Kuram ve Uygulamada Eğitim Yönetimi
Educational Administration: Theory and Practice
2023, Cilt 29, Sayı 1, ss: 245-252
2023, Volume 29, Issue 1, pp: 245-252
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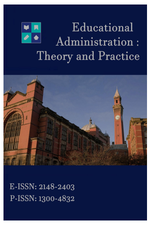

Study on Carbon Emission Strategies of Rural Land Consolidation from the Perspective of Sustainable Energy Development

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	Abstract
Article History ***Article Submission*** 08 November 2022 ***Revised Submission*** 01 January 2023 ***Article Accepted*** 30 January 2023	At present, China's rural land use change and remediation is one of the most important sources of carbon emissions in China's atmospheric environment, which has a special impact on China's natural environment change. In order to effectively analyze China's rural land consolidation carbon emissions strategies and reduce environmental pollution, this paper demonstrates and analyzes the development relationship between China's energy and low carbon economy from the perspective of industrial development, and then leads to China's rural land consolidation carbon emissions. In view of the limitations of the current carbon emission statistical research work, a new analytical model for evaluating the carbon emission structure of rural land consolidation was constructed, including the carbon dioxide assessment algorithm for fossil fuel consumption and the carbon emission analysis method for rural land consolidation, the basic data sorting calculation and the analysis of the carbon emission structure of rural land consolidation, and the carbon emission status of rural land consolidation was reconstructed.From the perspective of industry development, this study firstly argues and analyzes the development relationship between energy and low carbon economy in China, which leads to the issue of carbon emission from rural land consolidation in China **Keywords:** Sustainable Development; Rural Land Consolidation; Carbon Emission Strategy

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Introduction

Fossil fuels of China and the latest assessment report of the Committee on Climate Change (IPCC) pointed out that the current rural land use change as well as rectification in China is one of the most China's important sources of atmospheric environmental carbon emissions and has a special impact on the natural environmental changes in China (Wei, Li & Chao, 2016). In recent years, a large number of scholars in China have conducted various studies on energy consumption and carbon emissions from rural land finishing, including carbon cycle simulation and carbon sequestration simulation. The research theories have precise plans from global carbon emission development to the actual carbon emission of each township. Among them, the carbon emission effect of land consolidation in rural areas has been one of the weak points of the research. Experts in related environmental fields prefer the study of carbon emission technologies as well as sustainable development strategies, and ignore the importance of carbon emission effects under rural land consolidation. According to the precise calculations of Wang Changbo et al. (2020), carbon dioxide emissions from rural energy consumption in China will reach about 45% to 57% of the national proportion, and carbon emissions from rural energy consumption will remain at a high level for a long time, so research on rural carbon emissions and emission reduction should be the focus of the national sustainable development strategy. In the current situation, the study of carbon emission statistics under rural land consolidation relies to a large extent on household surveys and statistical reports from relevant departments of rural governments, including real-time consumption data, which has a certain lag and can hardly reflect the latest situation of carbon emission activities. Land preparation itself also affects soil balance, because the process of land preparation inevitably destroys the physical and chemical structure of soil while increasing carbon sinks, which further increases atmospheric carbon emissions. Since the current development theories rarely analyze land carbon emission collation from the perspective of sustainable development and energy consumption, this paper constructs a complete structural analysis model of land collation carbon emission from the relationship between low carbon economy and energy, and proposes future development suggestions for land collation and carbon emission, aiming to reduce the carbon emission of rural energy consumption and maintain rural ecological environment (Ding, 2015). In order to effectively analyze China's rural land consolidation carbon emissions strategies and reduce environmental pollution, this paper demonstrates and analyzes the development relationship between China's energy and low carbon economy from the perspective of industrial development, and then leads to China's rural land consolidation carbon emissions

