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Xiaolong Li
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Proceedings of the 5th International Conference on Economic Management and Green Development

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Preface

The International Conference on Economic Management and Green Development (ICEMGD) is a leading conference on economic management, public administration, and green development. This conference is hosted by Eliwise Academy. Aiming to build an international platform for researchers, scholars, and academicians for effective academic communication, ICEMGD welcomes everyone interested in relevant fields to share findings, achievements, and inspiration. It hopes to further promote academic collaboration.

This volume contains 77 excellent papers accepted by the 5th International Conference on Computing and Data Science (ICEMGD V). Each of these papers has gained a comprehensive review by the editorial team and professional reviewers. Each paper has been examined and evaluated for its theme, content, structure, language, and other necessary elements of an academic paper. Topics covered in this volume include economic management, public administration, green development, etc.

Taking account of participants' safety, ICEMGD V was held online on YouTube and attained great success. Invited keynote speakers including Prof. Avanidhar Subrahmanyam, Distinguished Professor of finance from the University of California, Los Angeles (UCLA), Prof. Thomas Reuter at the Asia Institute of the University of Melbourne, and Prof. Tim Forsyth from London School of Economics and Political Science have given brilliant speeches on their latest research. In addition, 12 authors of high-quality papers were invited and presented their works at the online conference.

We would like to express our sincere gratitude to all authors who have contributed their works to ICEMGD V, editors and reviewers who have guaranteed the quality of papers with their expertise, and the committee members who have devoted themselves to the success of this conference. We are also grateful to Springer for publishing the conference proceedings.

We hope this volume of proceedings would be helpful and inspirational.

November 2021

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Contents

Bioreactor of Horizontal Type Taking Local Weather and Economic Factors into Account

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Abstract. This article provides a comparison of biogas plants for waste processing of various modifications, advantages and disadvantages, as well as a description of a biogas plant of its own development of a horizontal type, taking into account the local climatic and economic conditions of the development of farms in Kazakhstan. The article discusses the use of our patented pneumatic motor for mixing biowaste, a bioreactor of our own production and describes the analysis of the development of biogas technologies in the countries of the far and near abroad. And using of bioenergy plants makes it possible to obtain mineralized organic fertilizer and biogas. Biogas plants based on the production of biogas and biofertilizers by anaerobic digestion of animal waste under the influence of microorganisms helps to prevent the release of methane into the atmosphere, the best way to prevent global warming is to capture methane. Consumption of this gas reduces the impact of methane.

Keywords: Biomethane · Biogas · Bioreactor · Bio-waste · Bio-fertilizer

1 Introduction

Biogas is a renewable energy source whose demand for automotive fuel or fuel for the production of heat and electricity is constantly increasing. Biogas is a mixture of more than half of methane and a third of carbon dioxide with admixtures of other gases such as ammonia, hydrogen sulfide, nitrogen, etc. Biogas is formed due to the action of special methane-forming bacteria, which process waste of biological origin loaded into the reactor without oxygen access. In addition to gas, high-quality biohumus fertilizers are obtained at the outlet of the dry residue of processed raw materials, which prevent soil erosion and enrich its fertile layer.

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Around the world, much attention is paid to the problem of obtaining and using biogas. In a short period of time, a whole industry for the production of biogas has emerged in many countries. The European Commission has identified bioenergy as an independent area of general energy, which was confirmed at the Pan-European Conference on Bioenergy in October 2003 in Budapest.

2 Materials and Methods

Efficient using of agricultural waste is a global and important problem of the world. Therefore, development of technology for utilization of liquid cattle manure in the current environmental situation, providing not only environmental safety, but also contributing to the creation of closed energy-saving production with the receipt of mineralized organic fertilizer, which allows to increase the yield of crops; feed supplements; additional source of energy in the form of biogas become particularly relevant. The main advantages of biogas are its renewability, the availability of local sources of raw materials for fuel production, the reduction of the greenhouse effect and environmental damage from organic waste collection systems, and the provision of an environmentally closed energy system [1, 2, 12].

In the United States, currently, the annual volume of biogas production is 500 million m^3. A significant part of it is supplied to power plants. The total electrical capacity of biogas plants is about 200 Mw. In the United States, there are more than ten large biogas plants, one of which (with three feedlots for 110 thousand heads) supplies the produced biogas to the gas distribution network of Chicago. In addition, in the United States, installations for using of waste on small cattle farms with a cattle population of up to 150 heads have become widespread.

In the UK, about 200 million m^3 of biogas is produced per year. The total capacity of the UK bioelectric power plant is about 80 Mw.

France produces about 40 million m^3 of biogas per year. At one of the landfills near Paris, a bio-power plant was built using biogas, the emission of which is 1.5 thousand m^3 per day.

