Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 1847-1862
Article History: Received: 02 April 2022, Revised: 15 April 2022, Accepted: 24 April 2022, Publication: 04 May 2022

Research Hotspots and Evolution Trends of Land Resource Assets in China—Visual Bibliometric Analysis Using CiteSpace

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Abstract:

The expansion of China's land system reform has gradually led to the importance of land as an asset. This study aims at determining research progress as well as research frontiers. Moreover, hotspots and evolutionary trends in the area were explored. To this end, using CiteSpace software, bibliometric analysis and visualization were carried out on the China National Knowledge Infrastructure (CNKI) and Web of Science database. Accordingly, 227 articles published from 2001 to 2021 were descriptively analyzed through keywords co-occurrence analysis. Consequently, the number of published papers, high-yield authors, research institutions as well as the hotspots and evolution trends were identified. As a result, a theoretical framework for the research of land resource assets was proposed. It was demonstrated that: (1) four phases can be identified for research in land resource assets in China, including the stage of the embryonic, mitigation, high-speed development, mature and stable; (2) relatively few high-yield authors and research institutions were found to have tight cooperation and connections; (3) research intensity was closely related to national policies, and research hotspots were evolved in multiple directions, but gradually focusing on key areas such as "value accounting", "outgoing audit" and "ownership by the whole people"; (4) the content of the research suffered from shortcomings regarding discipline integration, standard unification, and diversified methods. In addition, in future research, fundamental research should be strengthened, the relevant concepts need to be scientifically defined, and the theoretical basis is required to be improved. Additionally, the construction of a unified standard for land resource asset accounting system needs to be accelerated through theoretical research. Also, empirical research was suggested to be inclined toward establishing a multi-level land resource asset assessment system. Furthermore, recommendations about "ownership by the whole people" and "trinity" land resource asset assessment in China were suggested for further research in the field. In conclusion, the present study is expected to provide a reference for the construction of a comprehensive and systematic assessment system of natural and land resource assets.

Keywords*: Land resource assets, Research hotspots, Evolution trends, Research review*

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I. INTRODUCTION

The land is the carrier of natural resources and the material basis for human survival and development [1] [2]. It plays a vital role in the development of the human population, environment, and economics [3] [4]. The demand for land resources as well as the utilization of these resources is growing which is due to the rapid development of the social process [5]. Accordingly, the value of land resource assets (hereinafter referred to as LRA) has increasingly become obvious [6]. Moreover, coordinated development of land exploitation and utilization has become an important issue for sustainable development [7]. As a result, studying the growth of the value of such an asset has provided a new area of research in the sustainable utilization of land resources [8] [9]. Research on land resource assets in China is increasingly focusing on the physical quantity statistics value accounting and the assessment of government cadres' outgoing audits [10] [11].

Currently, researches on land resource assets are mainly focused on defining land resources, property rights, balance sheet compilation audit of outgoing leading cadres [12-16], etc. Thus, certain areas are understudied and required more attention. These included adapting the management system of land resource assets to China's "ownership by the whole people", as well as improving and promoting value positioning, accounting system, evaluation methods, and assessment of land resources assets [17] [18]. Moreover, research hotspots, evolution processes, and development trends need to be further studied based on networks of knowledge in this area [19-23]. Thus, the visual analysis of CiteSpace was used in the present study to review the literature in the past 20 years and accordingly, to present the quantitative and qualitative results through such nets. Using theoretical concepts, value cognition, and evaluation methods of land resource assets, the developments and the shortcomings of the existing research were investigated. Moreover, research hotspots, contents, trends, and evolution were explored, and accordingly, an adapted research paradigm of land resource assets to "ownership by the whole people" was put forward. Hence, the present research provides a reference for the evaluation and reform of land resource assets.

II. RESEARCH DATA AND METHODS

2.1 Data Sources

The data was mainly collected from the China National Knowledge Infrastructure (CNKI) and Web of Science databases. The reviewed literature included articles published from 2001 to 2021 through searching the keywords of "land resource assets", "land resource asset assessment", and "land resource asset accounting", selecting the searching option of "OR". The final sample of 227 valid and full articles was selected after reviewing the obtained papers manually.

