

Ecological Development of Industrial Clusters of Biomass Energy and Chemical Industry Bases in the Yellow River Eco-town

Na Guan^{a,*}, Zhanchi Shao^b, Jiansheng Xin^a

^aXi'an Technological University North Institute Of Information Engineering, Xi'an 710200, China

^bPower China Northwest Engineering Corporation Limited, Xi'an 710065, China
naguansun372@21cn.com

This paper studies the industry of biomass energy chemical base in the ecological towns along the Yellow River based on the ecological concept of modern urban development and in order to deepen the understanding of the development of ecological towns of the Yellow River. In order to understand the characteristics of cluster ecological development, this paper mainly studies the present situation of industrial cluster of biomass energy chemical base in ecological towns along the yellow river on the basis of industrial cluster theory and equipment manufacturing theory so that the development stage of the industry can be fully understood. Through the research results, we can effectively understand the development stage of the industry so as to improve the deficiencies.

1. Introduction

Based on the industrial background of biomass energy chemical base in ecological towns along the Yellow River, this paper studies the energy supply in China. The operation of modern society has great demands for all kinds of energy. Under this premise, with the increasing demand of social operation, the traditional energy supply is beginning to be stretched. In order to supply energy and keep up with the demand of society and even meet the demand of future development, many modern energy chemical bases begin cluster development to realize more efficient energy production and increased the output capacity of the energy supply.

In order to understand the chemical industry of energy ecological cluster development, this paper adopts the research frame of the empirical analysis method. This paper includes two parts: the theory research and the experience research, which are interlinked and mutually supportive, and analyses the resource-based industry clusters by the combination of the normative research and the empirical research, and the qualitative research and the quantitative research.

2. Literature review

The industrial clusters literature has shaped contemporary thinking on the potential of small firms to become globally competitive through agglomeration gains and collective action (Yoon and Nadvi, 2018). E Giuliani's paper addressed the critical gap by integrating the industrial cluster and industrial ecology frameworks. It analyses case evidence from the Banwol-Sihwa textiles dyeing cluster in South Korea to show that 'eco-collective efficiency' is achievable through cluster-based collective action. We argued that cluster firms' adoption of CSR policies, often indiscriminately imposed by global buyers, should be differentiated from firms' actual human rights practices. Based on this distinction, we elaborate a typology of industrial clusters (low-road, window-dressing, rights-oriented) and identify a set of factors likely to influence their practice. Against this background, we discuss an agenda for future research and elaborate on the potential methodological intricacies related to research on the interface between industrial clusters and human rights (Giuliani, 2016). The burgeoning literature on global value chains (GVCs) has recast our understanding of how industrial

clusters are shaped by their ties to the international economy, but within this context, the role played by corporate social responsibility (CSR) continues to evolve. New research in the past decade allows us to better understand how CSR is linked to industrial clusters and GVCs. With geographic production and trade patterns in many industries becoming concentrated in the global South, lead firms in GVCs have been under growing pressure to link economic and social upgrading in more integrated forms of CSR. This is leading to a confluence of “private governance” (corporate codes of conduct and monitoring), “social governance” (civil society pressure on business from labour organizations and non-governmental organizations), and “public governance” (government policies to support gains by labour groups and environmental activists). This new form of “synergistic governance” is illustrated with evidence from recent studies of GVCs and industrial clusters, as well as advances in theorizing about new patterns of governance in GVCs and clusters. (Gereffi and Lee, 2016). Mueller, E. F.’s study examines how contextual, structural and functioning characteristics of industrial clusters influence their effectiveness. They develop a conceptual framework that identifies potential influencing factors, validate the factors statistically, and estimate the factors’ impact on cluster effectiveness. The results show that among the important determinants of cluster effectiveness are long-term planning security and procedural trust among the cooperating firms (contextual conditions), formalized rules and sustainable structures (structural elements), and clear goals and tasks (functioning characteristics) (Mueller and Jungwirth, 2016).

