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摘 要

煤矿开采分为井工开采和露天开采两种方式，但不论何种方式开采，均会对煤矿区生态环境造成扰动，引起煤矿区地面景观格局发生变化，破坏地质结构，危害煤矿区的土地生态安全与持续发展。矿区土地生态安全问题在国外矿区也同样存在，探求合理有效的矿山复垦与复垦后土地利用结构用地模式一直是国内外矿山实践与研究的目标。

以往国内外研究多从单一的角度进行矿区复垦土地结构优化研究，本文结合导师的课题，在大量调查分析和广泛阅读国内外文献的基础上，考虑中国矿业开发的具体实际情况，首次系统地运用生态足迹、景观生态学原理和经济学原理，多角度地对复垦土地利用结构进行了优化研究，并利用实际矿山进行了实证，具体情况如下：

(1) 明确了矿区土地持续、合理利用的内涵：土地利用系统是以生态-经济-社会为内容，合理性与可持续为目标的复合系统。土地可持续利用的内涵包含三层含义：一是生态容许；二是土地分配与使用上的代内和代际公平；三是土地资源的永续利用和保值增值。提出了矿区土地利用系统是复合系统，合理利用与持续利用是这一系统的总目标。这个总目标又有经济效益目标、社会效益目标和生态环境目标三个分目标相协调。

(2) 指出了矿区复垦土地利用结构的优化过程是在矿区寻求土地的生态、经济、社会系统的平衡过程，并通过垦后土地利用的生态优化、空间优化和产权制度优化具体实现。

(3) 本文明确指出了矿区土地是因采矿和直接受采矿影响而

形成的“矿区飞地”。既然矿区是矿区可持续发展研究的起点，那么，矿区可持续发展问题的展开就不可能是只以矿业企业的发展为研究中心，矿区也不能单纯走以矿物开采和加工为主导的工业化道路，矿区应采取“飞地”方式持续发展。

(4) 提出了矿区土地复垦是“矿区飞地”持续发展的基本措施。矿区土地复垦不仅是对受采矿扰动的矿区系统的修复，更是对受采矿扰动的矿区系统的综合治理。通过对“矿区飞地”的复垦治理，使矿区的生态、经济、社会效益相协调，获得高于原系统的叠加效能。通过对“矿区飞地”复垦，不仅可以恢复损毁土地，而且通过损毁土地的复垦，恢复矿区“经济飞地”和“社会飞地”的效能，使矿区土地复垦与其他损毁地复垦具有明显区别，如通过复垦实现工业资本带动农业发展。

(5) 分析得出了矿区土地复垦不仅仅是矿区损毁土地质量的物理修复，更重要的是矿区复垦土地利用结构的优化。生态足迹是一种将生态、社会与经济关系有机联系起来，表达当前土地利用数量结构对生态环境以及土地利用是否可以持久维持的合理方法，是实现矿区土地利用结构数量优化方法。

(6) 初步对我国煤矿区进行了可持续类型区划分。本文依据生态足迹指标，根据我国生态足迹的计算结果和 Wackeragel 关于世界 52 个国家和地区生态足迹的计算结果和我国煤矿区的区位特征得出，云南的小龙潭煤矿区处于生态可持续环境之中，其他矿区均为生态不可持续区。

(7) 研究得出了提高矿区生态经济系统发展能力的手段是提高矿区生态足迹的多样性，即增加矿区的土地利用类型。矿区复垦土地方向应根据土地自然特点，首先增加矿区复垦土地利用类型，在此基础上，通过多方案生态足迹对比，寻求矿区复垦土地利用的合理结构，最终确定矿区损毁土地的复垦方向和复垦数量，并通过复垦带动矿区经济发展。

(8) 明确了采矿活动发生之前，当地的景观生态系统通过内

部生物之间、生物与环境之间、环境与社会之间的相互作用和系统内物种的自我组织、自我调整过程而逐步达到了相对稳定状态，其物种组成、物种数目、丰度以及食物网的结构都是与该地、该时的环境相适合的“最佳选择”。