2.2 Research Method

CiteSpace software was used to perform a bibliometric and visualization analysis. Figure 1 displays a technical route of the study. First, the perspective of the field was described by counting the number of

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published documents and the relevant policy documents. Next, CiteSpace was used to perform network analysis and to come up with cooperation between high-yield authors and institutions. Subsequently, keywords clustering analysis was carried out and the time sequence net of keywords was drawn to reveal the hotspots and evolution of the research. Then, the concepts, content, and methods were analyzed to discover the shortcomings of the papers. Finally, the research trends were explored from the three aspects of the theory, method, and content of the articles.

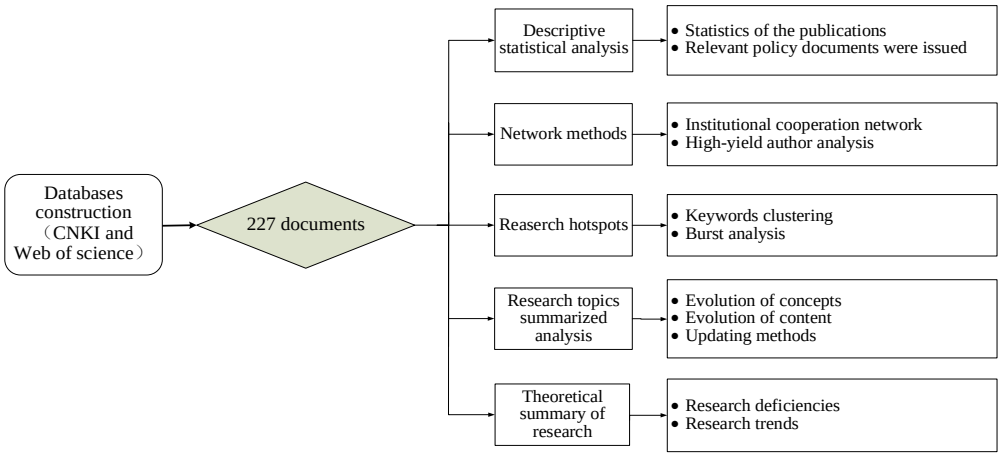

Fig 1: the technical route

III. RESEARCH RESULTS

3.1 Statistical Analysis

3.1.1 Quantity of published papers

As can be seen in Figure 2, the number of published papers was collected from 2001 to 2021. The analysis of the period demonstrates a slow increase in the trend of the published papers. As the result, according to the characteristics of the studied papers in this period, research on land resource assets was divided.

- The first phase is the embryonic stage (2001-2007). This stage was characterized by the publication of a relatively stable mean annual number of 6-7 papers, mainly on the relevant concepts and theories of land resource assets. Influential events in this period were mentioned in the following. In 2001, the National Bureau of Statistics of China carried out a resource and environment accounting in Chongqing on a pilot basis. Consequently, the green GDP accounting theory was initially formed [24]. In 2002, the construction of ecological civilization, as part of the goal of building a moderately prosperous society in all

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respects, was proposed in the 16th National Congress of the Communist Party of China which led to the initial proposal of the green GDP accounting system [25]. In addition, *Study Report on China's Green National Economic Accounting (2004)* was jointly published in September 2006 by the State Environmental Protection Administration of China and the National Bureau of Statistics of China which established a green GDP accounting system. However, despite these advancements, the concepts related to land resource assets were not thoroughly developed and the evolution of the concepts in land asset assessment was rather slow.

- The second phase is the mitigation development stage (2008-2012). In this period, the number of published articles decreased significantly and the research hotspots changed. In other words, while research on land resource assets showed a declining trend, it was replaced by research on land resource backflow which was guided by the Chinese government's land resource development goal of tight constraints. However, during these years, the theory of asset evaluation was improving gradually [26], which laid a theoretical foundation for the study of land resource assets.

- The third phase is the high-speed development stage (2013-2018). During which the average annual number of articles increased significantly, reaching mean annual number of 14-15. A landmark event was the proposal of the third Plenary Session of the 18th CPC Central Committee in 2013 for the preparation of a natural resource balance sheet. This led the land resource asset accounting to become the focus of research [27]. Furthermore, *Regulations on Audit of Outgoing Leading Cadres' Natural Resource Assets (Trial)* was issued in November 2017 by the General Office of the State Council of PRC. land resource asset management policies were issued continuously, and the popularity of research in this area continued to increase. The highest number of published papers was observed during this period with about 29 in a single year.

