THE COORDINATIVE DEVELOPMENT OF BOOMTOWN IN INDUSTRY, SOCIETY AND POPULATION

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ABSTRACT

The paper researches into a typical example of a developed region with a boomtown of China, studies the coordinate development of economy, and population migration of that region, analyzes the mechanism and theory of industrialization and urbanization of the rural area. A system dynamics model created to study of urbanization is exhibited and explained. The paper makes comments on current policy. And by the simulation, various policies are examined, the paper finds out the more reasonable coordinative growth rate and scale among industry, agriculture and town construction. The interaction between a special region and outside in the process of industrialization and urbanization is also a subject of discussion. The general conclusions and suggestions on industrialization and urbanization of rural area in China are put forward.

I. INTRODUCTION

The urbanization of rural population, in fact, is a dynamic transition of the displacement from farming labor to nonfarming labor or the migration of population from countryside to cities.

China is a country with a majority of rural population. Because of the low productivity in agriculture and low speed of economy development, the urbanization has stagnated for several decades. A great number of surplus farming labors have been seeking the outlet for improving their economic condition and income.

With the development of non-farming economy in developed rural area, a large number of farming labors were moved into non-farming labors. industry was developed rapidly. As a result, the boomtown grew up in rural area.

1. The Difference Between City and Countryside

City and countryside are two different basic types of economic and social living activities in function and structure. They differ from each other, associate with each other, influence each other as well. There are two main differences between them: one is the gathering density of inhabibtants in living spaces, the other is their different economic function in social life. There doesn't and shouldn't exist a clearcut between them. Instead there exist a lot of intersections, permeations, migrations and interflows.

Each country has its own definition for urban population. During recent thirty years, the definition in China has been improving. It consists of two parts, one of which is the gathering level, the other occupation structure.

A city or a town is an area in accordance to one of the following characteristics:

1) The place where the town or the government of a county(or above that) locate.

2) The place where has habitants over 2,000, half of them are non-farming population.

3) The place occupied by the big enterprises, railway stations, business center, middle schools, scientific research institute, and where has habitants below 2000 but over 1000, 75 percent of nonfarming population.

Of the above, it is called a city that a area has over 20,000 habitants and where the government of county(or above that) and big business locate. the rest are defined as town.

2. The Way of Urbanization

There are three principal ways of urbanization: The first way is the direct migration from countryside into big or middle cities. The second way is to build boomtown by government's investment to attract a large number of surplus rural population. The third way is the industrialization and urbanization of original countryside by developing the local rural economy.

The first two ways of urbanization are popular to most developed and developing country. Considering China has the largest population and backward economic level in the world, these two ways are unsuitable for the urbanization of Chinese rural area.

For the spacious countryside in China, it must rely on itself to promote rural economy, realize the transfer of the surplus farming labors, take the particular way of the urbanization of the rural population.

The so-called industrialization and urbanization of the rural population means that proper percent of original farming labors become non-farming labors and rural economic structure is reformed, the urbanization of rural population can be realized. This process is not isolated but related. The industrialization of the rural economy can provide the conditions for the urbanization of the rural population. The final purpose of urbanization is to reform rural production structure, promote the rural economy, make full use of the economic resources and set up the boomtown suitable scale for the development of rural economy and the increase of living stardard.

II. DYNAMIC MECHANISM AND STRUCTURE

1. System's Overview

Urbanization is the inevitable result of economic development. Nevertheless, the process of urbanization is a comprehensive proccedure relating to the development of economy, society and population.

Generally speaking, the development of urbanization depends on political factor, productivity and economic structure, population size, society and environment. Of all above, the economic factor is the most essential one.

All four factors above are the basis on which we analyze the urbanization system. We survey a particular system under the relatively independent surrounding, make research into its inner structure and mechanism, overlook the impact of surrounding. Political factor is supposed as an exogeneous test variable. The other three factors are considered as the main parts of system. The development of urbanization is the result of the interactions of economy, society and population in the system. If the model is in specific surroundings(under the condition of policy and external social economy), the behaviors of a system not only depends on but also affects its inner mechanism and structure.

2. The Main Structure of System

The model consists of seven sectors as shown in Fig. 2-1. They are agricultural production sector, industrial production sector, population and migration sector, urban facility construction sector, urban housing construction sector, land sector and pollution sector. The figure gives relationships and influences between each sector in the model, the kernel of which is population and migration sector. From the Figure we can see the population sector connects with other sectors of the system. The urban area is divided into four parts: industry, urban facilities, urban housing and population. Countryside is divided into agricultural production and rural population. In fact there exist no clear edges between them. There are many rural labors in the urban enterprises, also there are many urban enterprises in the countryside. As the rural economic trading center, the small town is closely related to the countryside. On the other hand, it is also the reliable support of the agricultural production. Though the urbanization of rural population is the inevitable result of the rural economic development, it is not infinite for the urban area expansion, as there are many limitations on the development of urban area such as allocation of land, labor and capital shortage and etc.. However, it is the interaction of these motivation factors and limitation conditions that dominate the development of the urbanization.