(9) 总结得出了我国目前的矿区景观恢复模式基本为三种类型，并指出了各自存在的问题。这三种基本模式包括华北平原区耕作类型结构、江苏省铜山县的水陆并举类型结构和淮北水养类型结构，这三种类型存在的普遍问题是对影响矿区复垦的经济因素考虑较多，对生态因素考虑较少，不但缺乏对景观结构特征和空间关系的定量分析，而且斑块-廊道-基质模式的确定缺乏现代大农业生产的思想。

(10) 构建了适合于北方平原、丘陵地区的矿、村综合开发的矿区景观恢复空间结构。在这种新的结构中，村庄实施城镇化搬迁与矿山生产生活区连接，分布在大农业区的边缘，畜禽养殖场以及农副产品加工厂分布在村庄附近，畜养场以外布局果园或农田，采取种、养、加一体化，贸、工、农一条龙的综合经营模式。在农、牧各行业横向并联的基础上，向各行业投入产出远端发展，做到农、牧、工、商多层次多专业综合经营，实现矿区复垦土地利用结构的空間优化。

(11) 本文分析得出了合理持续的土地复垦方向首先应满足生态要求，同时空间布局上应满足景观原理，这样不仅有利于提高土地生产力，而且有利于实现土地的环境保护功能。指出了实现上述要求，必须首先满足三个基本条件：一是矿区土地复垦的资金保障，即能按生态要求提供相应复垦工程资金；二是矿业用地、农用地和垦后土地产权清晰；三是垦后土地有适宜的收益项目。明确了当前国内矿山开发引发的许多社会与经济矛盾源于矿区沉陷地等土地的所有权虚为国有；矿山复垦主动性减弱；矿区复垦资金难有保障；矿、农互为对立体、缺乏有意识的联合等因素，使矿区土地复垦难以形成良性循环，必须进行矿业用地模式

和土地复垦制度改革。

(12) 明确指出了目前尝试的矿业用地和矿区土地复垦制度的不足。本文对临时用地制度、年租制、土地股权制度、土地等量置换制度等进行了系统分析,认为这些类型各有其不同的特点和适用范围,但共同的不足是:把矿业用地作为矿业成本;矿、农没有共赢的意识和没有发挥强大的、先进的工业资本的优势。最基本的问题是上述的矿业用地实践没有从根本上解决矿区土地复垦的资金、产权和收益问题。

(13) 确立了矿区复垦土地产权优化的总体思路应该是立足矿区特殊的开采破坏特征和矿区的生命周期,立足我国新时期、新世纪的发展目标,立足矿区与矿业的持续发展、农民增收等中心问题,以资源产权为纽带,以市场为导向,以复垦土地产权结构优化为突破口,创新矿业用地获得方式,整合矿用土地与矿业产权,使矿、农双方由补偿消费型矛盾对立方转变成开发增效型的经济利益共同体,在矿区形成城乡统筹、矿、村互动共同发展的新格局。即:以矿区损毁土地复垦为起点,矿山可以采取购并的方式将塌陷损毁地以及涉及人员一并并入矿山,由矿山出资复垦并组建公司实行产业化经营使用复垦土地;或者矿山以投入复垦资金和后期产业开发资金为股本,农户以损毁前土地估价金额为股本,组建产业公司,在复垦后的土地上开展产业化经营,农户和矿山是产业公司的股东,土地经营权属于产业化经营公司。

(14) 明确了矿业用地新制度框架的意义是为新设立矿山的用地制度提供新思路。通过矿区土地股份合作制度改革,微观层次上,改善矿区农民因征地造成的耕地减少而导致的生活水平下降的问题;宏观层次上,实现工业带动农业发展,为国内矿山如何化解长期以来形成的矿、农对立,分割发展的矛盾提供先例;通过矿山经营模式的创新,为国内矿业集团如何在落后农村地区做大做强实现可持续发展提供了经验;通过多元化切实增进矿山的后劲与抗风险能力,为矿山提高自身的经济效益进行示范;带