- The fourth phase is the mature and stable stage (2019-2021). During this period, 20 articles were published annually which indicates a steady growth trend. *A Document on Promoting the Reform of the Property Rights System of Natural Resource Assets in an Integrated Manner* was issued in April 2019 by the General Office of the State Council of PRC. The council emphasized, "the study and establishment of an asset accounting and evaluation system, performance of physical statistics, and exploration of value accounting" [24]. This was the first time that a state document was proposed on the reform of natural resource assets which demonstrated the significance of promoting land resource assets [28].

Therefore, research on the area was closely related to property rights management and fluctuated greatly under the influence of policy promotion and formulation. However, it was generally popular and the number was growing.

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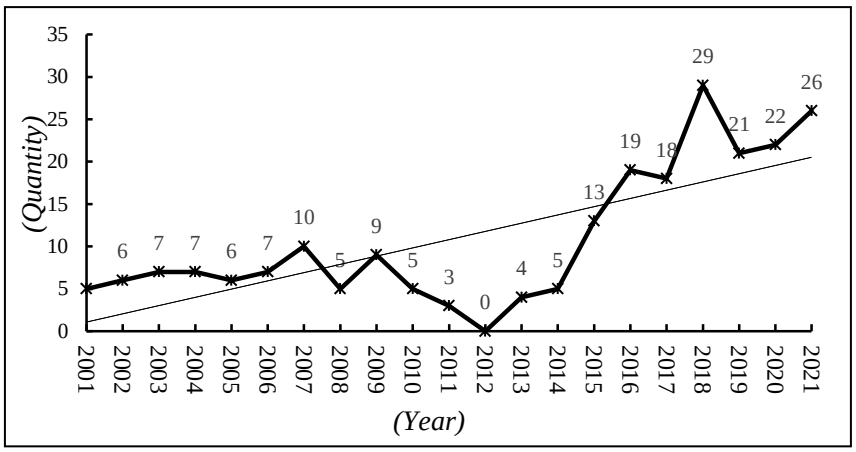

Fig 2: the quantity of published papers

3.1.2 High-yield authors

Table I shows the top three authors with the highest number of published articles. With 6 publications, Jianxin Geng is placed at the top of the list followed by Shuzhong Gu and Daolin Zhu with 4 and 3 papers, respectively. Geng (2018) explored the compilation of natural resources balance sheets of Zhongshan city by taking land resources as an example [15]. As one of the highest cited articles with 43 citations, Gu (2016) defined the concept, attributes, and classification of natural resource assets and systematically discussed the compilation of natural resource balance sheets and audits in the field [29]. Greatly contributing to the theoretical hypothesis, Zhu (2019) set forth the logical rule of investigating natural resource assets through supplementing physical quantity by value quantity [30]. Generally, as shown in Table I, relatively few researchers have investigated land resource assets in China.

TABLE I. Top 3 counts of authors with citations

Authors	**Counts**	**Citations**
Jianxin Geng	6	14
Shuzhong Gu	4	43
Daolin Zhu	3	13

Figure 3 displays the analysis of the co-occurrence network of authors in the literature. As depicted in the visual network, 223 nodes and 131 links were found, the network density of which is 0.0056. The font size of the nodes, the size of the wheel and axle of the nodes, and the thickness of the lines represent the author's centrality, the number of his/her publications, and the closeness of the cooperation relationship, respectively. As can be seen, the overall distribution of authors was relatively dispersed, and there was less cross-field and cross-institution cooperation among high-yielding authors.

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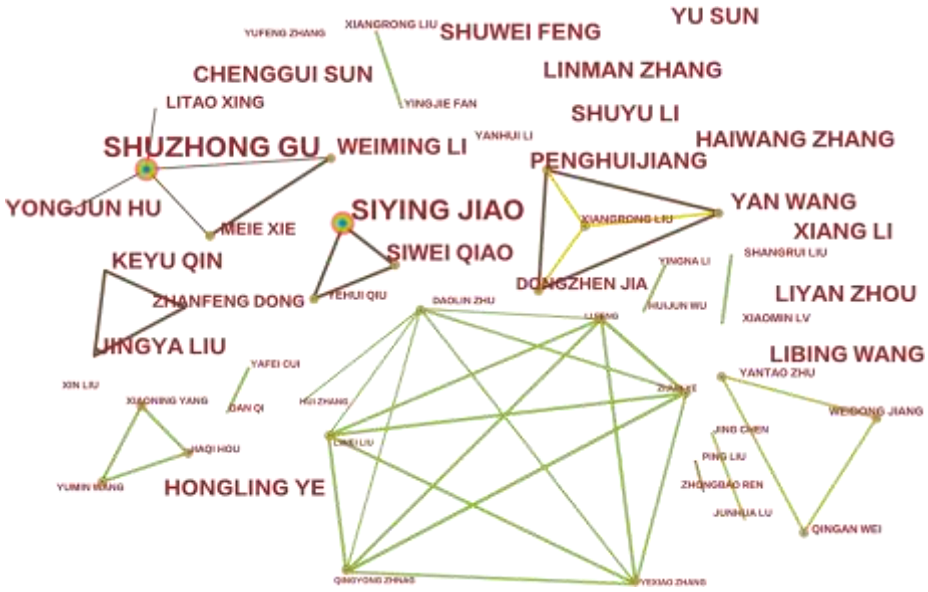

