CHINESE GEOGRAPHICAL SCIENCE
Volume 12, Number 3, pp. 206 - 211, 2002
Science Press, Beijing, China

STUDY ON THE OPTIMUM PATTERN OF DAQING URBAN SPATIAL STRUCTURE

SONG Yu-xiang[1], ZHENG Hong-bo[2]
(1. Changchun Institute of Geography, the Chinese Academy of Sciences, Changchun 130012, P. R. China;
2. Information Center, National Bureau of Oceanography, Tianjin 300171, P. R. China)

ABSTRACT: Daqing is a mining city that was set up on wetland by exploiting and processing petroleum. This paper points out that net-group urban system is the optimization mode for Daqing urban spatial structure through analyzing and appraising the present situation, characteristics, advantages and disadvantages of Daqing spatial structure. And the best way of optimizing Daqing urban spatial structure is to adopt sustainable development strategy, establish the coordinated grade structure of urban system, construct developed towns net system, prefect the function structure of the towns at all levels, make full use of resources and strengthen environmental protection. Spatial structure of Daqing must be accordingly adjusted in order to adapt to the transformation of future economy types and functions. Based on the foundation of keeping net group, the development should be from disperse to moderate centralization in order to give prominence to the multifunction of the central city. Constructing ruralizing city should be the future goal of Daqing City.
KEY WORDS: urban spatial structure; net-group urban system; sustainable development

CIC number: K928. 5 Document Code: A Article ID: 1002-0063(2002)03-0206-06

1 ANALYSIS AND EVALUATION OF DAQING UABAN SPATIAL STRUCTURE

Daqing Oil Field is the biggest oilfield and the important petrochemical industry base of China. Daqing has grown into an industry city of petroleum and petro-chemistry with the exploitation and the economic development of oil field. The GDP amounts to 107. 79 billion yuan(RMB), which is one third of GDP of Heilongjiang Province in 2001, and the synthesized urban competitivness ranks the 37th in the 237 cities and is the first one in the 46 resource cities. Daqing City is located between Harbin and Qiqihar, which are all important industry cities, and it is the important component of the Industrial Zone from Harbin to Qiqihar in the west of Heilongjiang Province. Executive Daqing has jurisdiction over city proper, Mongolian Autonomous County of Dorbot, Lindian, Zhaozhou, and Zhaoyuan counties. It covers an area of 21 000km^2, with a population of 2. 57 millions. Daqing urban area differs completely from the proximate four counties in the developmental conditions, pattern, and speed. The formation and evolution of spatial structure of the urban area is unique and this paper only studies how to optimize it.

1. 1 Present Situation of Spatial Structure

As a new developing petroleum city, Daqing originated from the Oil Battle in 1960. According to the guidelines of combining workers and peasants, combining urban and rural areas , and being favorable to production and life, with the objective of service for oil production, Daqing built a number of small towns and unattached mine areas , which took part both in industry and agriculture and were highly scattered from each other. After 1980, the urban construction planning has been strengthened. Because oil production is characteristic of many sites, long lines, wide areas, heavy mobility and wetland as its background ecotype, the measure of relative decentralization and appropriate centralization was adopted for cities and towns con-

Received date: 2002-07-26
Foundation item: Under the auspices of the Knowledge Innovation Project of the Chinese Academy of Sciences(KZCX2-SW-320).
Biography: SONG Yu-xiang(1955 -), male, a native of Nehe City, Heilongjiang Province, professor. His research interest includes urban geography.

struction. Consequently Daqing grew up to a unique inhabitancy hierarchy with three grades that is composed of small towns, central villages, and residential villages. The population in the downtown district exceeded 1 million in 1996, which made Daqing entered the megalopolis list. The population of downtown district is 1.08 million in 2001 (Table 1).

Arranged from southeast to northwest, among the six towns, Wolitun, Longfeng, Sarhu and Ranghulu are along the Bin – Zhou (from Harbin to Manzhouli) Railway line. Ranghulu is the joint of Rang – Tong (from Ranghulu to Tongliao) and Bin – Zhou railways. Dongfeng new village is located to the east of Sartu and the north of Longfeng. Chengfeng village is to the east of Tong – Rang railway, 13km away from Ranghulu.