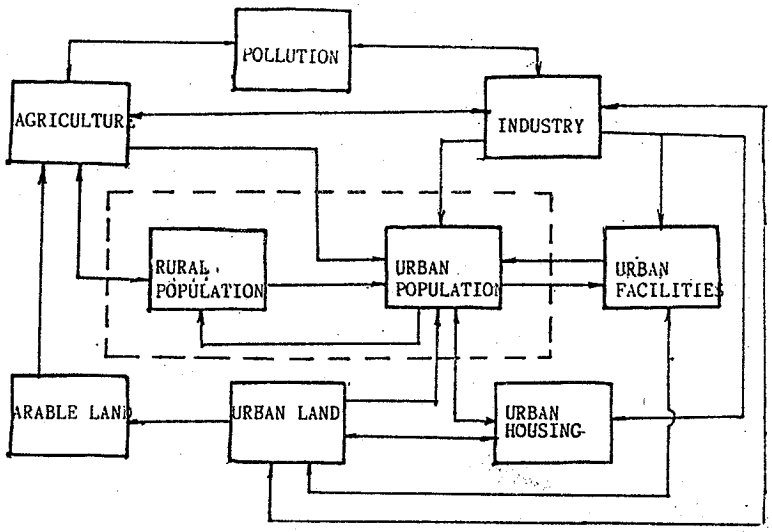

Fig. 2-1 THE OUTLINE OF THE MODEL

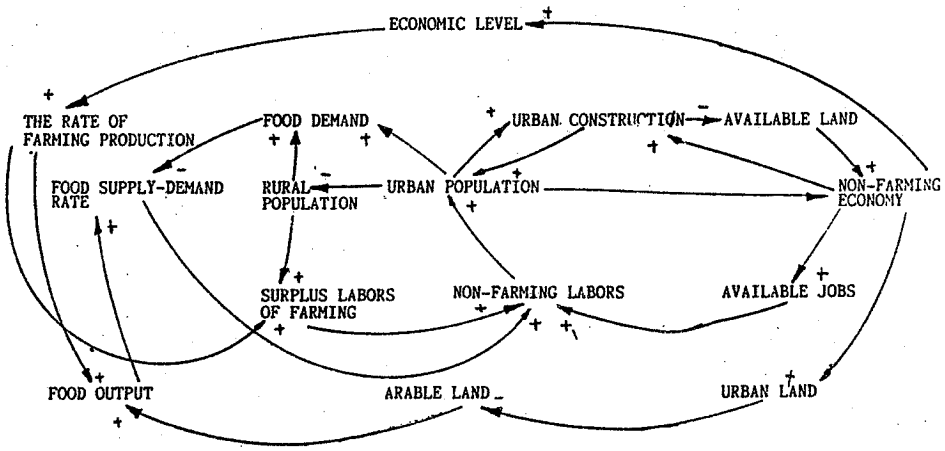

Fig. 2-2 THE CAUSAL LOOP OF MAIN VARAIBLES

3. Causal Loop and Feedback Mechanism

The causal loops of principal variables of the system are shown as Fig.2-2. The urban population comes from non-farming labor. And urban facilities and scale determine the migrating speed and degree from non-farming labor to urban population. There are three factors which affect the transfer from farming labor to non-farming labor: The first one is rural surplus labor. The increase of agricultural productivity and decrease of arable makes many rural labors overflowing. That forces them to seek new economic activities out of farming; The second one is the booming of urban employment. The rapid development of non-farming economy provides more jobs for rural surplus labors and attracts a large number of farming labors from rural area to urban area; The third one is the supply-demand rate of food. Only if food output meet the demand, is it allowed for farming labor to transfer to non-farming production.

Feedback loops of the model include three dominant positive feedback loops and four dominant negative feedback loops.

III. THE CONSTRUCTION AND TEST OF SDMURP MODEL

Based on the quantitative analysis, system dynamics model of urbanization of rural population(SDMURP) was constructed by means of DYNAMO language. The model consists of about 400 equations, including 11 level variables. The manipulation of the model is operated on computer VAX-11.

The construction of a model is a proccedure of comprehension and disintergration. It is also a proccedure of studying inner structure and function of a system and solving problems.

The construction of a model has gone through many steps. The principal ones of them are as follows:

1) The Improvement and Adjustment.
The primary model was separated into several sectors. Each one was tested and improved separately to determine the basic structure and parameters of the model, which is called partial test.

Following the partial test, the model was integrated gradually, tested in its entirety, revised and even reconstructed until the model satisfies the demand.

2) The Verification of the Model
Determining the vertibility of the model, i.e. the research and adjustment work on decisive degree of a model is known as the test and verification of the model.