Literature Review

Low carbon economy is a new way of economic development proposed by people to improve the security of energy applications under economic development in the face of global climate problems (Shang, Wu & Tian, 2014). At present, the massive application of energy by humans has led to global climate anomalies (Yang, 2014). In the face of climate change, the control of energy carbon emissions is the focus and the curative strategy. In terms of the relationship between low-carbon economy and energy development, the so-called low-carbon economy is an economic development approach that is based on the efficient use of energy, and solves the problem of carbon emissions without hindering development, as well as focuses more on economic development, changes in consumption patterns and energy emission needs than the traditional environmental protection economic development model, rather than simply reducing carbon emissions by reducing energy use and hindering economic development. The ultimate goal of low-carbon economy is to promote low-carbon development model, including low-carbon technology, low carbon industry development and application, as well as from the basis to rise to the social industrial economic development and energy consumption pattern reform, under the premise of sustainable development, through detailed data theoretical analysis, standard institutional framework and suitable policy impact, to promote the whole economy and society to high development, high application and low energy consumption model transformation. A Low-carbon economy needs to guarantee the stability of the relationship between itself and energy application because economic development needs to be combined with environmental protection, and the essence of a low-carbon economy in the new period is to improve the efficiency of energy application through technological innovation, and finally achieve sustainable social and economic development (Yu & Yang, 2012; Yang & Cao, 2019).

The stability of energy has an important impact on the country's economic prosperity, and a low-carbon energy application system can not only effectively reduce environmental pollution, but also improve the safety of energy applications. In the face of decreasing non-renewable energy and increasing overall energy demand, China needs to continuously promote the rate of low-carbon economic development. After entering the 21st century, China's industrialization and urbanization development process has been accelerating, and the energy demand has been increasing, the issue of energy application and sustainable development has become the most core strategic issue at the national development level in China. From the distribution of energy applications, the proportion of urban and rural energy applications in China is similar, and the types of applications include coal, oil, natural gas, etc., which are the core components of greenhouse gases. And China is a large economic and demographic country, so one can imagine what significance it has for China and the world to continuously deepen the research on low carbon economy and promote the country to move towards a low-carbon development model. In this regard, it is necessary to construct a suitable carbon emission analysis model based on a detailed demonstration of the relationship between low-carbon economy and energy, to evaluate and analyze the quantitative structure of carbon emission in detail, and to make a corresponding decision.

Methodology

Collation of basic data

To effectively analyze and organize the carbon emission strategy of rural land and construct a complete assessment model, we need the support of basic data. The data of this study are all from relevant agricultural land preparation projects, including China's Statistical Yearbook and the relevant data from the IPCC Guidelines for National Greenhouse Gas Inventories. Some of the data were obtained from land preparation project planning forms and feasibility study reports, project budgeting forms, corresponding consumption data, and so on (Guo & Zou, 2020).

Carbon dioxide assessment of fossil fuel consumption

Most of the rural agricultural land preparation uses fossil fuel consumption, and to save carbon emissions need to first construct a fossil fuel carbon dioxide emission assessment model. Most of the analyses applied at this stage in China are material model algorithms, which can effectively analyze carbon dioxide from fossil fuel consumption, but have more estimation data and are more computationally intensive, so they are not recommended in the assessment of environmental development in large quantities. The current study improves on the original method and constructs a new trading strategy with the following model equation：

$$C=\sum_{i=1}^{m}A_i\times B_i \qquad (1)$$

$$A_i=\sum_{j=1}^{n}U_{ij}\times Q_j \qquad (2)$$

In the above equation: C indicates the target of this assessment, that is, the total carbon dioxide emissions, while A_i indicates the current carbon emission consumption of the material, B_i indicates the carbon dioxide emission factor of the main fuel, U_{ij} indicates the total carbon emission unit consumption of the project, and Q_j indicates the project carbon emission of the project.

Combining the standard types of materials consumed in rural land preparation projects in China and relevant data and information, the carbon emission coefficients of specific land preparation materials such as steel, cement, electricity and fossil fuels can be deduced as shown in Table 1 and Figure 1.