Kumar, A. et al. discussed biomass energy resource, its potential, energy conversion and policy for promotion implemented by Government of India. The study reveals that India has large potential for bio mass feed stock from different sources. Government of India deployed different policies and executed that the strategies for biomass power generation. Such approaches have included the whole biomass energy sector which incorporated the bio gas, bio diesel etc. in the policies. Government of India has focused on the deployment and development biomass energy sector with strategic policy and program which is notable portion of this review paper (Kumar et al., 2015). Bilgili, F. et al revealed the long run dynamics of biomass energy consumption and GDP growth through homogeneous and heterogeneous variance structures for G7 countries. The results confirmed the growth hypothesis in which biomass energy consumption have positive effects on economic growth of G7 countries. As a policy implication, energy policies which improve the biomass energy infrastructure and biomass supply are the appropriate options for G7 countries since biomass energy consumption increases the economic growth (Bilgili and Ozturk, 2015). India has a huge potential of biomass resources to reduce the dependence on fossil fuels and to produce electrical and heat energy. As part of furthering the development of biomass technology, it is essential to understand the environmental merits and demerits of biomass. It also aims to increase the use of biomass energy for domestic purposes. The interest behind the review is boosted by the rapid development of biomass conversion techniques and continual increase of biomass energy generation (Herbert and Krishnan, 2016). The potential of biomass energy in Sabah, Malaysia was analysed by data which was established from literature, statistic data and available documents for estimating the potential of biomass energy derived from oil palm, coconut shell, rice, livestock and forest. Nowadays, the issue of solid biomass residues including effluent from the palm oil milling process has become a big concern for the industry and the public in Sabah, because oil palm residues provide a huge potential of biomass energy in Sabah. Their paper showed that biomass energy potential in Sabah was around 267,179,818 GJ/year in total, which was derived from oil palm EFB, shell, OPF (oil palm frond), OPT (oil palm trunk), coconut shell, rice, livestock and forest. Potential of biomass energy from oil palm, coconut shell, rice, livestock and forest was 263,635,079 GJ/year, 95,713 GJ/year, 710,028 GJ/year, 750,696 GJ/year and 1,988,301 GJ/year, respectively. Most biomass energy came from oil palm, which was around 98.7% of total potential. If this total energy potential is applied at a power plant with efficiency ratio of 25% and 8000 h per year of operation, this has potential of 2,288 MW, which is equivalent to around 3.8 times of total supply of electricity in 2010 in Sabah. Their paper also suggests that relevant policy and innovative technology be developed based on the result to effectively utilize biomass (Suzuki et al., 2017).

3. Methodology

3.1 Combination of the normative research and the empirical research

In the process of studying resource-based industrial clusters, firstly, through analysing the relevant literature, comparing the characteristics of resource-based industrial clusters, scientifically defining the connotation of resource-based industrial clusters, inducing and analysing their typical characteristics, motive factors and relations among each factor, the study develops a dynamic mechanism, life cycle, upgrading transformation and competitiveness of resource-based industrial clusters. In addition to these theoretical studies, this study has purposely selected resource-based industrial clusters to carry out empirical research and comparative research, in order to enhance the reliability of the research conclusions and the operability of policy recommendations.

3.2 Combination of the qualitative research and the quantitative research

In constructing the model, the characteristics of this research are to combine the qualitative analysis method with the quantitative statistics method. In studying resource-based industry clusters, dynamic mechanism and its characteristics, the study mainly uses the qualitative research methods such as literature review and logic deduction to identify the life cycle model of resource-based industry cluster, while in upgrading the transition path, it uses the quantitative method such as system dynamics to describe the evaluation system of resource-based industry cluster competitiveness. In the whole process of the study, the combination degree of various methods is higher.

3.3 Other conventional methods

Methods including questionnaire survey, statistical analysis and comparison have been applied to some extent in this study in order to establish stronger empirical support. The technical route is shown in Figure 1.

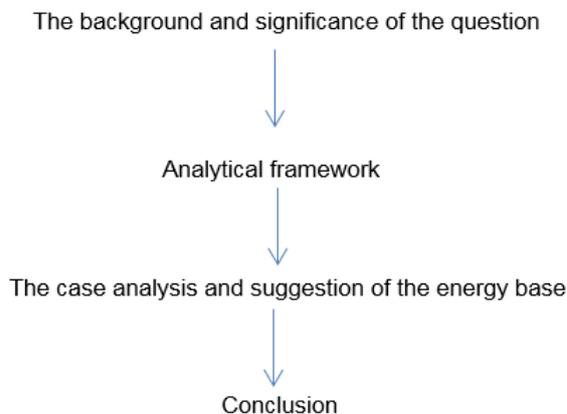


Figure 1: Technical route

3.4 Knowledge and research on resources in modern economics

In theory, the scarcity of resources is regarded as a basic assumption of economic development. Whether from the perspective of microeconomics, macroeconomics or development economics, they all think that resources are scarce. In the process of economic development, the problem of resource consumption becomes more and more prominent, and the scarcity of resources becomes more and more serious. The modern economic growth is no longer under the condition of abundant resources, but in the environment of increasingly scarce resources. Therefore, all resources including natural resources are scarce, and the scarcity of resources has become a basic assumption for the study of economic growth and economic development. This has become the consensus of economists and the starting point of research.