Table1 The scale structure of Daqing City

Population of city proper ($\times 10^4$)	Built up area (km^2)	Road area per person (km^2)	Towns number	Number of central villages	Number of residential villages	Number of small residential areas
108	136	15.2	6	24	27	> 50

1.2 Characteristics of Spatial Structure

Urban system is a composition composed of towns with different functions and grades, which contact and depend on each other and are rationally distributed in a relatively integrated region. Through more than 30 years of construction, integrated urban system has been formed. The characteristics of spatial structure are as follows.

1.2.1 One city with many towns

The essential characteristic of Daqing urban spatial structure is one city with many towns scattered in many places. Many inhabitancy districts of various sizes disperse within an area of 5107km^2 at present. The gross population density is 211.5 persons/km^2, which is smaller in domestic cities.

1.2.2 City with mining area characteristics, mining area with urban features

That urban areas blend with mining areas is the layout feature of many mining cities in China at present, which can be seen clearly in Daqing City. Located in oil field, the town layout of Daqing depends on petroleum and petrochemical industry enterprises, which is the distinct characteristic of mining cities.

1.2.3 City combining with countryside and industry combining with agriculture

The towns of Daqing are surrounded by farmlands and wetland patches. The asymmetric distribution and combination of natural conditions and resources decide the towns' arrangement. Towns contact each other by such networks as transportation, communication and pipelines and so on. Diversified town types and explicit function division demonstrates a unique urban system and the visage of the combination of city and countryside in spatial layout (Fig. 1).

1.3 Evaluatation of Daqing Spatial Structure

The hierarchy of three-grade inhabitancy districts of Daqing, which is composed of small town, central village, and residential village, is formed on the background of special time and place and the special social and economic conditions. It is rational at that time. Seen from future development, the spatial structure has both advantages and disadvantages to economic development and city construction.

1.3.1 Advantages

(1) Combination of city with countryside will be favorable to industrial and agricultural production.

The layout that many towns belong to one city is flexible. Industry districts combines with neighboring inhabitancy districts. There are combination of not only industry and agriculture but also city and countryside. It is favorable to industry and agriculture production and convenient to the livings of workers and their relatives, which is the guarantee of highly steady petroleum yield and economic development.

(2) Rational division benefits to alternative industry exploitation and development.

The remarkable characteristic of urban land use structure is dispersive in large scale and centralized on small one, which optimizes urban structure and is highly flexible. The east part of Daqing City, including Longfeng and Wolitun, is the petro-chemistry industry district that is the developing pivot at present. The development zone of high-new technology industry, which is the dominant industry of Daqing City, is also located here. High-tech content and high value added are the characteristics of the two industries. The two industries are being arranged in one area by taking the advantage of spatial structure created the extremely favorable condition for opening up the development path of Daqing substitution industry.

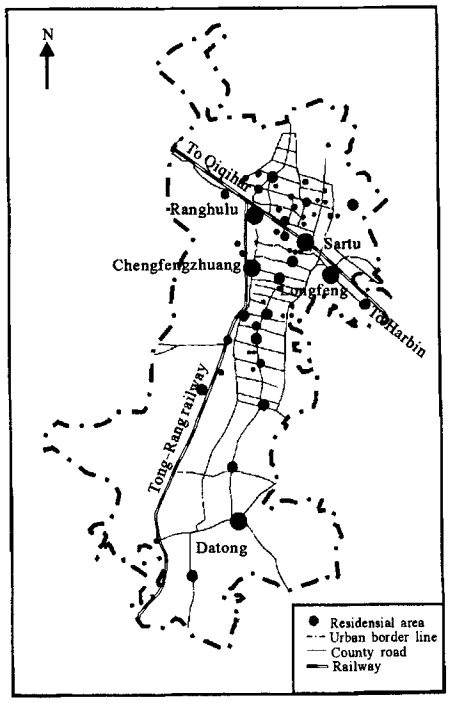

Fig. 1 The distribution of urban system of Daqing

(3) The so-called big city diseases, such as traffic jam, land use tension and environment pollution are avoided.

The characteristics of Daqing City, such as disperse town layout, low population density, small pressure of communal facilities, blend of industry and inhabited districts, reduce traffic distance and avoid traffic jam phenomenon of big city. The environmental cost is relatively low because of the natural combination of artificial ecosystem and organic ecosystem that is characterized by "city surrounded by rural areas" landscape. The landscape is composed of cities and large stretches of farmland, greenery space and wetland between cities.

1. 3. 2 Disdvantages

(1) The centralization and radiation functions of central city are not strong.