Table 1. Carbon source emission factors for land preparation

Main materials	**Carbon dioxide emission factor**
Steel	0.235t/t
Main materials	**Carbon dioxide emission factor**
Cement	0.887 t/t
Electricity	1.305t/MW·h
Coal	1.9779g/kg
Crude Oil	3.067 g/kg
Gasoline	3.155 g/kg
Kerosene	3.120 g/kg
Diesel	3.110 g/kg
Fuel Oil	3.250 g/kg
Natural Gas	2.184m3

Note: CO2 emission factors are calculated based on relevant data in 2021

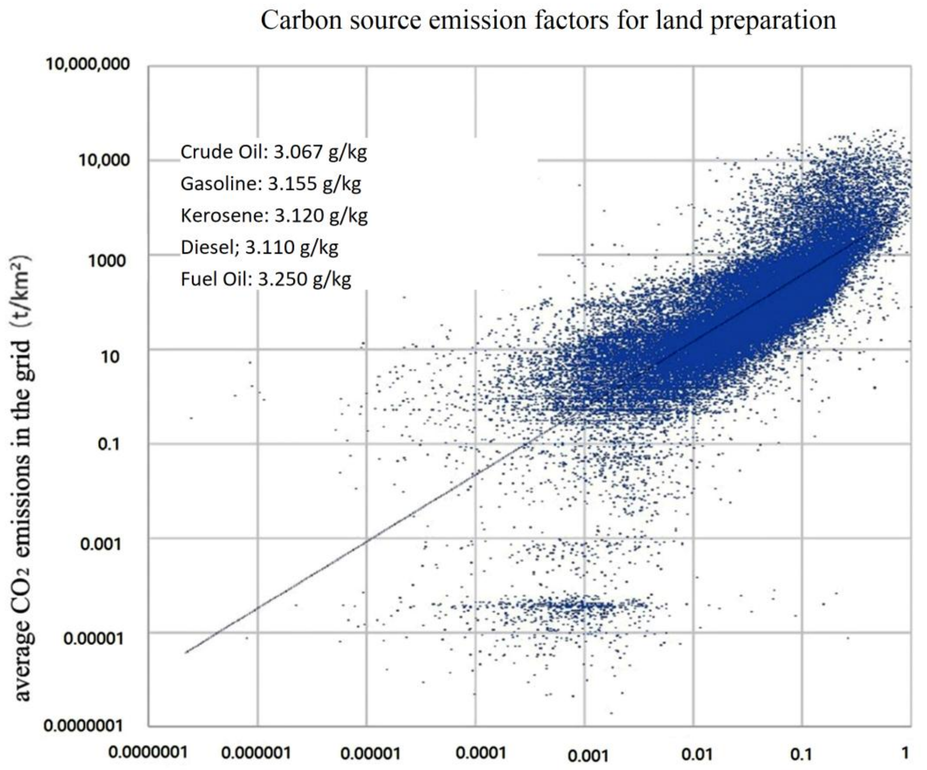

Figure 1. Carbon source emission factors

Results

This study updated the calculation method starting from the basic energy consumption and calculation, in the analysis of carbon dioxide emission factors and the overall consumption data of materials as the core observation, from both industrial and agricultural aspects, the analysis of rural land preparation energy consumption is summarized, it can be determined that the carbon dioxide emissions in the process of rural land preparation are directly related to the land preparation project, their conventional ranking position cement, thermal power, steel performance fossil fuels. The specific carbon emissions depend on the consumption of each project material are also related to the land preparation project and the structure of individual projects.

Structural analysis of carbon emission from rural land consolidation

According to the latest IPCC inventory data, energy consumption analysis, industrial sectors and product use energy belong to a single structural system, so the rural land preparation carbon emission of this study also needs to rely on energy categories to build an independent research system.

From the application point of view, the energy carbon emission consumption required for rural land preparation projects is mainly in the following two aspects: one is the carbon energy emission of industrial consumables such as cement and steel needed for land preparation projects; the other is the mechanical system operation during construction including gasoline and electricity consumption; other consumption can be ignored due to the small energy share.

In order to effectively analyze the carbon emission structure of rural land preparation, the design divides the energy material categories involved in the land carbon emission project into the following three categories: engineering material items, machinery items and mixed items of machinery and materials. Based on the budget data of the land consolidation project, the unit price of the main material energy budget can be determined, and then combined with the carbon dioxide emission calculation model, both the material consumption of the rural land consolidation carbon emission strategy can be deduced, and then the total value of all carbon dioxide emissions from the land consolidation activities can be estimated (Figure 2 and Table 2).