3.5 Related theories of industrial cluster research

In fact, the researches on industrial clusters have been carried out a long time ago. The well-known theories are shown in Table 1:

Table 1: Related theories of industrial cluster research

| Name | character | Time |
|--|--------------|-----------|
| External economic theory | Marshall | 1920years |
| The theory of location aggregation in the industry | weber | 1910years |
| Industrial Zone Theory | paul krugman | 1990years |

At the same time of introducing the theory of industrial clusters in the domestic theory circle, this paper makes some localized explanation to the concept of industrial clusters in combination with China's reality. The main

points of view are shown in Tables 2 and 3, which show that industrial clusters, as a typical economic phenomenon, have attracted wide attention from different disciplines. Due to the different backgrounds and angles of studying industrial clusters, the theories related to industrial clusters coexist in many aspects. Therefore, based on different angles, different scholars define the concept of industrial clusters from different focal points, but from the point of view of domestic and foreign scholars, the common point is that industrial cluster is not only a simple cluster of enterprises, but also a grounded complex network system.

Table 2: The concept of foreign cluster

| character | Time | concept |
|-----------|------|---|
| Porter | 1998 | The geographical concentration of related enterprises and institutions in a particular region, from a series of phases Associated enterprises and other entities that have an important impact on competition. |
| Feser | 1998 | The economic cluster refers not only to the related and supportive industries and institutions, but also to that. Some related and supportive institutions that are more competitive because of relevance. |
| Enight | 1996 | A regional cluster is an industrial cluster in which members are closely linked with each other. Poly. |

Table 3: The concept of cluster in China

| Angle of view of theory | author | Conceptions |
|---|--------------|--|
| Industrial cluster is a new form of industrial organization | Qiu | Small enterprise clusters are small businesses that are independent and independent of each other. |
| | Rui | SME cluster refers to the combination of small and medium-sized enterprises formed by information sharing and personnel interaction. It is a new system of enterprise and industrial organization. |
| Industrial cluster is a regional enterprise network | Shyh-Bao Lai | The relationship is not necessarily maintained by a contract, and the commitment is equally valid. |

3.6 Development mode of industrial clusters

The generation mechanism of industrial clusters has obvious regional characteristics. According to the generation mechanism of industrial clusters, the industrial clusters are generally divided into three types: endogenous traditional type, endogenous brand type and investment type, as shown in Table 4.

Table 4: Model of three types of industrial clusters

| Name | Cause an inducement | formation mechanism |
|------------------------------|--------------------------|----------------------------|
| Endogenetic traditional type | Traditional accumulation | Blood related relationship |
| Endogenetic brand | Brand enterprise | brand effect |
| Investment type | Investment | Colony chain replication |

The development models of these industrial clusters have different life cycles. For details, see Figure 2:

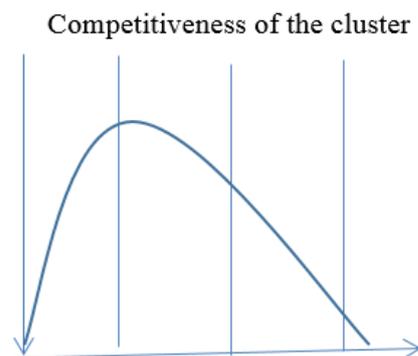


Figure 2: The relationship between the life cycle and the competitiveness of the industrial cluster

Many scholars divide the industrial clusters into three stages: birth, development and decline, and analyze the causes of cluster disintegration. He pointed out that after the emergence of the cluster, it's in dynamic evolution, and may lose competitiveness due to external threats such as technological discontinuities and changes in consumer demand, and internal rigidity due to excessive merger, cartel, cluster thinking to suppress innovation and so on.

4. Results and analysis

The so-called cluster environment refers to the environmental support system consisting of external environmental factors which can help to solve the problems of "market failure" and "system failure" and promote the sustainable development of industrial clusters. Cluster environment includes cluster policies of explicit formal institutional arrangements, such as mandatory policies and regulations, and concept of development, as well as implicit informal institutional arrangements such as culture.

The cluster environment has the following three salient features:

First, it has the duality of identity. The cluster environment includes the explicit cluster environment and the implicit cluster environment. The explicit cluster environment including cluster development strategy, industrial policy and other rigid policies while implicit cluster environment mainly refers to cultivating advanced cluster culture based on regional culture. The explicit cluster environment and the implicit cluster environment combine with each other to form a cluster environment system. As an external variable of cluster development, cluster environment provides a good external environment guarantee for dynamic mechanism of resource-based industry cluster; as an endogenous variable of cluster development, cluster environment is also a subsystem of dynamic mechanism of cluster development, which forms a dynamic complex system of cluster development together with the endogenous dynamic mechanism subsystem, promoting the sustainable development of resource-based industry cluster system in a better and fast way.