动农业发展,解决农民问题,实现“公司+农户”的深层次突破,切实实现“发展自己,服务社会”的企业宗旨。

(15) 本文运用系统学理论和线性规划的方法针对矿区土地复垦中的用地结构进行了分析,并以山东新汶矿业集团华丰矿区为例,进行了矿区复垦土地利用结构的优化实证研究。这种实证使我们对我国北方地区矿区复垦土地利用优化模型的建立有以下两点认识:矿区整治土地利用最优结构模型的质量取决于决策变量、价值系数和约束条件的选择和确定。决策变量要从矿区生态、景观和社会经济条件选择可控制的因素;价值系数只有在全面分析矿区土地利用现状的基础上,采用各种方法进行预测,才能正确给定;而约束条件则要全面分析实现目标的限制因素,准确地选出关键性制约因素和平衡条件。华丰矿区复垦土地利用结构优化模型是采取定性分析与定量分析有机结合的优化模型方法而建立的。这种方法能在定性分析的基础上进行系统性的定量综合,用简明的数学模型表达复杂的矿区土地利用系统,从满足诸约束条件的众多规划方案中寻求使目标函数达到最佳的规划方案。实践表明,这是一种研究矿区土地复垦较为有效的定量综合方法。

(16) 目标规划法是矿区土地复垦土地利用结构优化首选方法,它不但可以克服目前常用的线性规划、灰色线性规划方法存在的仅以土地利用的数量优化为重点的单目标优化的弊端,还可以改变单纯以经济效益为目的的土地利用方式,实现土地利用理念的变革。

任何一座矿山,不论它地处发达富裕的城市地区,还是位居贫穷落后的边远山区;不论是在高原沼泽,还是在荒漠草地,社会经济发展方向和可能达到的发展目标都不是惟一的。一个矿区工农业生产布局存在各种不同的方案可供选择,矿山垦后土地利用方式也存在着多种多样的方案,可以出现许许多多的状态和空间景象。在多种方案的比较和选择中确定适合矿区未来发展目标

的土地利用结构，将会避免盲目性。

本文的最终目标是通过矿区复垦土地利用结构优化改变矿区土地粗放利用、退化严重、生态环境恶化以及人们对矿区经济社会普遍不满的现状，使人类需求与生态完整性协调，走出恶性循环，走向良性发展。

关键词：矿区土地，土地复垦，复垦土地利用，土地利用结构，利用结构优化

Abstract

There are two types of coal mining -surface coal mining and underground coal mining. However, no matter which type we choose, surely it will affect the ecological environment in mining area, cause the change of landscape structure, destroy the geological structure, and endanger land ecology security and sustainable development in mining area. The problem of mining area's land ecology security can also be found in foreign area, and to find a reasonable and effective model of reclaiming mining area land has always being a goal both in the work of practice and research.

At past research in and out of China mostly begins with one single angle. In this dissertation it combines the tutor's subject on the basis of a large number of investigation and analysis and reading the domestic and foreign literatures extensively, considers the existing condition of the mining industry in China, systematically uses the ecological footprint and landscape principle landscape principle and law of economics for the 1st time to do optimize research on the utilization structure of reclaiming land, and also do a positive research on a existing mine.

The concrete condition is as follows:

(1) provide the meaning of sustainable and reasonable use of mine land. The land use system is a compound system taking ecology-economic-society as its content, reasonability and sus-

tainability as its object. The sustainable use of land must goes like this: 1st, ecology permission; 2nd, balance of at the same period and balance between two conjoint periods in land in allotment and utilization; 3rd, the sustainable use of land resource and the preservation and incensement of land value, The meaning provides that land-use system of mining area is a compound system, and reasonable and sustainable use is the general object. This general object contains the object of economic benefits, object of social benefits and object of ecological environment which correspondingly coordinate each other.

(2) Point in out the optimization procedure of the utilization structure of reclaim mining area land is a procedure which seeks for high quality system of the balance among ecology, society and economics, and through the optimization ecology room and property rights system institution of land-use to realize it concretely.