The model has experienced the test under extreme condition, parameter estimate and sensitivity analysis. The outputs of the

model approximate to real history data with satisfying degree of precision. The difference of main variables ranges from 1.4 to 9 percent. The testing results of the model prove that the model give reasonable output under extreme conditions, the structure of the model is stable and reliable.

IV. A SPECIFIC EXAMPLE OF REGIONAL ECONOMIC DEVELOPMENT AND URBANIAZATION

1. The Conditions and Surroundings of the Base Run.

1) In the population and migration sector, it is supposed that the natural birth rate is around 0.9% and migrating multiplier variable named NMMRT equals 0.1, which determines the population migrating rate with urban housing factor(AMMHT), urban public servics factor(AMMPS) and population crowding factor(AMMCT).

In simple way, the fraction of labor forces to population is around 50%.

2) In housing construction sector, the normal constructing rate variable named HCFB equals 0.017, which will be adjusted by urban land factor and housing supply-demand factor.

The housing standard is 12 square meters per capita.

The housing lifetime is 100 years.

3) The normal constructing rate of urban construction is named NPSCF which will also be adjusted by urban land factor and demand factor.

The average lifetime of urban public facilities is 50 years.

4) In agriculture production sector, the output rate of the agricultural capital named ALPHAA equals 0.2.

The multiplier of potential farming output named MPOF equals 0.326.

The normal increase rate of land output named NIR equals 0.06.

Food demand (FD) consists of three parts: one is the food purchased by state; another is the food left; still another is food ratio.

The allocation of farming capital investment named NFEFP is a decisive variable which can act as either policy test variable or intrisic variable. Normally it equals 0.84.

5) In industrial sector, the elastic coefficient of industrial capital in Cobb-Douglass function is 0.5 named ALPHA. Normal fraction of industrial investment named NFCIR is 0.13.

2. The Results and Comments of Base Run

Under the condition and surrounding stated above, the model gives out the results of developing tendency of society and economy of the region from 1975 to 2000.

1) Urban Facilities Trend

Yangshi district began its urban construction in 1983. The development of urban facilities is rather quick, but nowaday state of population is that gathering population has been up to 10000 while residents are only about 3000 and that a large quantity of people commute between urban area and countryside. This is due to the present rural economic structure and urban residential condition. In terms of recent urban constructing speed and scale, the developing curves of urban occupying area, housing construction and urban facilities are shown in Fig 4-2. From the result of the model, we can see that all the urban facilities are increasing constantly before 1990, but they are limited after that time as the urban available land shrinks. Another group of curves show the incomformity and unreasonableness of the development of urban facilities. Fig 4-1 is the availablity curve of the urban facilities. The curve of housing availibility per capita is declining from 1975 to 2000. Although the curve of the capital of urban services availibility is declining from 1975 to 1983(the standard value is set as fixed capital of urban facilities at the starting year), it has the tendency of growing in the ensuing year which will soon be restricted by the limited urban land. And it is estimated that it will be greatly declined in the last ten years of this century. And the living urban area will have the same changing trend.

2) Population Growth Trend

According to current policy of population migration and developing scale and rate of urban construction stated above, the developing tendency of urban living and gathering population is shown as Fig 4-3. The simulating results show that in the future urban area of that region, the gathering populatin will make up the overwhelming majority of population, but the living population constitutes a small fraction. the urban population grows slowly and the mechanical increase rate (migrating rate) of population is declining rapidly.

3) Industrial Developing Trend

Fig. 4-4 is the curve of industrial developing tendency. From 1975 the industrial output value seized the dominant position. The industrial output was booming from 1979 and the increasing rate of its output value keeps risng until it reached its peak in 1980. In the following year, it declined but was kept over 20%. the increasing rate of industrial output value will decline to 8% in the next 15 years. According to the current policy of industrial development, fixed capital of industry will be keeping increasing from 1985 and industrial scale will be expanding. Whereas, with the rise of occupying rate of urban land, urban