Germany is a leader in the production of biogas in Europe. The country aims to reduce carbon dioxide emissions by 40% and phase out nuclear energy. Government acts that set out strategies to reduce emissions include national targets for biomethane production – 6 billion m^3 of gas per year by 2020 and 10 billion m^3 of gas per year by 2020. Cubic meters per year by 2030. In this regard, a further significant expansion of German biogas production is expected.

The Danish government provides significant tax incentives for biogas producers: about 20% of capital investment for centralized biogas and 30% for individual plants or installations. The total annual energy capacity of producers of biogas produced in Denmark from all sources is currently up to 4PJ. It is planned to further increase its production to 6PJ. Currently, there are 18 biogas plants in operation in Denmark, capable of handling 1.2 million tons per year. Tons of biomass (75% of animal waste and 25% of other organic waste), giving up to 45 million m^3 of biogas, which is equivalent to 24 million m^3 of natural gas.

In farms in Europe and Canada, installations with a capacity of up to 100–200 m^3 of biogas per day are common, which provides the farm with thermal energy in summer by 100%, in winter-by 30–50%.

In Russia, there is no national program to support the construction of biogas plants, and no centralized biogas plant is being built. However, according to the plans of the Government of the Russian Federation, the installed capacity of biogas and biomass power generating plants in 2020 was to grow by 5.5 times compared to 2012 – up to 7850 Mw. But significant indicators are not yet noticeable, and the participation of biogas energy in the program of surcharges to the price of the wholesale market is difficult due to technological reasons-usually electricity and heat from cogeneration plants are used for their own needs and are not sold to the network, and no real alternatives to this support system are offered. At the same time, in the domestic market there are models of small biogas plants of own production, intended for use in personal subsidiary and farm farms [11, 12].

China is currently a world leader in the introduction of biogas production technology in rural areas. More than 31 million Chinese families have already installed biogas plants in their homes, and this figure continues to grow rapidly, increasing by several million annually. The total output of biogas is 10.2 billion m^3/year (equivalent to 13.5 million tons of fuel), which puts China on a confident first place in the world in this indicator. China is the only country in the world where biogas has been used since ancient times. Data on the first biogas plants in China date back to the beginning of the XVI century BC. Today, the Chinese biogas complex is developing with the direct support of the state. Since 2003, the country has been implementing the "National Program for the Development of Rural Biogas Energy" – a large-scale project designed to increase the number of families using biogas to 40 million. Thus, about 70% of farms use biogas technologies to minimize their costs for heat, electricity and fertilizers. In addition, in 2010 4,000 large biogas plants were built, operating on the basis of animal farm waste, and the share of agricultural enterprises using biogas technologies increased to 80% [7, 12].

The biogas industry is also developing in Kazakhstan, although it cannot yet compete with other areas of renewable energy. Nevertheless, the share of biogas energy in 2019 amounted to 18 million kWh or 0.75% of all RES electricity. This energy was generated by three biogas plants (BGS) with a total capacity of 2.42 MW, which are monitored by the Ministry of Energy of the Republic of Kazakhstan on a quarterly basis. Since this year, this list includes another BGS-Water Resources-Marketing LLP with an installed capacity of 0.4 MW at the sewage treatment plants of Shymkent. Thus, according to the Ministry of Energy, 2.82 MW of biogas capacity will be monitored in 2020. One of those included in the list – a 1 MW biogas station built from railway tanks – belongs to the Karaganda agro-industrial complex "Volynsky" LLP. The raw material for its operation is pig farm waste; the generated electricity supports the operation of the fish shop of the complex. The biogas plant for 0.35 MW of "Karaman-K" LLP is located in the Kostanay region and operates on the waste of a cattle farm; the generated electricity is directed to its own needs. The development of the project and delivery of the equipment of this station was carried out by LLC "Zorg biogas Ukraine". The same supplier provided similar services to Karaganda LLP “Agrofirma Kurma” for the construction of BGS with a capacity of 1.07 MW [2, 3, 10, 22].

3 Results

For the realities of Kazakhstan, taking into account economic and climatic factors, we invented a domestic bioreactor. Next, we will describe its main features and compare it with existing models.

Currently, biogas plants with various design and technological features have been developed. There are industrial and artisanal installations. Industrial installations differ from artisanal ones in the presence of mechanization, heating systems, homogenization, and automation. Types of biogas plants are classified according to the methods of loading raw materials, methods of collecting biogas, materials used for their construction, using of additional devices, the horizontal or vertical location of the reactor, underground or ground construction. Two-stage and one-stage biogas complexes are used. Single-stage technology is used for most substrates and this technology can be considered basic. According to the number of stages of the installation process, there are single-stage, two-stage and multi-stage installations. Single-stage plants consist of a single bioreactor, in which the complete fermentation of biomass takes place. In two-stage systems, the process takes place in the main fermentation bioreactor and in the final fermentation and sludge deposition reactor. Multi-stage systems include a different number of basic fermentation bioreactors and fermentation reactors.