(3) This dissertation argues that “the mining abandoned land” formed by the reasons of mining or directed by mining. Since mining area is the starting point of sustainable development research of mining area. The expansion of mining area sustainable development of mining industry, nor walk a industrialization road which singular with mineral explanation and manufacture. should be sustainable developed by model mining abandoned land.

(4) Bring forward reclaim mining area land is the fundamental measure of mining abandoned land model. It is not only the mend to mining protuberance system, but also comprehensive man-garment. It can coordinate ecological, economical and social benefits by reclaim mining abandoned land get more effica-

cy than original system, by arrangement of reclaim of mining abandoned land. It will not only restore the destroyed land, but also it can restore the efficacy of economic mining abandoned land and social mining abandoned land in mining area, and distinguish itself out from other Kinds of restore destroyed lands, for example, using industrial capital to further the development of agriculture.

(5) Get the point by analysis that the reclaim of mining area land is not simply the physical mend of destroyed land's quality, more important, the utilization structural optimization of reclaim lands. Ecological footprint is a reasonable say mechanically combining ecological, social and economical relationship to show whether the current land utilization quantity structure can be sustainable to ecological environment and land use, and it is the way to realize quantity optimization of mining area land use structure.

(6) Having plotted out the sustainable types of coal mine area. According to index and calculating results of our country's ecological footprint and Wackeragel's calculating results of 52 countries and areas ecological footprint, as far as our country is concerned, only the Xiaolongtan mine in Yunnan province is still in well state of ecological sustainable development. Other areas are unsustainable ecological areas.

(7) The studies has drawn conclusion that the meaning to improve the developing ability of ecological-economic system is nothing but to improve the diversion of mining area ecological footprint. That means to increase the diversion of mining area land-use types. the direction of reclaim mining area land must following the natural character of regional lanes, lstly increases

the mining area land-use types on the ground of which, to find a reasonable and effective model of reclaim mining area land by multiplexing comparison of ecological footprint. Ultimately determine reclaim direction and reclaim quantity of mining area destroyed land, and promote mining area economic development by reclamation.

(8) Provide the before the activity of mining, the landscape ecological system forms a comparative stable state through the interaction between internal biosphere, biosphere and environment, environment and society; the self-organized and self-conciliate processes of species in the system. All its species composition, species quantity, species abundant degree and the structure of food chain is the best choice which is suitable for the environment.

(9) Here it shows that basically there are 3 types of landscape restoration models and questions in our country nowadays, i. e. , cultivation typed structural design in Plain of North China, terruqueous typed structural design in Tongshan County, Jiangsu Province and westerly typed structural design model in North of Huaihe River. These types have the common problem of viewing too much from the economical angle, whereas less ecological consideration, lack of analysis both to the characteristic of landscape structure and quantitative analysis of spatial relationship, the establishment of the theory-porphry-corridor-matrices lacks of modern agricultural production thoughts.

(10) Having established a mine-village comprehensive development type of landscape structure model. In this new structure, villages move out urbanely connecting to mining settlement area, spreading on the verge of agriculture; animal husbandry

plants and relative factories spread nearby villages, outside of the animal husbandry plants is orchards or farms. Thus we take such a comprehensive operation model that planting, penning and manufacturing are fully mechanized. On the basis of the lateral integration of farming, animal husbandry, etc, we take a further step to fully develop the terminals of investment and production, to accomplish such kind of comprehensive operation that farming, animal husbandry, manufacturing and commerce multi-leveled and multi-professionalized, to achieve the spatial optimization of the reclaim mining area land's structure.

(11) The analysis of the dissertations conclude that reasonable and sustainable reclaim land direction should firstly satisfy the ecological requirement, at the same time, it's spatial disposition should conform to landscape principal. This not only make for the improvement of land productivity, but also in favor of the achievement of the function of land environment protection. It must have three essential conditions to achieve the requirement above. The finance secure of reclaim mining area. Relevant finance of reclaim project by ecological requirement must be provided. The property right of mining land farmland and reclaimed land must be distinct. Reclaimed land has proper income item. Currently, domestic mining exposure has caused many social and economical contradictions. The state formalizes has mining area sink-land's ownership apparently, but actually doesn't own it. The initiative of reclaim mining area is decreasing. The finance doesn't has security, mining and farming against each other, there is lack of consciously unite. There cannot form virtuous circle of reclamation. so it is necessary to improve the mining industry land-use type and reclaim land system.