The urban plan thoughts have been transformed from constructing small function-complete towns to building a central city with some scale of centralization and the net-group agglomeration made up of Sartu, Dongfeng new village, the high-tech industrial development zone and Longfeng has had some functions of central city. But the functions are incomplete and it is difficult to play the role of centralization and radiation function of central city, especially when it comes to the radiation to the outer four counties.

(2) The residential area is too scattered and in small scale, which could not benefit infrastructure construction and lack scale benefit.

The number of towns and residential areas amounts to over 300. These towns and residential areas are excessively dispersed in layout, and excessively small in scale, most of which have been less than 20 000 people except of some big towns. Many residential areas are short of complete accommodation facilities, such as water, electricity, and gases, and short of matching basic facilities, such as business, finance, communication, medical treatment, and education. Resident's living condition is inconvenient and life is of low quality. For lack of scale benefit, the development of industry, agriculture and local economy has been restricted.

(3) Some residential areas are built on oil fields, which bring conflicts of oil exploitation and urban construction in land use.

The conflicts of oil exploitation and urban construction are very common in Daqing, which limits not only petroleum exploitation but also urban development.

(4) Spatial sustainable development is restricted by the distribution and limitation of resources(ZHANG, 1997).

The towns' formation and development of Daqing are closely related to the exploitation and utilization of petroleum and natural gas. But, petroleum is non-renewable resource and it is unavoidable that the petroleum resources are depleted. The petroleum output, which has being sustained over 50 millions tons for 26 years, was 51. 50 million tons in 2001. It is estimated that the annual output will reduce to below 50 millions tons in future. It will be 35 millions tons in 2010, and 20 million tons in 2020. At present this spatial structure could not fit for the future comprehensive development demand of city economy owing to the shortage of centralization and scale benefit. With the resource exhausted, spatial structure has to be adjusted.

(5) The terrain is low and wet, the urban built up areas and wetland interweaves, which both increase the difficulty to prevent from flood and protect environment.

Daqing is located in the first class steps of the Songhua River and the Nenjiang River with an altitude of 126 – 165m above sea level. In most low places there exist seasonal low-lying land, low-position swamps, and large and small alkalescent-water lakes, all of which have not smooth drainage. There are no natural rivers in urban districts. Lakes become the influx areas of natural precipitation and the discharge areas of industry and living waste water. The tasks of preventing and con-

trolling flood, protecting environment are more arduous in Daqing than other cities, for example the large flood of 1998 caused greater threat to Daqing City.

2 NET-GROUP URBAN SYSTEM — THE OPTIMUM PATTERN OF THE DAQING URBAN SPATIAL STRUCTURE

According to the status quo of urban system layout and the direction of industries and functions development of Daqing, we believe that " the net-group urban system of one city with many towns, one growth pole standing out, many growth poles assisting" is the ideal development pattern of Daqing City.

2. 1 Significance of Net-group Urban System

Net-group urban system is composed of a number of central cities and residential areas around with different levels, different scales and different natures, which has the characteristics of centralization and decentralization (WANG, 1995). The urban system is the comparatively ideal spatial development pattern of resources-mining city whose formation is relative to traffic and production layout. The control of city sustainable development can be realized in this system (ZHANG and HE, 1997).

The advantages of net-group urban system are as follows: 1) All parts of city come into a whole by close traffic connection, which make large city gain intensive function and economic benefits. 2) The characteristics of small cities are helpful to creat the living environment closing to nature, which can avoid the diseases of large cities. 3) The flexible layout and combination of industry districts and inhabited districts not only meet the demands of resources-mining cities but also reduce inner traffic distance, which guarantees rational division and benefits alternative industry development. 4) There is great elasticity, developing space and steady structure in net-group urban system, which is adaptive to urban scale expansion.

At present, Daqing is developing a net-group urban system with downtown as central city, Ranghulu, Chengfengzhuang, Wolitun, Datong, Honggang as outer places, and tens of big and small residential areas as important components. They are integrated while independent. They are separate in layout, but there is convenient traffic among them. Seen from present conditions and the development trend, net-group urban system is feasible in Daqing, and should be enhanced and improved.

2. 2 The Spatial Structure of Net-group Urban System of Daqing

The spatial structure of town means the spatial combination of cities and towns with different functions and different scales and the combination of cities and towns with other cities and towns, traffics and regions (ZHOU, 1995).