According to the operating mode, continuous, semi-continuous and periodic installations can be distinguished.

Batch plants consist of a single bioreactor, which is fully loaded with the initial substrate, and then completely emptied after a certain process time. In semi-continuous installations, the process of producing biogas takes place in two or more reactors, which operate in turn.

In continuous operation, the substrate is fed into the bioreactor continuously or at short intervals, while the corresponding volume of the fermented substrate is removed. Installations operating in continuous mode are characterized by stability and high performance compared to other modes.

According to the position of the bioreactors are vertical, horizontal and inclined. The choice of location of the reactor depends on the operating mode and the availability of free territory. In our case, we use a bioreactor of a horizontal type, semi-underground location with continuous operation. This bioreactor allows you to save energy on mixing and keep warm in cold weather conditions.

Our bioreactor is made of a ribbed shape, located horizontally and divided into three sections: loading, working and unloading. The working section consists of one or more modules, each of which is equipped with an agitator with a drive and a heat exchanger. In the upper part of each module, a trolley with a drive is mounted on horizontal guides, to which an additional element in the form of a float device is connected (integrated) by means of vertical rods (see Fig. 2).

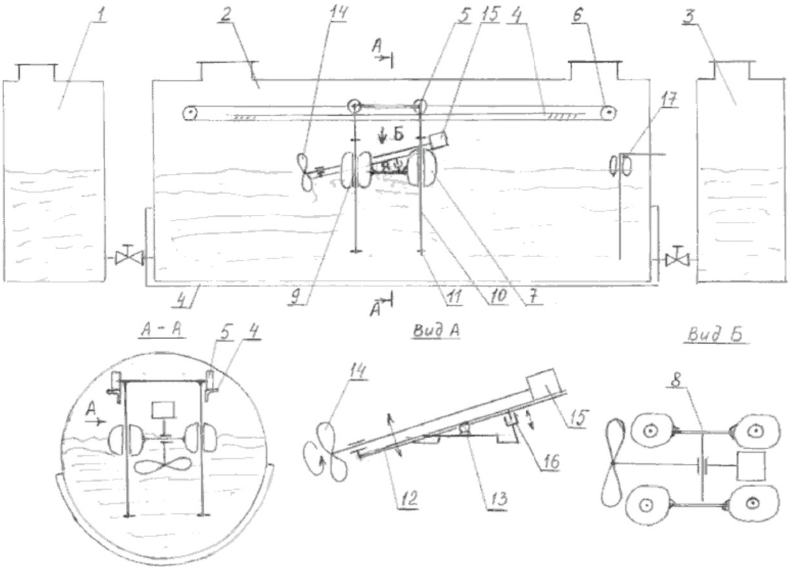


Fig. 1. The bioreactor is a horizontal type with float mixing device in the pneumatic engine that runs on compressed air

Introduction to bioreactor design float device, which is mounted agitator drive with possibility of moving along the bioreactor, and rotation about a horizontal axis in a vertical plane, ensures the achievement of the technical result [4, 6, 21].

Figure 1 shows a bioreactor with a single module: 1 - boot sector; 2 - working sector (module); 3 - unloading sector; 4 - heat exchange jacket; 5 - cart; 6 - wheel drive truck; 7 - float; 8 - horizontal rods; 9 - bushings; 10 - vertical rod; 11 - limiters; 12 - lever; 13 - lever axis; 14 - agitator; 15 - agitator drive; 16 - hydro (pneumatic) cylinder; 17 - level sensor.

The bioreactor consists of three sections: loading 1, working 2 and unloading 3 (Fig. 1).

The working section can consist of several modules. The module in the lower part has a heat exchange jacket 4.

In each module, a trolley 5 with a drive 6 is mounted in its upper inner part. Inside each module, on the surface of the biomass, there is a float device consisting of floats 7 rigidly fastened together by horizontal rods 8, while each float 7 is movably integrated into a vertical rod 10 by means of bushings 9. Vertical rods 10 are provided with limiters 11 for moving floats 7 along the rods.

On the horizontal rods 8 of the float device, a stirrer 14 with a drive 15 is mounted on a lever 12 with an axis 13. The lever 12 is equipped with a hydro (pneumatic) cylinder 16. To control the level of biomass inside each module there is a level sensor 17, electrically connected to the control system of the hydro (pneumatic) cylinder 16.

Mixing of biomass in each module occurs as follows.