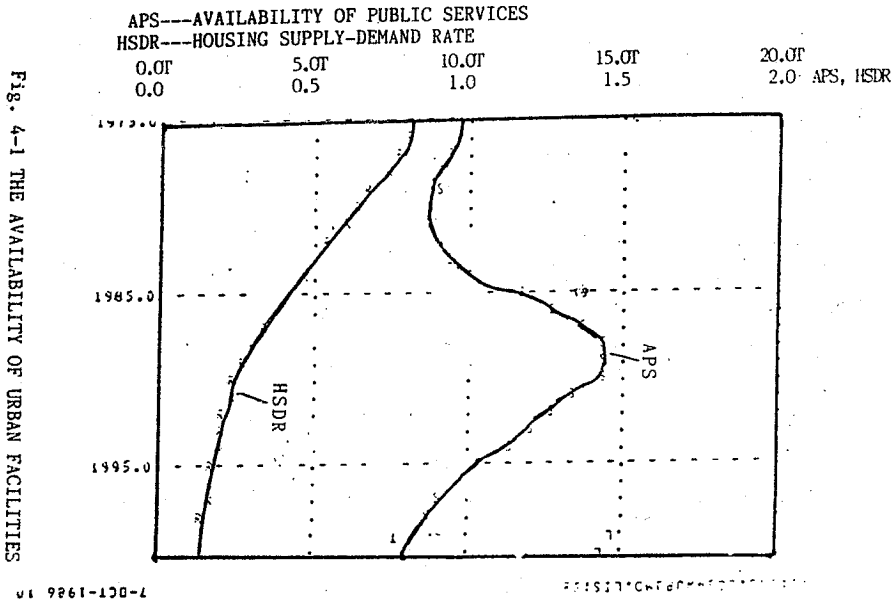

Fig. 4-1 THE AVAILABILITY OF URBAN FACILITIES

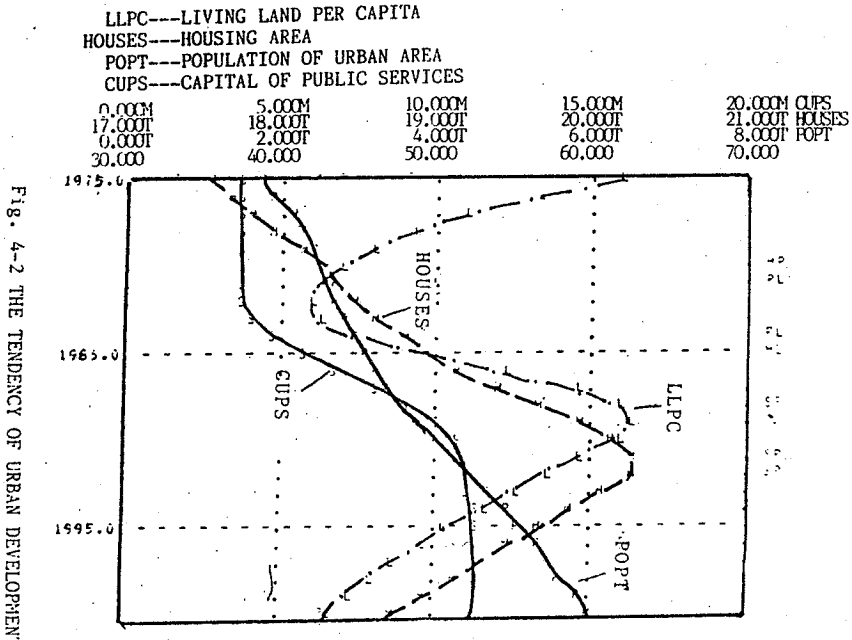

Fig. 4-2 THE TENDENCY OF URBAN DEVELOPMENT

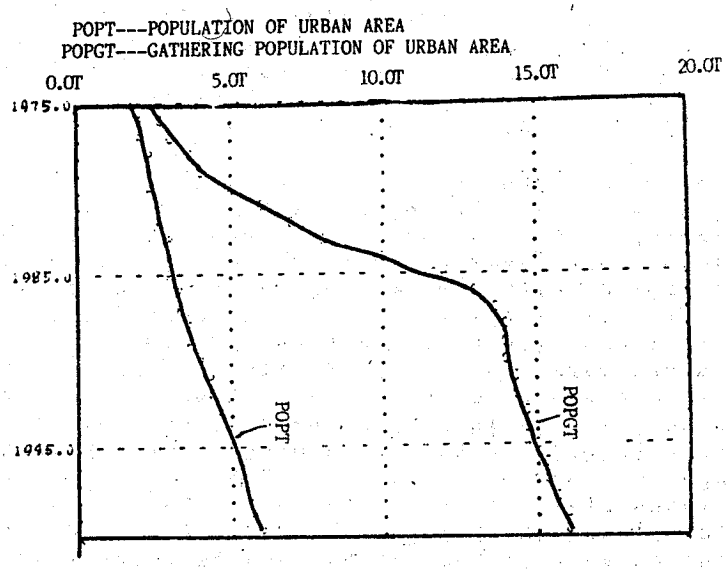

Fig. 4-3 THE GROWTH OF URBAN POPULATION

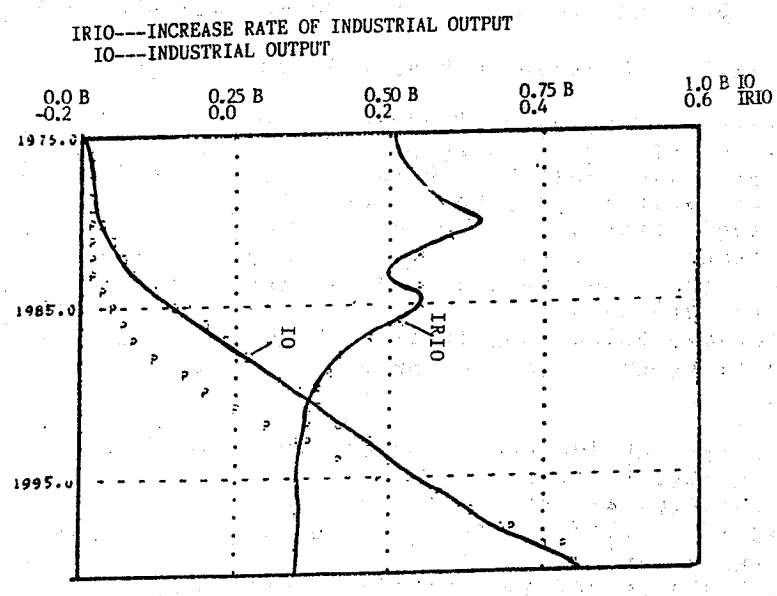

Fig.4-4 OUTPUT VALUE OF INDUSTRY

available land will be reduced rapidly, which constraints the expansion of industrial scale. From the curve in Fig. 4-5, we can see that the increase of fixed capital will tend to be flat in 1995, capital accumulating rate also reduces constantly. Therefore, it can be learned that increasing output by the expansion of industrial scale through investment on a large scale will be restrained by limited land.

4) The allocation of labor force
Fig. 4-6 shows the curves of labor transfer. From the curve of industrial labor, it can be seen that there are only 1500 industrial labors but farming labors are up to 8000 which make up 79% of total labors. With the development of rural industry, a great number of rural surplus labor forces were displaced to non-farming businesses.There is a turning point in 1980 when industrial labors began to surpass farming labors, which marked the rural economic structure begining to transfer from dominant by farming production to industrial production. Four fifth of labors has been transfered to non-farming labors, whereas farming labor decreased to 1020 only making up 7.5% of total labors. Up to 1985, an industrial ecnomic system on certain scale had been set up, the displacement of labors had been finished. From 1985, the developing curve will keep stable and be ralatively balanced. Industrial labors can't meet the demand all the time. Through surveying the whole developing proccedure, the labors development of Yangshi district will experience a process as follows:

SURPLUS ------- SATURATION ------- SHORTAGE

That will be a new approaching problem.

5) Agriculture Developing Tendency
After the low tide of farming products in 1983, the farming products had risen next tow years. However, the declining tendency of capital and labors input of agriculture dosen't stop at that time. Delay effects of declining of capital input and constant reduction of farming labors makes farming products shrink rapidly. From the fig. 4-7, it can be seen that the agricultural production will give rise to a crisis. Food supply will be largely below food demand, which will cause unavoidable serious effects on ecnomy and people's living standard of that district.

3. The Research on Reasonable Developing Plan or Strategy
As stated above, there are many obstacles and potential crises in urban, population and economic development. The analysis last section show possible problems in the future developing tendency of that region. In this section, we will seek the reasonable plan or strategy and select quasi-optimal developing policy to solve the potential crises and problems.

1) The Suitable Range of Urban Land
As stated above, the development of urban facilities and industry will be constrained by available land. Therefore, the first