Second, it has a distinctive industrial feature. Based on the exploitation and utilization of non-renewable natural resources, resource-based industrial clusters have distinct characteristics of resources and resource industries, such as distinct life cycle, great influence on regional economic and social development, and being more closely related to ecological environment. Compared with technology-based industrial clusters and processing-based industrial clusters, the environment of resource-based industrial clusters has more distinct characteristics of resource industry.

Third, it has distinct dynamic characteristics. Resource-based industrial clusters have distinct life cycle, and the dynamic mechanism of clusters in different life cycle stages has their own emphasis. Therefore, the cluster environments supporting the dynamic mechanism of clusters are different in different life cycle stages. In the birth stage of resource-based industrial cluster, the dynamic mechanism of clusters mainly comes from the transformation of resources, the cluster environment often has the characteristics of traditional industry policy with focus on generally providing tax, subsidy, transportation, communication, infrastructure and other preferential conditions for the cluster, reducing the business cost of clusters, attracting the enterprise clusters, promoting the division of labor and specialization of enterprises, and foster various driving forces for cluster development.

5. Conclusions and prospects

5.1 Research conclusions

Resource-based industrial cluster is a dynamic complex adaptive system, and the dynamic mechanism is the core problem of resource-based industrial cluster. The dynamic mechanism of so-called resource-based industry clusters refers to a strongly grounded process of self-organization, which is coupled by enterprises, entrepreneurs, scientific research institutes, intermediary agencies, government, culture and other systems under the strict restriction of resources, ecological environment and so on. The interaction of the main factors in the resource-based industrial clusters realizes the coupling of the endogenous power and the exogenous power of the clusters, which makes the clusters emerge into a self-organization with strong grounding. The formal system and the informal system constitute the external environment of the cluster. The external environment is the external cause of the dynamic mechanism of the cluster. It plays a role in the evolution of the cluster through the emergence of the network of each main body in cluster as the internal cause.

5.2 Prospects

Although this paper describes the operation mode of the dynamic mechanism of resource-based industry clusters, it's necessary to carry out further standardized research on the evolution mechanism of resource-based industrial clusters due to lack of the detailed description and simulation of mathematical method. In addition, the upgrading and transformation of resource-based industrial clusters run through all stages of the life cycle. Although innovation is its core problem, the innovation mechanism and upgrading conditions in different stages are different and need to be further studied. The evaluation system of resource-based industrial cluster competitiveness needs to be further improved.

References

- Bilgili F., Ozturk I. 2015, Biomass energy and economic growth nexus in G7 countries: Evidence from dynamic panel data, *Renewable and Sustainable Energy Reviews*, 49, 132-138, DOI: 10.1016/j.rser.2015.04.098
- Gereffi G, Lee J. 2016, Economic and social upgrading in global value chains and industrial clusters: Why governance matters, *Journal of Business Ethics*, 133(1): 25-38, DOI: 10.1007/s10551-014-2373-7.
- Giuliani E. 2016, Human rights and corporate social responsibility in developing countries' industrial clusters, *Journal of Business Ethics*, 133(1), 39-54, DOI: 10.4324/9780203815557.
- Herbert G.J., Krishnan A.U. 2016, Quantifying environmental performance of biomass energy, *Renewable and Sustainable Energy Reviews*, 59, 292-308, DOI: 10.1016/j.rser.2015.12.254.
- Kumar A., Kumar N., Baredar P., Shukla A. 2015, A review on biomass energy resources, potential, conversion and policy in India, *Renewable and Sustainable Energy Reviews*, 45, 530-539, DOI: 10.1016/j.rser.2015.02.007.
- Mueller E.F., Jungwirth C. 2016, What drives the effectiveness of industrial clusters? Exploring the impact of contextual, structural and functioning determinants, *Entrepreneurship and Regional Development*, 28(5-6), 424-447, DOI: 10.1080/08985626.2016.1186748.
- Suzuki K., Tsuji N., Shirai Y., Hassan M.A., Osaki M. 2017, Evaluation of biomass energy potential towards achieving sustainability in biomass energy utilization in Sabah, Malaysia, *Biomass and Bioenergy*, 97, 149-154, DOI: 10.1016/j.biombioe.2016.12.023.
- Yoon Y., Nadvi K. 2018, Industrial clusters and industrial ecology: Building 'eco-collective efficiency' in a South Korean cluster, *Geoforum*, 90, 159-173, DOI: 10.1016/j.geoforum.2018.01.013.