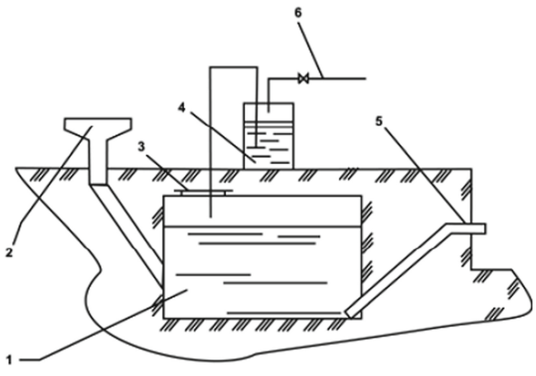
The agitator 14 with a drive 15 mounted on the float device mixes the biomass along the entire length of the module, moving along it by means of a trolley 5, which can be moved, for example, by means of a cable-block drive 6. Vertical rods 10 ensure stable movement of the float device along the module. The limiters 11 do not allow the float device to fall below the critical point at which the agitator could touch the walls of the module.

The angle of rotation of the lever 12 with the agitator 14 placed on it with the drive 15 relative to the horizontal axis 13 is coordinated depending on the level of biomass in the working Sect. 2 by means of a level sensor 17.

4 Discussion

In biogas plants, bioreactors of oval, cylindrical and cubic shape are used. Our bioreactor is a single-stage, cylindrical tank. Cylindrical tanks are much more effective in reducing the energy consumption of mixing, as opposed to oval and cubic, which is confirmed by most laboratory studies.

Also, biogas plants are distinguished by the method of heat supply and the method of mixing. The heat required for the process can be supplied directly or indirectly. For our bioreactor, we use an indirect method, since the direct method is performed directly by supplying hot water or steam under pressure to the fermentation mass. To heat the biomass in this way, it is necessary to install a steam generating system, which leads to additional costs. In addition, when steam or water is supplied, an uneven temperature distribution occurs in the reactor, resulting in overheating of the biomass [3–5].



1-reactor; 2-loading hopper; 3-access hatch to the reactor; 4-water gate; 5-discharge pipe; 6-biogas outlet

Fig. 2. Diagram of the simplest biogas plant with manual loading without mixing and without heating of raw materials in the reactor

The biogas plant (Fig. 2) is designed for small farms. The reactor volume is from 3 to 10 m^3, designed for processing 50–200 kg of manure per day. The plant contains a minimum of components to ensure the processing of manure and the production of biofertilizers and biogas. And it works in a psychophysics temperature range from 5 °C to 20 °C. The biogas produced by the plant is immediately sent for use in gas appliances. The processed mass is removed from the reactor through the discharge pipe at the time of loading the next batch of raw materials or due to the pressure of biogas. The discharged fermented mass enters a temporary storage tank, which must be at least the volume of the reactor [5, 9–11, 20].

5 Conclusion

Thus, the invention makes it possible to improve the quality of mixing of biomass over the entire volume of the bioreactor module, reduce energy consumption for its operation. The bioreactor installation is a horizontal tank, semi-underground type, which allows you to save energy for heating in cold climatic conditions. In addition, a greenhouse can be built over the bioreactor, which allows the production of biogas to use its final products, except for biomethane, such as carbon dioxide and biofertilizers in greenhouse vegetable growing and horticulture. In addition, the use in the bioreactor of the patent invention of a mobile mixing device of the float type, with a pneumatic motor of its own design, gives significant savings in energy consumption during mixing (according to our calculations, up to 60 W at least 40 rpm per 1 m^3 of bioreactor volume, for comparison: the best foreign samples have about 100 W per 1 m^3 of bioreactor volume at the same speed. Our horizontal bioreactor is made of reinforced concrete construction and provides high-quality thermal insulation and uniform mixing of biomass throughout the bioreactor volume, which is very difficult to implement in the best vertical biogas plants in the world. And also to our biogas plant the peristaltic pump and the chopper of own development is applied patents of RK No. 31872 and №33061 [13–15].

The underground location provides for a horizontal bioreactor design due to the obviously lower material costs compared to the low reliability and inefficiency of a low-height vertical design. In addition, according to our preliminary calculations, reinforced concrete construction in Kazakhstan is 1.5–2 times cheaper than steel.

Currently, in many countries of the world, biogas plants with various design features have been created, which operate mainly according to the same scheme. Many of them require the use of thermal energy for heating manure, as well as electricity for mixing and pumping manure. By eliminating the process of heating manure from the outside, the energy intensity of the process and the construction costs of the installation, which is located underground, are reduced.