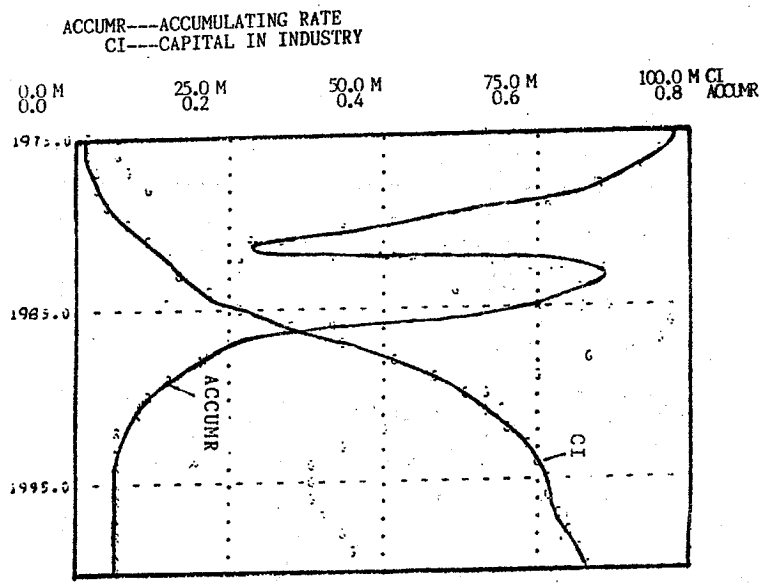

Fig. 4-5 THE FIXED CAPITAL AND INVESTMENT IN INDUSTRY

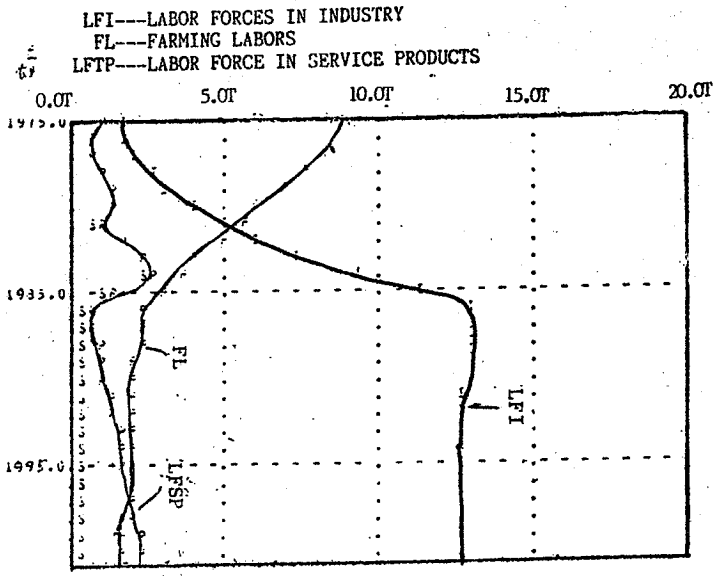

Fig. 4-6 THE CURVE OF LABOR DISTRIBUTION

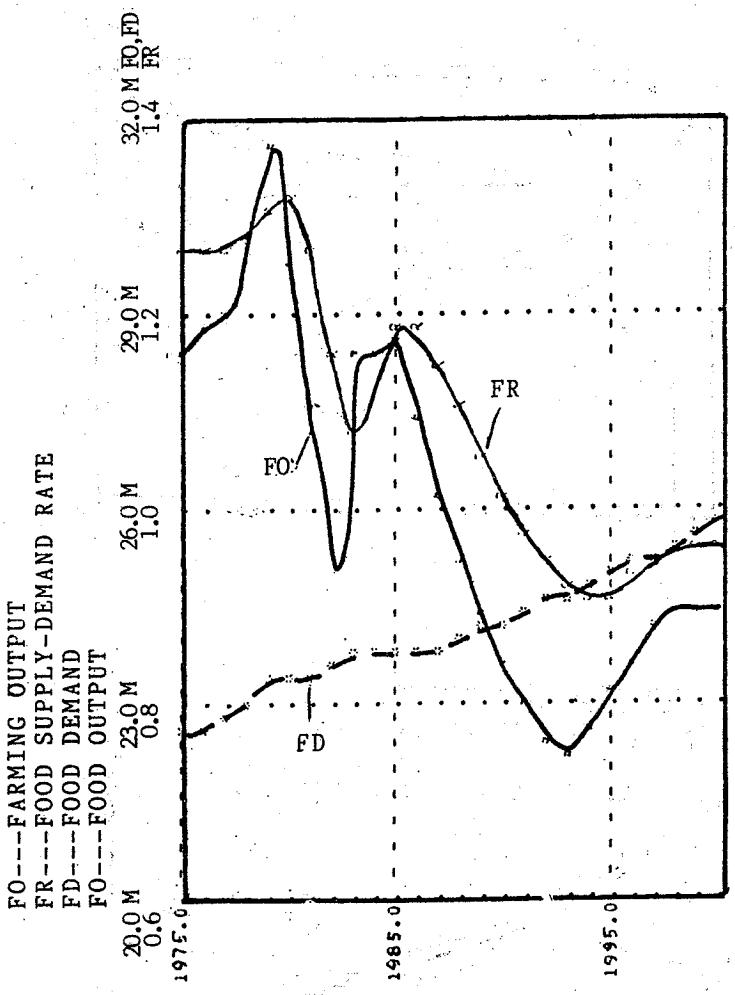

Fig. 4-7 FARMING OUTPUT AND FOOD SUPPLY-DEMAND RATE

problem to be solved is to determine minimum arable land and land occupied by urban facilities and industry. If we make a pessimistic estimate on the output rate of land, it can be supposed that only if arable area is kept over 112600 acre, food supply can meet food demand, from which it can be reasoned that the suitable urban area is around 3.5 square kilometers.

2) The Appropriate Scale of Urban Population
The growth of urban population depends on the level of facilities and urban scale, but more important one is the policy of population migration. According to nowaday migrating policy, the migration of population is so slow that it can't meet the demand of urban development and economic increase. Through tests and selection by means of simulation of model, it is suggested that the appropriate scale of urban population be around 10000.

The growth of urban population of that region is mainly due to mechanical increase of population, i.e. migration. As shown in Fig. 4-8, the mechanical increase rate of urban population will be up to 10% per year and 600 persons per year, reach the peak in 1995.

3) The Strategy of Development of Urban Facilities
The rapid growth of urban population and development of urban economy raises the new demand to the construction of urban facilities. From the simulation of the model, the level of urban housing per capita and urban facilities will be much lower than the standard.