Fig 3: co-authorship network

3.1.3 Research institutions

In order to better understand the distribution of research power, the institutions and the affiliation of the authors were counted. As shown in Table II, the top 10 institutions with the highest number of publications were mainly concentrated in China's "double first-class" universities and national research institutes, comprising 60% and 40%, respectively. The analysis of the cooperation network of the institutions revealed a total of 166 nodes and 1 link, with a network density of 0.0001. As can be observed, few links between the nodes were detected and the overall density, as well as the research institutions, were scattered. This indicates that the research institutions were not closely linked, and the cooperation between universities and research institutions needs to be strengthened.

TABLE II. Top 10 counts of research organizations

Number	Organizations	Counts
1	Institute of Geographic Sciences and Natural Resources Research; China Research Institute of Land and Resources Economics; China land Surveying and Planning Institute	6
2	Renmin University of China	5
3	Agricultural University Of Nanjing; China Agriculture University; Development research center of the State Council; University of Chinese Academy of Sciences	4
4	China University of Mining and Technology; Inner Mongolia Normal University	3

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3.2.3 Research hotspots evolution

Figure 4 shows the co-occurrence analysis of the keywords of the articles. As can be seen, the figure included 326 nodes and 635 wires. The average contour and module values were 0.8637 and 0.9467, respectively, indicating a good clustering effect. While "land resources" had the largest node, "land assets", "value accounting" and "outgoing audit" were close to each other. Accordingly, it was concluded that research hotspots were taking "land resources" as the core of their focus. This involved such fields as "land assets", "value accounting", "magnitude of value", "ownership by the whole people", "ecological value", "natural resources", "land reclamation reform", etc.

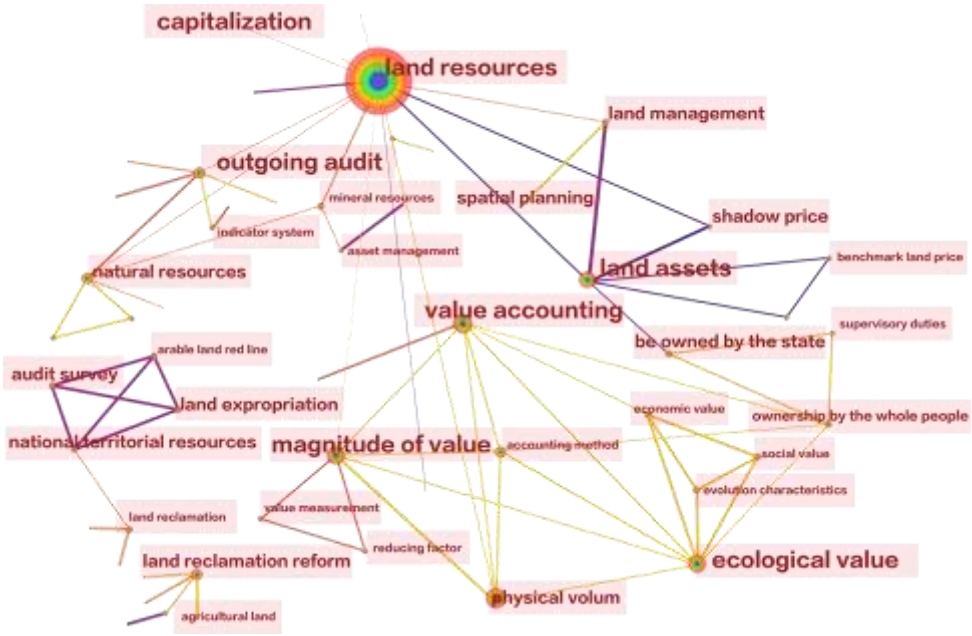

Fig 4: keywords co-occurrence network

Burst detection of the keywords was carried out to discover the keywords' period of high intensity, their dynamic change rules, and the research frontiers and developmental trend. Table III shows the frequency, intensity, and starting and ending years of the top 20 keywords. The results showed "agricultural reclamation reform", with the most robust citation burst of 3.37 for three years from 2015 to 2018. It was followed by "land assets", with a burst of 3.08 for a longer time range of 2001 to 2006. In addition, the longest time range was 8 and 7 years for "asset management" and "value accounting", respectively.