As a result of the analysis of the market of biogas plants, we have established the following: there are currently no enterprises in Kazakhstan that produce biogas equipment (and even more so complexes). Foreign equipment is very expensive, which cannot afford to buy even relatively large farms (about 1000 heads of k. r. s.). For example, the cost of a biogas complex in the Kostanay region was 400 million tenge [17], that is, more than 1 million US dollars for a farm where there are about 1000 heads of k. r. s. It is important to note that most suppliers of BSU abroad, including the Russian Federation [18], as well as individual entrepreneurs in the Republic of Kazakhstan [19, 21], widely advertise and sell BSU (and expensive, about 1300 US dollars per 1 m^3 of bioreactor), not including such important and necessary equipment for the normal implementation of the technological process as a raw material shredder. Shredders of our development

[22] are effective, practical and inexpensive in comparison with foreign analogues (for example, the German shredder of average productivity has a cost of about 13,000 euros). Also, in most cases, the biogas treatment system and other equipment are not included in the kit. In addition, there are often BGS with inefficient energy consumption of the mixing device (up to 3.4 kW per 1 m^3 of bioreactor volume).

Against this background, the proposed development of a bioreactor seems to be really effective and takes into account the economic and climatic features of the region as much as possible.

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Research on the Uncoordinated Development of Land Urbanization and Population Urbanization

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Abstract. Focusing on the local government's promotion of urbanization, this paper attempts to establish the political economic logic behind the incoordination between the land urbanization and population urbanization in China. By constructing a theoretical framework of political and fiscal incentives, this paper analyzes the process of urbanization promoted by local governments since the reform of the tax-sharing system, and concludes that promoting uncoordinated urbanization is a rational choice under financial and political incentives. The reason why local governments focus more on land urbanization is mainly affected by financial and political incentives. They rationally and strongly pursue economic growth by expansion with land urbanization. On the contrary, there is insufficient investment in population urbanization that cannot promote GDP growth in the short term or demonstrate the performance of local government officials. Therefore, the phenomenon that population urbanization lags behind land urbanization is determined and formed endogenously by local government behaviors under this institutional background.

Keywords: Chinese land urbanization · Population urbanization · Fiscal incentives · Political incentives · Local government behavior

1 Introduction

Since the reform and opening up, especially since the mid-1990s, China's urbanization process has developed rapidly, and urbanization has become a great engine to promote economic growth after industrialization [1]. However, it cannot be ignored that a prominent problem in China's urbanization is that the level of population urbanization lags significantly behind that of land urbanization [2]. According to China Statistical Yearbook, from 1990 to 2000, the expansion rate of land urbanization calculated based on urban built-up areas was 1.71 times the rate of population urbanization calculated based on urban permanent population. The gap further widened to 1.87 times between 2000 and 2012. This development model in which the rate of land urbanization is much faster than that of population urbanization has promoted the increase in government revenue and economic growth in the short term, but it has also brought a series of long-term

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negative effects on Chinese economy. For example, the rapid expansion of land urbanization with land as the core has led to serious waste of land resources and disorderly growth of urban scale [3].

In response to the phenomenon that China's population urbanization lags behind land urbanization, scholars have put forward explanations from different perspectives. For example, Yao Yang and Xie Dongshui considered restricted population flow and government monopoly of land supply to be the reasons of uncoordinated urbanization from the perspectives of household registration system and the land system respectively [4, 5]. However, these views ignore the influence of government behavior, because China's urbanization has an obvious government-led characteristic [6]. In addition, some scholars have put forward the influencing factors of local government behavior on the problem of the incoordination between population and land urbanization. For example, Cai Jiming believed that factors such as current fiscal system, urban-rural land system, and the performance evaluation mechanism of local officials are important reasons for population urbanization lagging behind land urbanization [2]. Li Lixing believed that the land and fiscal motives of local governments interact with their financial pressure to provide social welfare for the agricultural migrant population, resulting in population urbanization lagging behind land urbanization [7]. However, these studies ignore the whole Chinese-style decentralization model, including incentives of fiscal decentralization and political incentives under local government competition [8–10]. Existing literature explains the phenomenon that China's population urbanization lags behind land urbanization from different perspectives. However, it fails to systematically explain the uncoordinated development of land urbanization and population urbanization. Thus, this paper will analyze from the perspectives of both financial incentives and political incentives.

In order to provide a logically consistent theoretical framework for understanding the imbalance between land urbanization and population urbanization (Fig. 1), this paper first attempts to discuss the influencing factors of land system and household registration system on the uncoordinated development of land and population urbanization from the external institutional reasons. Then, it discusses the reasons why local governments pay more attention on land urbanization while ignoring promote population urbanization from the internal incentives affecting local officials. Focusing on the motives of local officials to promote uncoordinated urbanization, this paper believes that China's urbanization is largely driven by local governments under the direct influence of financial and political incentive mechanisms. This is because the promotion of land urbanization can greatly increase the fiscal revenue of local governments, promote rapid economic growth and improve political performance, while promoting population urbanization will increase the financial burden of local governments, and increase labor costs in cities, affecting regional economic growth and local officials' performance. Therefore, local governments have a strong motivation to promote uncoordinated urbanization.