On the problems above, the following strategy is suggested:
First, the housing contructing rate should be increased greatly The housing construction rate should be increased by 50%.
Second, urban land should be distributed with reasonable share among urban services, industry and housing construction. The policy of urban land distribution shown as Fig. 4-9 is suggested. Three curves in Figure. suppose that when available land is sufficient, there will be no limitation to all three sectors. With the decrease of available land, more limitation will be put on industry, but the preferential treatment will be given to urban housing and facilities construction.

In accordance with the policy stated above, the simulating output is shown as Fig. 4-10, which states that the availability of urban housing and services satisfy the requests. All facilities develop with reasonable fraction. The housing availability is over 1 and living space per capita is over 42 square meters.

4) Simulating Test of Industry
By analysis, land and labors are the principal affecting factors to future development of industry. Of limited labors and land resourses, it is the most important and key problem how to distribute and make full use of those resources to coordinate with the development of urban facilities and indusrtry. It is suggested that technology progress should be speeded up. The

PIMRR---PURE IN-MIGRATION RATE FROM RURAL AREA
POPT---POPULATION OF TOWN
PBRT---PURE BIRTH RATE OF TOWN
BR---BIRTH RATE

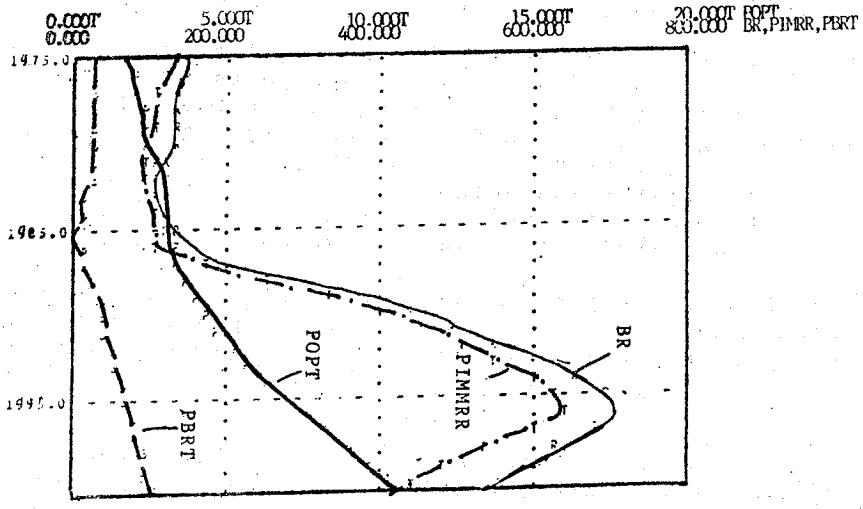

Fig. 4-8 THE INCREASE RATE OF URBAN POPULATION

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ELSC---EFFECT OF LAND ON SERVICES CONSTRUCTION
ELIC---EFFECT OF LAND ON INDUSTRIAL CONSTRUCTION
ELSHC---EFFECT OF LAND SHORTAGE ON HOUSING CONSTRUCTION

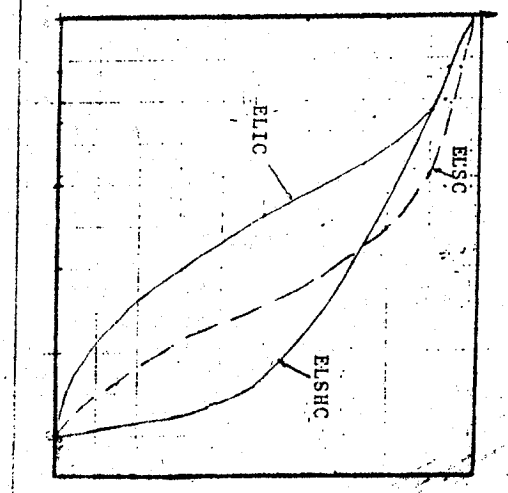

Fig. 4-9 THE POLICY CURVE OF LAND DISTRIBUTION

investment of funds and the increase of educational level will promote the development of technology. From 1986 to 1990, the accumulating rate will be reduced to around 30%, and the capital investment of industry decreases within that periods. The capital will be used to develop urban construction. After 1991, with the increase of marginal output rate of capital, the capital investment should be increased which will make industry develop constantly. Fig 4-11 shows the developing tendency of industry after improvemnet.

5) The Reform of Agricultural Production
the analysis of agricultural production in the last section suggests that main reasons for the reduction of farming output are the reduction of capital investment and labors. On those problems, it is suggested that farming labors be kept over 1500, and that farming capital investment should reach 600 yuan per acre as early as possible.

V. CONCLUSION

With the high speed development of rural business economy in Yangshi district, the surplus labors in the district has been displaced. But that doesn't mean the urbanization has met the requests. The period from 1985 is just the begining of urbanization of population. Migratory labors is only the result of the uncomplete development of urban facilities. Therefore, to make population urbanized it needs not only the development of non-farming economy but also the development and construction of urban facilities. From the simulating results showed above, we can conclude that:

In future 20 years, the investment on industry development should be reduced, on the contrary, the investment on urban construction should be increased. More attention should be paid to the construction of urban facilities especially urban housing. The urban area scale is supposed around 3 square kilometers and the suitable urban population will be 10000 by the year 2000.