Table 2. Analysis of total carbon emissions of individual projects in the land consolidation process based on energy consumption perspective

	Total consumption of major materials				**Carbon dioxide emission/ t**	**Main material**
	Hybrid item	**Material**	**Mechanical**	**Subtotal**		
Steel	350.05	0.00	0.00	-	85.85	Steel sheet galvanized sheet
Cement	3455.25	2228.22	0.00	-	5081.25	The power of wind
Thermal Power	1955.58	0.00	8.25	-	1825.95	mechanical
Gasoline	3.11	0.00	0.00	-	0.01	mechanical
Diesel	22.58	0.00	358.58	-	1.55	-

Note: This table is for proportional analysis only

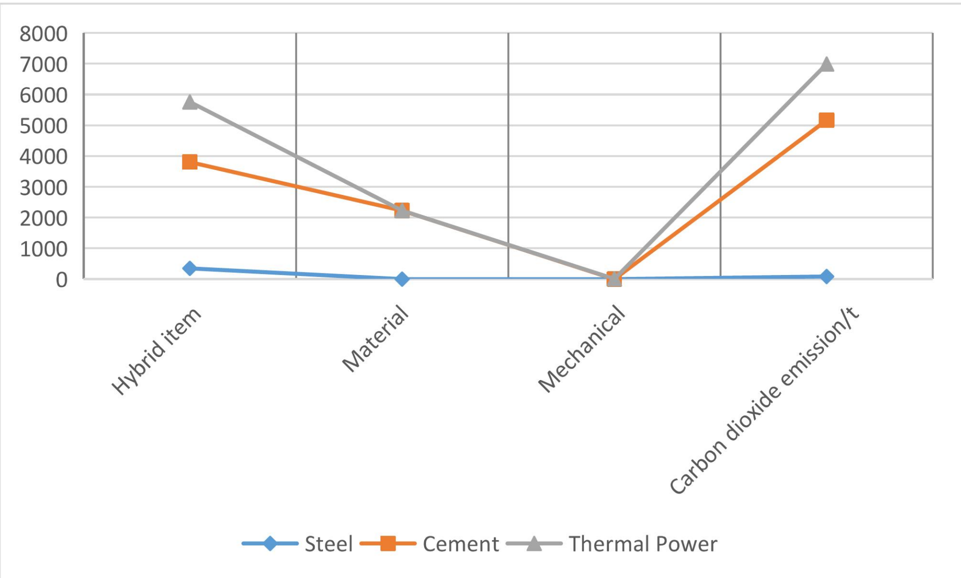

Figure 2. Carbon emissions of individual projects in the land consolidation process

According to the above measurement table, it can be seen that for the rural land preparation project at this stage, among all carbon dioxide energy consumption, cement consumption has the largest carbon emission, followed by the consumption of thermal power and steel. This is because the construction of rural land preparation projects requires a large amount of concrete for pouring ditches, culverts and water conservancy facilities such as machine-operated bridges and water pumping stations. Cement is one of the largest raw materials for concrete pouring, its production process itself has a large number of carbon emissions, the operation of mixer cranes in land preparation projects requires a large amount of electricity, and the proportion of carbon dioxide emissions from thermal power itself is more than a quarter (including the consumption of electricity used to manufacture wind volume). Based on the results of the calculation of equation (1) it can be determined that in rural land preparation activities, carbon dioxide emissions are not only related to the carbon dioxide emission factor of the relevant materials but also have a direct relationship with the consumption of the main types of materials, including their engineering volume. By comparison, it can be determined that cement and electricity have the largest material consumption and therefore become the most central carbon sources in land consolidation activities. The recasting of steel including its product use is much smaller than fossil fuel consumption but its carbon emissions are much higher than those of fossil fuels.

From a macro perspective, the engineering volume and carbon emissions of rural land preparation are much greater than the volume of rural farmland water conservancy projects, which have much higher carbon emissions than other agricultural projects. It is clear from the above analysis that the energy consumption per unit of project volume is related to the current number of construction machinery and quota. In addition, the different projects of land preparation projects also lead to carbon emission differences.