This paper is structured as follows. The second part discusses the land system and household registration system from the perspective of external institutions. The third part discusses internal incentives and focuses on the impact of financial and political incentives on local government behavior.

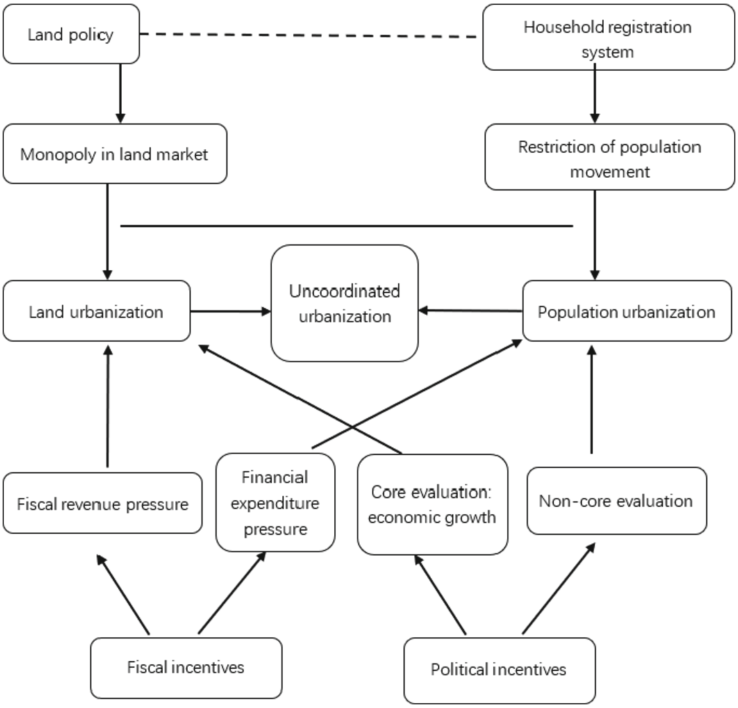

Fig. 1. Analytical framework of uncoordinated urbanization.

2 Current Situation of Population Urbanization and Land Urbanization

At present, China's land urbanization and population urbanization are seriously uncoordinated. Commonly used methods are single-factor method and comprehensive-factor method. Among them, the former mostly conduct measurement according to the growth elasticity coefficient of urban land scale. This indicator compares the ratio of urban land growth rate to urban population growth rate, and uses 1.12 as the dividing point. When the ratio is larger than 1.12, it indicates that land urbanization is faster than population urbanization. As shown in Fig. 2, the growth rate of urban built-up areas is always higher than that of urban population except for few years. In the 13 years investigated, the elasticity coefficient of 11 years is larger than 1.12, indicating that land urbanization and population urbanization are uncoordinated. The objectively existing uncoordinated development of population and land has also caused a series of social problems. For example, serious secondary problems are caused by the fact that non-permanent urban migration is not conducive to the promotion of domestic demand and the improvement of the service industry. Uncoordinated urbanization of land and population has become an important obstacle to expanding domestic demand, and the limitations of land resources and the characteristics of land income make land finance unsustainable [4].

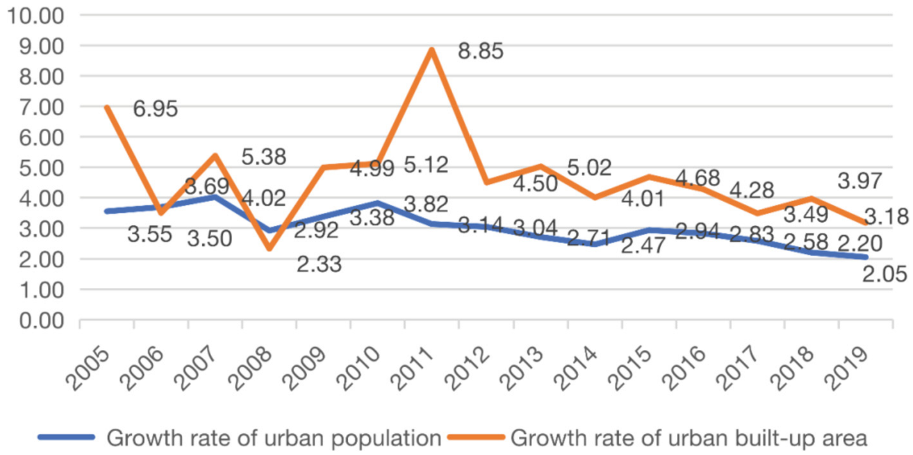

Fig. 2. Fluctuation of urban land growth rate and urban population growth rate.