According to present spatial structure and the demand to construct an integrated city, Daqing needs to establish a central city with clustering and radiating function as a growth pole to command and drive all parts. At the same time, rational division must be done in the city so as to make every part with explicit function. Every function area should establish a central town respectively, which has the function of clustering and radiating in their own area and assists the central city as well. So the spatial structure of net-group urban system should be composed of one central city whose function is like an outstanding growth pole, many outer towns that assist the central city in urban district and other numerous residential areas.

The central city is the center of economy, politics and traffic. It radiates, drives and commands the development of the city. This paper believes that the clustered central city could be composed of Dongfeng new village, the development zone, Longfeng and Sarhu that have clustering function in the whole urban district (Fig. 2).

The outer towns of Ranghulu, Chengfengzhuang, Wolitun, Datong and Honggang form the second system that contact with central city in substance and information flowage and assume respective function. These towns are also the radiation center driving the development of residential areas, and are the bridge and ligament between the central city and residential areas.

The net-group of residential areas is the low-grade system composed of small central residential areas and smaller ones around. The activities of residents inhabiting around are centralized at center. Dozens of large and small residential areas compose the many net-groups in Daqing.

3 COUNTERMEASURES OF THE NET-GROUP URBAN SYSTEM OF DAQING

3. 1 Establishment of Sustainable Development Strategy

Harmonizing the development of society, economy, resource and environment is the core of sustainable development. The spatial structure of urban landscape

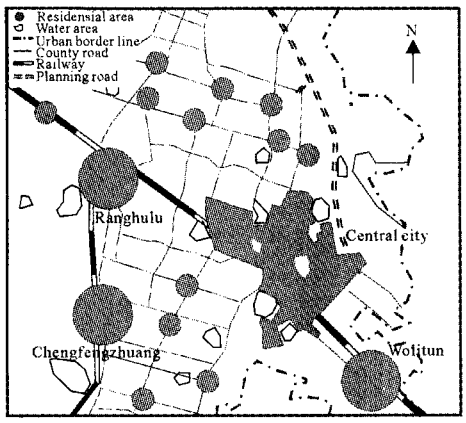

Fig. 2 The sketch map of central city of Daqing

ecology relates directly to the rational utilization of resources and the influence on physical environment, and it is the connecting link between the preceding and the following in harmonizing society, economic development, resources utilization and environment protection in city.

The following measures must be done in optimizing urban space structure of Daqing in order to realize sustainable development. Firstly, establish grade scale structure for harmonizing urban system according to present spatial structure and the demand of developing integrated economy. Secondly, construct developed network system in order to make all sorts of contacts orderly, convenient and expedited. Finally, perfect functional structures of towns at all levels so that the towns could play their proper roles, improve their inner function structure, and meet economy development and facilitate residents life.

3. 2 Establishment of Harmonious Grade Scale Structure of Urban System

According to status quo of Daqing urban system and the demand of developing integrated economy, disperse urban construction should be controlled. What is the most important should be given top priority, and the periphery should be weakened. The three grade structure is the ideal urban system of Daqing. The first grade is the central city with the function of convergence in the whole city. It is expected to become a middle scale city with integrated function in the future one or two decades, which can drive economic development of the whole city. The second grade is composed of towns with partial clustering function, including Ranghulu, Chengfengzhuang, Wolitun, Datong, and Honggang. These towns belong to the outer parts that have suitable distance with central city. So they can be developed as satellite towns of the central city (QIAN, 1986). The third one is made up of numerous residential areas with main function of petroleum exploitation and agriculture production, especially the production of green foods that is important in realizing integrated development of Daqing or the future main function of the third grade residential areas.

3. 3 Establishment of Developed Urban Network System

Urban network system is composed of cities and towns, traffic, connection flow and connection areas. The construction of network system is concentrated on the parts mentioned above.

The spatial structure of the urban system of Daqing should be developed into the mode with characteristics of one city with many towns, one outstanding core with many assistant growth poles. The mode is composed of the inner city that could be seen as the core of the system and towns such as Ranghulu, Chengfengzhuang, Wolitun, Datong, Honggang as the emphasis point, Bin – Zhou Railway as the first development axis, and the west main line and Sa – Da(from Saertu to Datong) Road as the second axis.

Transportation system should be improved. Transportation potential should be developed to high level, station facilities should be rebuilt, and the handling capacity of railway transportation should be expanded. The network system should be unceasingly improved, and main lines and exits should be added in road transportation. It is very necessary to set up air transport pass way according to the social economic development direction of Daqing.