(12) Pointing out the shortage of the mining land-use system and reclamation system which being tried nowadays. Land temporary used system, annual tenancy system, land stock privities system, land equivalence requirement system and it suppose that though these models have their characteristics and applicable area respectively, they have a common disadvantage that the consciousness that mining land is the cost of mining industry is still not changed. Miner and farmer do not have the coconsciousness of cooperation and they are not exerting the advantages of the powerful, advantaged industries above didn't resolve the reclaim fund, property right and profit problem ultimately.

(13) This dissertation point out that the general plan of reclaim mining area land property right optimization should forms a new pattern which united prepare for mine and farmer corporation. This new pattern should drives at peculiar mining destroyed character and life circle in mining area; drives at the development object of our country in this new stage in this mew country; drives at the central problem of mining industry's development and farmer income's increasing, etc.. This new pattern related by the sources' proper right, directed by market, found the way through reclaim land's property right optimization, create mew getting means of mining land-use, concordat the property of mining land-use and mining industry, change the style of expiatory-profit increased economical community. i. e. with the starting point of reclaim mining area land, mine take the way of buying to merge the collapsed land and the relative staff into mining industry, and mining industry provide finance for reclamation and corporation to practice industrial operated with reclaim land. Or, mining industry provide reclaim capital and

subsequent industrial development capital as capital stock, found industrial corporation to develop industrial operation on the land after reclaim. Farmer and mine are the stockholder of industrial corporation. The land's operated right belongs to industrial corporation.

(14) The prominent effect of mining area reclaim land's property rights optimization is: provide new ways for reform of the new mine land-use system. Through the reform of share co-operation, on microcosmic level, it reform the decrease of standard of living problem for reasons of commandeers land and shortage of land. On macrocosms level, achieve industry development promote agriculture development. Set a good example for domestic mine in how to resolve deterioration on farmer and mine corporation; by the innovation of the operation style provide experience for mine group in how to be powerful and how to accomplish sustainable development in the backward countryside. Though diversion development actually improve the stamina on how to improve economic benefits for mine itself, accelerate the development of agriculture, resolve the problem for farms, achieve deep of cooperation add farmers, actually achieve the aim of develop itself benefit the society.

(15) Using the method of system and theory of the linear programming, it analyzes the land-use structure at the right place of the mining area ; taking Huafeng Mining area, Xinwen Mine Group in Shandong Province for example, it gives an optimized positive research on the land-use ness offers us two points of view towards the optimized land-use model of reclaim mining area land-use structure model definite by the choice and definition of decision-making variability, valve rate and restraining condi-

tion. Decision-making variability comes from the choice of controllable elements of mining area ecology, landscape and social economical condition; Value rate can be definite only on the basis of fully analyzed the current condition of mining area land-use and forecasted in various kinds of ways; whereas restraining condition means we should fully analyze the restraining condition to meet the goal, exactly pick out the key restraining elements and balance condition. Optimized structural model in reclaiming mining area land is established on mechanized optimization model way of qualitative analysis and quantities analysis. This method can systematically and qualitative analysis, use the brief mathematical model to illustrate the complicated mining area land-use system, to seek for the best programming plan to optimize target function among several of programming plans that satisfy the restraining elements. Practice proves that this is a relatively efficient quantities way to research the reclamation of mining area land.

(16) Target programming method is the 1st choice for utilization structural optimization structural optimization in reclaiming mining area land. It can not only overcome the shortcoming that single target optimization emphasized by currently widely-used methods -leaner programming and grey lineal programming, but also change the land-use way only aiming at the economic benefits, cause a conceptual revolution of land-use.

(17) Every mine, no matter it locates in urbane downtown, or in poor rural villages; no matter in plateau and marsh, or in desert and meadow, is impossible that social economical developing direction and the possible achieving goal is single. there are various different programming plans for a mining area's layout of