3 Influencing Mechanism of Population Urbanization and Land Urbanization

In order to further analyze the reasons for the incoordination, this section focuses on the analysis of the external system that contributed to the uncoordinated urbanization, namely the household registration system and the land system.

3.1 External Institutional Factors – Dual Household Registration System and the Land System

Land and household registration systems are often considered as together causing the uncoordinated development of land urbanization and population urbanization. Household registration control can explain the lagging development of population urbanization because it restricts the transfer of rural population to urban areas. The household registration system is closely related to people's lives. It brings not only the difference in identity, but more importantly, different social welfare and rights. There is a big difference between different household registration status, from medical insurance, labor and employment to housing subsidies, and to college enrollment, retirement and pension [4]. Therefore, the reason of strict control of urban household registration is the uneven social services. The land system is also often considered to be the cause of the incoordination between population urbanization and land urbanization, because agricultural land expropriation and use systems have different economic effects on urbanization [11]. The expropriation system gives land expropriation a government attribute, while land transfer is a market attribute. Therefore, the difference between the two behaviors allows the government to obtain a larger benefit in land expropriation, leading to the rapid expansion of land urbanization. Specifically, land expropriation compensation is based on the income generated by the original use of the land, rely on the principle of using several times of the annual output value of the land as the calculation basis of compensation, and does not consider the market value of the land. However, land transfer is based on the market value. Therefore, when local government faces financial pressure, it mainly uses various channels to make the land a real source of wealth.

However, although the combination of these two external systems led to the uncoordinated development of land urbanization and population urbanization, these systems failed to explain local governments' motives for the actual implementation of this difference. Therefore, scholars such as Xiong Chai, Gao Hong believe that the dual land system and household registration system are the direct causes to the contradiction in between, but the underlying cause is the behavior of local officials [6]. Local governments are the actual executor of urbanization, that is to say, urbanization is a process of institutional change promoted by the local government, and the land system and the household registration system are only tools used by local governments in this process. The maximization of interests is the code of conduct of local governments. Thus, studying the behaviors and motives of local governments is the key to understanding this contradiction.

3.2 Internal Incentives

Fiscal incentives. After the tax-sharing reform in 1994, fiscal incentives faced by local governments have always been regarded as a key factor in increasing the incoordination between land and population urbanization. To put it simply, after the 1994 tax-sharing reform, fiscal revenues were centralized to the central government, but the actual powers were not properly adjusted, which made local governments' fiscal revenue cannot cover the expenditure. The transfer payment system that balances the gap in local governments' financial resources is not comprehensive. Facing the fiscal incentives, local governments therefore resort to filling the vacancy with land transfer, which is one of the important reasons for the seriousness of land expropriation.

After the 1994 reform, the central government collects the fiscal power but delegates administrative power to local governments. The proportion of local government revenues dropped significantly, and that of expenditures rose sharply. The degree of mismatch between the central government's fiscal power and administrative power had an increasing trend (as shown in Fig. 3 and Fig. 4). As of 2019, the general public budget of the central government was 3.5 trillion yuan, and that of local governments was 20.4 trillion yuan. The central and local government fiscal expenditures accounted for 14.7% and 85.3% respectively and their fiscal revenues accounted for 47% and 53% respectively. The contradiction between central and local fiscal power and administrative power is prominent.

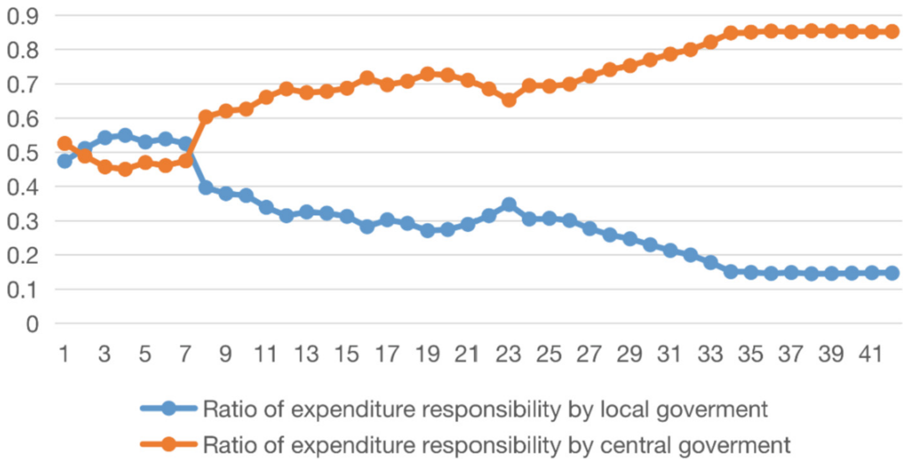

Fig. 3. Fiscal expenditure rates of central and local governments from 1978 to 2019