The social and economic connection between the cities and towns of Daqing at all levels should be realized by partial combination and relative centralization. The powerful attraction and radialization of the first-grade cities drives, organizes, and harmonizes concurrent development of all towns, which forms an town network system connected closely together.

3. 4 Improvement of the Function Structure of Towns at All Levels

Based on the principle of limited centralization, the first and the third grade residential areas should be developed emphatically along main axes. The inner city as the center of politics, economy and culture should strengthen the traffic, communication, business, culture and administrative management functions. The

traffic, communication, business and inhabitation function of the second grade towns should be enhanced. The third grade residential areas are central and residential villages with scattered layout and small scale. Taking into account the demand of future agriculture economy development and the adjustment of residential areas with the main function of oil exploitation, we should select a large-scale central village with convenient traffic in certain region, and perfect its function structure to meet the demand of economy development and resident life of that region. Daqing should enhance radiation to the outer four towns and confirm the functions of main towns in the labor division and cooperation of Ha(Harbin) - Qi(Qiqihar) economic belt.

3.5 Utilizing Resources Rationally and Enhancing Environment Protection

Utilizing resources rationally must consider the demand of contemporary development of society and economy and future development as well. Firstly population growth should be curbed in order to prevent the scale of population from going beyond the bearing capacity of the urban resource and environmental system. Daqing should make great efforts to limit population to 1.25 million in 2010. Secondly, it is necessary to utilize rationally non-renewable resources such as petroleum and natural gas for social and economic sustainable development. The crude oil should not be exploited at full capacity till substitute industry in Daqing has been formed. Thirdly, the ecological balance should be safeguarded, the foundation of renewable resources and the absorbing and transforming ability of the environment be protected. It is necessary to protect farmlands, maintain grassland ecological balance and prevent grassland from degradation caused by grazing excessively(ZHOU and GUAN, 1992). The freshwater of Daqing is short at present. It is necessary to advocate making full use of water, limit the development of industry that consume water heavily and prevent water environment from being contaminated by industry development.

The contamination of water and soil by petroleum exploitation has been serious and it is essential to strengthen environment protection to prevent eco-environment from being destroyed by economy development and avoid the irreversible changes of environment. There should be essential forestation interval between components of the city to prevent crowding and pollution and keep fresh air. Landscape design is needed, and city greening and contamination treatment will improve environment quality and create pleasant eco-environment and colorful city image both in oil field and city.

4 CONCLUSIONS

Petroleum exploitation is the polymerization strength of urban development in Daqing, which is also a process of sub-group expansion in space. Large environmental capacity is the obvious superiority of net-group structure of this type, but there are also such disadvantages as excessive dispersion, weak functions of central city.

With petroleum decreasing, it is inevitable to adjust industry structure, develop alternative industries and transform it's economy from resource-oriented to comprehensive economy. Spatial structure of Daqing must be accordingly adjusted in order to adapt to the transformation of future economy types and functions. Based on the foundation of keeping net group, the development should be from dispersion to moderate centralization in order to give prominence to the multifunction of the central city.

According to the status quo of spatial structure and developmental orientation of social economy, the net-group urban system of one city with more towns, one growth pole standing out and many growth poles assisting is the optimum pattern of Daqing urban spatial structure. Constructing ruralizing city is the goal of Daqing on the foundation of urbanizing country.

REFERENCES

QIAN Ming, 1986. *The Construction on Satellites City · City Cathedra*[M]. Beijing: Peking University Press. (in Chinese)

WANG Ming-li, 1995. Construction on net-group city[J]. *Urban Planning*, (5): 21 - 24. (in Chinese)

ZHANG Ping-yu, 1997. Sustainable structure and regional sustainable development[J]. *Economic Geography*, 17(2): 16 - 20. (in Chinese)

ZHANG Xin-sheng, HE Jian-bang, 1997. Urban sustainable development and spatial decision-making sustainment[J]. *Acta Geographica Sinica*, 52(6): 507 - 517. (in Chinese)

ZHOU Yi-xing, 1995. *Urban Geography*[M]. Beijing: Commerce Press. (in Chinese)

ZHOU Yu-cheng, GUAN Li-fang, 1992. *Total Planning on Land Use in Daqing*[M]. Harbin: Heilongjiang Province Science and Technology Press. (in Chinese)