The current policy of population migration will not be of benefit for reasonable distribution between urban and rural area. More migrating from countryside to city should be encouraged before 2000.

To keep the food output meet the food demand, the arable land should be kept over 112600 acres, farming labors over 1500 and farming capital investment reached 600 yuan per acre as early as possible.

The future development of industry mostly relied on the technological progress. Therefore it is more imperative to promote the technic level and educational level of industrial labors.

APS---AVAILABILITY OF PUBLIC SERVICES
HSDR---HOUSING SUPPLY-DEMAND RATE
POPT---POPULATION OF URBAN AREA
LLPC---LIVING LAND PER CAPITA

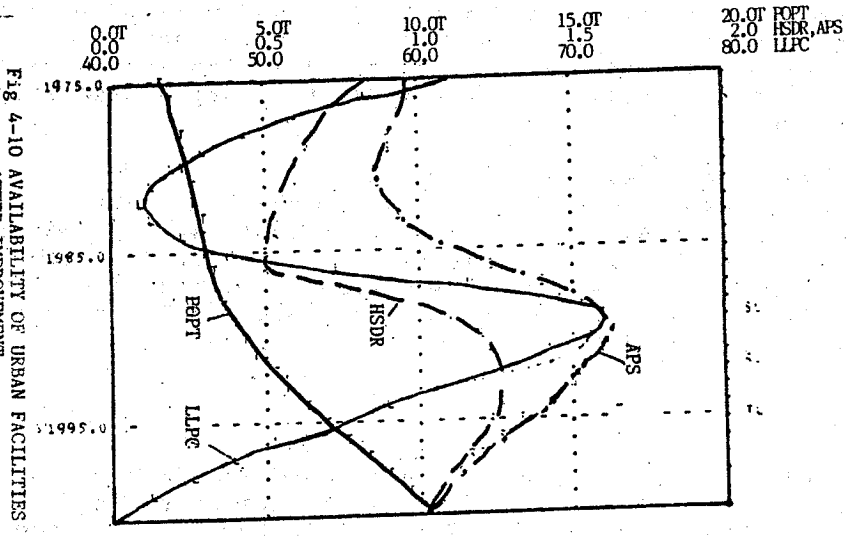

Fig 4-10 AVAILABILITY OF URBAN FACILITIES AFTER IMPROVEMENT

LFI---LABOR FORCES IN INDUSTRY
TEI---TECHNOLOGY IN INDUSTRY
IO---INDUSTRIAL OUTPUT
CI---CAPITAL IN INDUSTRY

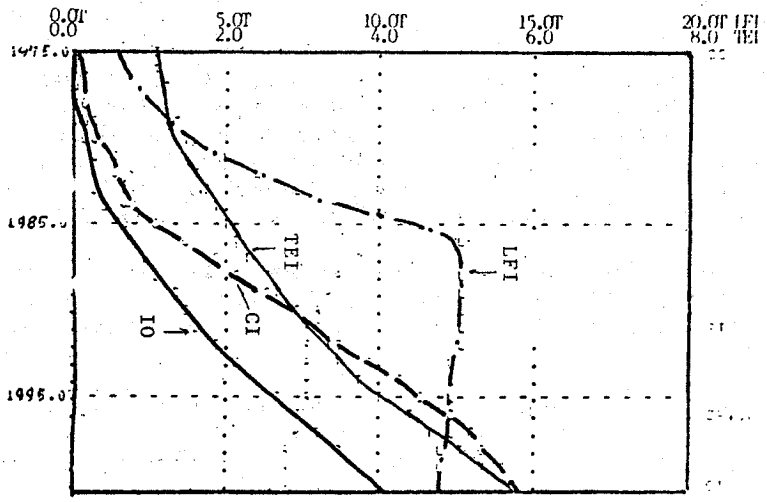

Fig. 4-11 THE REASONABLE DEVELOPING TENDENCY OF INDUSTRY

SDMURP model is constructed on the purpose of planning the coordinate development of regional urban facilities and economy with population growth and migration. Through a Example showed above, it is proved that the model describes the actual structures and dynamic behaviours of the real system, give out reasonable results. Therefore it can be concluded that the model is successful and useful although there are some structures and machnisms needed improving, and it provides an effective and scientific tool for solving urban and regional problems.

REFERENCES

Forrestor, J.W.,1961, Industrial Dynamics, Cambridge, Mass, The MIT Press

Forrestor, J.W.,1969, Urban Dynamics, Cambridge, Mass, The MIT Press

Forrestor, J.W.,1977, World Dynamics, MIT Press

Gordon, Geoffrey, 1979, System Simulation, Prentice-Hall, Inc., New York

Helly, Walter, 1975, Urban Systems Model, ACADAMIC PRESS, London