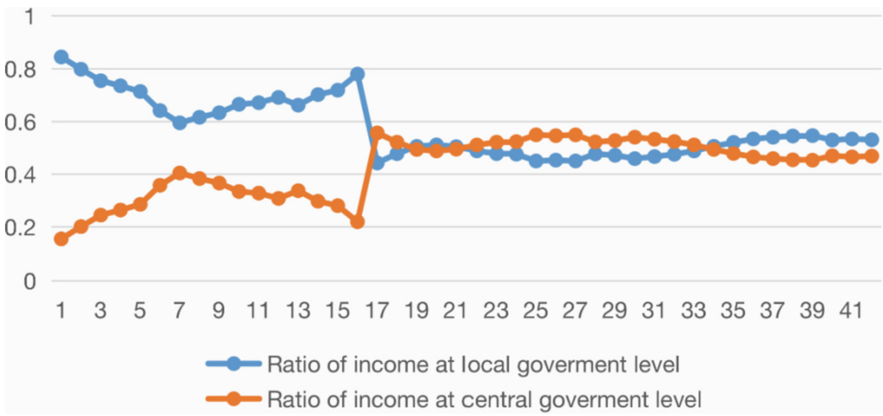

Fig. 4. Fiscal revenue rates of central and local governments from 1978 to 2019 (%).

In addition, an important research perspective is to analyze income and expenditure separately, because they reflect the opposite characteristics. From the perspective of fiscal revenue distribution, the tax-sharing system is undoubtedly a "centralized" reform, because 75% of the increase in value-added tax, the main tax collected by the local government, is concentrated in the central government. The tremendous change in the proportion of central and local fiscal revenues after the tax-sharing system also clearly illustrates the intensity of fiscal revenue concentration. However, from the perspective of fiscal expenditures, the decentralization of fiscal expenditures among central and local governments has not undergone such great changes due to the tax-sharing system, and has continued to increase. This result undoubtedly increased local financial pressure. This institutional pressure pushes local governments to seek new sources for increasing local fiscal revenue.

(1) **From the perspective of fiscal revenue concentration.** From the perspective of the high degree of centralization of fiscal revenue, the concentration of revenue increases the pressure on local governments' expenditures, and promotes local governments to seek land as a channel to relieve pressure. Some scholars, such as Zhou Feizhou and Xie Dongshui, believed that as the main body of interest formed under the fiscal responsibility system that pursues fiscal revenue growth, local governments do not weaken this awareness after the tax-sharing system, but greatly strengthened it under the expenditure pressure [5, 12]. Therefore, for local governments, the urgent problem is how to find new and discretionary fiscal revenue to ease the pressure on expenditure. As an extra-budgetary income, the land transfer fee will all be retained in local finance, and local governments have strong incentives to earn the price difference through land grant. Therefore, coupled with the existence of the land system, the government's monopoly position in the land market also enables it to requisite agricultural land at a low cost and sell it at market price to obtain great income from land transfer.

An important phenomenon after the tax-sharing system is that the growth mode of local governments' fiscal revenue has undergone a significant change, that is, relying on corporate taxation in the past has changed to relying on other taxes, especially business taxes. Unlike value-added tax, business tax is mainly a tax levied on the construction industry and the tertiary industry, of which the former is the largest consumer of business tax. Therefore, it is logical for local governments to focus on the development of the construction industry. Secondly, in addition to the changes in local fiscal development patterns brought about by the structural adjustment of budgetary fiscal revenues, the reform of the tax-sharing system also has a great impact on the extra-budgetary and non-budgetary revenues of local governments. After the reform of the tax-sharing system, the central government issued a series of reforms for extra-budgetary funds in an effort to incorporate administrative fees into the budget for more standardized management. However, there has been no proper management for non-budgetary funds. So, non-budgetary funds, especially the land transfer revenue, have begun to become the main method for fiscal growth that local governments rely on. Therefore, the pressure on local governments from the tax-sharing system and income tax-sharing reforms has forced local governments to seek other ways to make money by developing the construction industry and increasing extra-budgetary items and non-budgetary funds. Taking Shaoxing County in Shaoxing City as an example, the proportion of indirect and direct taxes on land in the local budgetary revenue increased from 30.5% in 2001 to 38.4% in 2003. More than 1/3 of Shaoxing County's budgetary revenue are taxes from land [12]. At the same time, land-related income accounts for the main part of extra-budgetary finance. In Shaoxing County, both budgetary and extra-budgetary land revenue are of great significance, and land revenue is undoubtedly the pillar of local finance.

(2) **From the perspective of fiscal expenditure decentralization.** Contrary to the high concentration of fiscal revenues pursued by local governments under the tax-sharing system, China has implemented a high degree of decentralization for local governments in terms of fiscal expenditures. In the absence of revenue, local governments