Land preparation activities not only directly act on the soil and water to bring a large nmuber of carbon emissions, but also bring the development of energy-consuming intensive industries. Such as cement, iron and steel, power industry, etc. It contributes to atmospheric temperature including greenhouse gas emissions in different degrees. Therefore, the planning and research of rural land carbon emission and collation projects deserve greater efforts, and rural land collation projects have great potential for emission reduction.

Discussion

Currently, the relevant environmental protection departments as well as land planning departments in China have officially promulgated and implemented the National Land Reclamation Plan. With the promotion and consumption of land consolidation projects, a large amount of carbon emission may be further generated. In this regard, rural land management is bound to become an important direction for energy saving and emission reduction, which can be analyzed and sorted out from the following aspects of carbon emission reduction.

First, constantly improve the budgeting of land preparation to improve the overall construction quality. Scientific and reasonable budgeting can effectively improve the rationality of land preparation construction. Because the current land preparation does not have a clear quota standard, need to refer to the actual construction of various industries, resulting in a lot of rural land carbon emission work of material consumption quota is unknown, affecting the construction and the actual calculation and selection of the amount of work will also directly affect the choice of materials, so you need to constantly strengthen the science of rural land preparation projects, reasonableness and industry construction norms to ensure a high application rate of materials, reduce resource waste and reduce carbon emission.

Second, adding low carbon emission indicators to land preparation construction management. Optimizing the land preparation program and adding low carbon emission as a hard indicator to the land preparation program and post-audit can also effectively reduce the total carbon emission of rural land preparation. The current evaluation and optimization of rural land preparation projects in China are still in its infancy, but functionally both the comprehensive benefits of land preparation before implementation and the overall construction performance indicators, the core meaning of the development of the selection ground, is to constantly find the problems in the construction of land preparation, to effectively regulate the practical activities of land preparation projects. At this stage, many rural areas of China's land preparation activities are consciously improving the construction area and the efficiency of the quality of the project, the ecological benefits of taking into account the lower, and even some have disregarded the ecological environment, the unilateral pursuit of high rates, low-cost construction, which undoubtedly runs counter to the concept of sustainable development of our natural environment. The inclusion of a series of indicators such as carbon dioxide emissions into the construction evaluation system can fundamentally improve the low-carbon and environmental protection of rural land preparation projects, prompting those responsible to continuously integrate and analyze the corresponding construction projects, combine carbon dioxide emissions, build suitable land preparation projects and optimize land preparation programs.

Third, improve the industrial production capacity of energy-consuming basic industries, such as hydro power, steel and cement, to radically reduce CO_2 emissions. Most of the current carbon emissions in rural land preparation projects are concentrated in the use of cement, steel, electricity, and fossil fuel products during construction. In order to effectively reduce the actual carbon emissions from land preparation, it is necessary to consciously trace the root cause. Therefore, it is important to reduce the carbon emission of the industry in terms of the actual land construction process as well as the corresponding technology including fuel. At present, China's iron and steel, cement and other industries are facing a serious carbon emission situation, of which the total amount of carbon emissions generated by burning coal-based energy is the largest, and from the industry as a whole, China's electricity production is also coal-fired power as the core, so improve the energy industry structure and related technologies, improve the comprehensive energy utilization rate, and constantly save energy is the key to clean production and reduce carbon emissions in China.

Conclusion

From the perspective of industry development, this study firstly argues and analyzes the development relationship between energy and low carbon economy in China, which leads to the issue of carbon emission from rural land consolidation in China. Given the limitations of the current carbon emission statistics research work, a new analysis model for assessing the carbon emission structure of rural land consolidation is constructed, including the collation and calculation of basic data and the analysis of the carbon emission structure of rural land consolidation, and the carbon emission situation of rural land consolidation is reconstructed. Finally, from the perspective of sustainable development, opinions on the future development of China's rural land carbon emission work are proposed.

In the subsequent study, the researchers concerned should further analyze the statistical model from the perspective of land consolidation project engineering and energy consumption budget to improve the accuracy and comprehensiveness of the data, to provide ideas for the subsequent research on carbon emission policies and related rural land consolidation measures. The current study, because it is more inclined to a macro-structural system, lacks unified measurement for systematic experimental data, and there is a certain data inkling in the assessment process, so the follow-up needs to continuously improve the data accuracy.

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