TABLE III. Top 20 keywords with the strongest citation bursts

Keywords	Strength	Begin	End	2001-2021
land assets	3.08	2001	2006	
land revenue	1.84	2001	2005	

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benchmark land price	1.19	2001	2002	
market economy	1.02	2001	2004	
land market	1.64	2002	2007	
land reserve	1.41	2003	2006	
accounting treatment	1.5	2004	2007	
agricultural land	1.59	2007	2009	
accounting	1.14	2007	2009	
asset management	1.22	2010	2017	
land reclamation reform	3.37	2015	2018	
value accounting	1.35	2015	2021	
natural resources	2.86	2016	2017	
agricultural reclamation land	1.31	2016	2018	
land economy	1.41	2018	2021	
outgoing audit	2.4	2019	2021	
ownership by the whole	1.91	2019	2021	
double-entry bookkeeping	1.11	2019	2021	
land science	1.11	2019	2021	
ecological value	1.11	2019	2021	

According to the sequence of the high-frequency keywords network and the analysis of burst detection, it was expected that land resource assets to focus on such key fields as "value accounting", "outgoing audit", and "ownership by the whole people" in future. Furthermore, research perspectives on land resource assets as well as the research paradigms and methods were diverse. In general, research on land resource assets can currently be summarized according to the following three aspects:

(1) Evolution of concepts. The concept of land resource assets has not reached a consensus at the moment. Gruzalski (1999) believed that natural assets include the two valuable assets of natural resources and the ecological environment which support human life [31]. However, in a different definition, Bi (2001) maintained only land assets with market exchange value as the land assets [32]. Yet, Hu et al. (2018) referred to no essential differences except only for broad and narrow differences between land resource assets and land resources [33]. In Liu's (2018) view, the concept of land resource assets was not simply equivalent to that of land assets in land economics. That was, the concept could not be limited to the land assets that enter the market and generate economic value [34].

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(2) Evolution of content. The perception of the value of land resources had changed from merely a physical-economic view to a comprehensive one that encompasses economic, ecological, protective, social, and cultural aspects, and land resource asset accounting had changed from a single physical-economic value to a comprehensive value [35] [36]. Firstly, with relatively complete value theories and methods economic, value accounting research was the earliest. For example, Shi (2016) and Zhang (2020) calculated the economic value of owning land resources in Nanan District and Nanping City and analyzed the spatial dynamic characteristics, respectively [1] [37]. Secondly, being mainly based on substitution theory and relative evaluation, social value accounting develops gradually. An example study was the evaluation of the social values of forestland based on such substitution values of woodland comfort and employment opportunity by Wang et al. (2005) [38]. Yet in another study by Sun et al. (2019), the social value of cultivated land was estimated in Jiangxi Province using the substitution value method [39]. Thirdly, ecological value accounting was investigated and was shown to have experienced a transformation from ecosystem service value to land ecological asset value [40] [41]. Finally, the focus shifted to comprehensive value accounting of land resource assets based on their classification. In Zhang (2008) and Wang (2008), for example, the three aspects of economic, ecological, and social values were used to calculate the land resource asset value of Harbin and Shenyang by classifying land use status [42] [43].

