{crop} = \frac{GO_{irrigated} - GO_{non-irrigated}}{WA_{irrigated} - WA_{non-irrigated}} \times WA \tag{2.10}$$

where WI is the economic value of water consumption of crop farming industry, the GO represents the gross output of different land use types (irrigated and non-irrigated), the WA is the amount of water consumption of different land use types.

With regard to the water consumption of the other industries, the non-survey based method is used to calculate the water resource consumption of each sector,

Table 2.2 Regional industrial land users' guide

Name	Region	Plot ratio	Fixed investment	Land yield	Land use indicators		
					Production scale	Land indicators	
					Large	Medium	Small
Industry A							
Industry B							

in which the total water resource is allocated to each sector by using the water use coefficients. Numerous researches have been conducted to estimate the industrial water use coefficients of each sector by using the input output analysis. These research data can be used as references to obtain the water consumption of each sector. Since most industries and sectors of the secondary and tertiary industry are situated in the urban area, it can be assumed that the water price of a particular prefecture can be used to estimate the economic value of water consumption of each sector.

$$WI_i = GO_i \times C_i \times P \tag{2.11}$$

where C is the water use coefficients of each sector, P is the water price, and the WI and GO are the economic value of water consumption and gross output.

The urban and rural population is used to estimate the domestic water consumption. The existing statistic data associated with population is used to project the future population size which will be utilized to estimate the domestic water consumption. People live in different areas have different lifestyles in which the water use patterns are various. This is taken into consideration when estimate the water use per person in rural and urban areas.

2.3.2 The Land Resource Integrated Input–Output Table

In order to study the impact imposed on land resource of economic development, there is need to construct land resource integrated input–output table which includes the balance equations of the supply and use of the production sectors. Furthermore, this can provide scientific support to land management. Thus, it is necessary to develop a method to calculate the influence coefficient and sensitivity coefficient of land resources and carry out a quantity analysis on the change of land resources. In this part, the *User Guide of Industrial Land Use* written by the corresponding Guandong institutions is used to get the various coefficients of land use and management (Table 2.2).

2.3.2.1 Basic Regulations

The land resource integrated input–output table needs to satisfy the basic rules. It means that the land area shall not be greater than the corresponding scale of production land use indicator in the user's guide, and strength of investment shall not be less than regional guidelines index. The investment intensity is the fixed assets investment of per unit area within the scope of land. Furthermore, the plot ratio shall not be less than regional guidelines index. When calculating the plot ratio of the building which is higher than eight meters, it needs double calculate the construction areas. Otherwise, the coefficient of project construction shall not be less than 30 %. The construction coefficient is a proportion of all kinds of buildings and structures used in production and direct services to total land areas within the scope of land. Finally, the land output, which is the revenue of per unit land area within the scope of land, shall not be less than regional guidelines index.

2.3.2.2 Economic Value of the Land Resource of Each Sector

The land price in different regions is different. Thus, it needs to identify the areas with different situations. Then the total areas of industries can be collected from the regional statistical yearbooks and other public resources. Secondly, the plot ratio and fixed investment are used as the indicators to calculate the land use coefficients of each sector. Thirdly, the land areas of each industry can be calculated by multiplying the coefficients with the total areas used by all industries. Thereafter, the economic value of land resource can be estimated of industries. The equation is as follows:

$$\delta_i = \frac{Q_i}{\sum_{i=1}^{n} Q_i} \tag{2.12}$$

where δ_i represents the coefficient of industry i in industrial gross output, Q_i is the land yield.

$$D_i = S\delta_i \tag{2.13}$$

where S is the total areas of all industries, D_i is the land area of industry i.

$$V_i = D_i P_i \tag{2.14}$$

where P_i is the land price, and V_i is the land value of industry i.

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