(3) Updating methods. As demonstrated in Figure 4, current asset value accounting is mainly based on physical quantity statistics and value quantity accounting. In Xu et al. (2021), it was shown that while physical quantity statistics refers to the use of statistical methods to calculate the reserves of natural resources, value quantity accounting indicates the selection of certain methods to quantify the physical value of natural resources [44]. At the time, the main research areas of physical quantity statistics focused on statistical methods and models. Such a diverse range of keywords and methods as value measurement and reducing factors was detected in value volume accounting. Asset accounting methods were the most commonly used ones which include the market value method, cost method, and income method [26]. Moreover, subjective methods of value assessment, consisting of such methods as preference display, market-based, and preference statement methods were mainly applied in research in the 1990s. Two examples are the studies carried out by Daily (1997) and Costanza (1997) who quantified the ecosystem service function based on the value equivalent of ecosystem services [45] [46]. Furthermore, considering authentic context, the equivalent factor of ecological service value in China was formulated by Xie et al. (2015) [47]. Successively, methods such as the result-checking method, opportunity cost, income capitalization method [48], and substitution method were introduced into the land resource asset evaluation. The first example was the use of a result-checking method for the reconstruction of China's land resource value system by Li (2007) [49]. Additionally, Ye (2013) established a social value evaluation system by using the opportunity cost method, substitution method, and shadow price method [50]. Furthermore, the income capitalization methods and alternative market methods were utilized by Hu (2016) to establish an accounting system for the value of cultivated land resources assets, the purpose of which was to calculate the economic, social security, and development right values of the resources [51].

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Therefore, it can be argued that while the physical accounting method of land resource assets is relatively mature, the value accounting method and land resource asset assessment were in their infancy and have not formed a unified and standard approach. Research in this area has first shifted from merely physical quantity statistics to an effective but inaccurate value accounting, and then to an assessment framework that includes both physical and value quantities.

3.3 Research Theoretical Framework

3.3.1 Research deficiencies

(1) Insufficient abundance and breadth

The quantity of literature revealed a significant policy relevance to research on land resource assets in China, i.e., it was influenced and fluctuated by the consequences of policy transmission. There have been considerable disputes over the connotation and denotation of land resource assets. Accordingly, the relevant research paradigm and the theoretical framework had not yet been well established [52].

The visual analysis of the data shows that the main focus of research hotspots was on such areas as land resources, land resources asset outgoing audit balance sheets, property rights, and the value accounting aspects based on fundamental issues such as property rights, accounting [53] [54]. Research subjects mainly focused on the economics and management science classes. However, the quantity of relevant and hierarchical research, cross research, and cooperative studies as well as continuous research was not sufficient.

(2) Imperfect accounting system

The analysis of keywords co-occurrence network showed little literature on the comprehensive value assessment of various regions in China. Likewise, the analysis of the property rights system of ownership by the whole people was insufficient. In addition, there was a lack of socially recognized unified standards or methods to guide the accounting of land resources assets as well as a lack of comparability of value accounting across regions were observed. The development and integration of a localized evaluation system and mechanism of land resource asset value is vital in China as there exist vast areas with diverse topographic traits in the country.

(3) Relatively simple method

The analysis of research methods revealed the infancy of empirical research. Videlicet, mainly normative research with limited data was observed which varied in the actual implementation. Few studies were originally published on value accounting, in most of which only the existing literature and their results obtained from a similar regional environment were reviewed. However, the economic value of

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assets in different regions varied greatly, which could be attributed to the great influence of location on assets and the improper corrections. Moreover, only a few quantitative studies were carried out objectively and scientifically on social and ecological values.

3.3.2 Research trends

Due to the influence of land resource assets on population, environment, and economy, a single economic value cannot objectively reflect the value connotation of land resources. Accordingly, a "trinity" multi-asset value system including economic, social, and ecological values should be constructed. Thus, in order to overcome the deficiencies, future trends of research on land resource assets were summarized in the following.

(1) Scientifically defining the basic connotation and denotation of land resource assets. With the constant improvement of the theoretical basis and the gradual convergence of the values of land assets, research in the area shows a scientific trend. In line with this, hierarchical, multi-angle, and multi-scale systematic research is predicted as the important research direction.

(2) The effective construction of a standardized and unified land resource asset accounting system. Comprehensive consideration of the economic, ecological, and social values of land resource elements is expected to form a diversified evaluation method. Furthermore, a unified standard land resource asset accounting system is anticipated through the establishment of a comparable value evaluation model for similar areas.

(3) Implementation and application of a multi-level land resource asset assessment system. Considering values comprehensively, proposing an assessment framework for land resource assets, applying accounting methods to the assessment practice, and collecting and analyzing practical cases are anticipated to realize the transformation of research from a theoretical to a practical approach for different regions, environments, and property rights.

3.3.3 Research paradigm

As shown in Figure 5, a research paradigm for land resource asset assessment was established in this paper. We put forward the research paradigm of accounting and assessment of land resource assets based on summarizing and considering the deficiencies, trends, and future possible hotspots.

The paradigm was proposed on two levels.

(1) On the one side, the existing research shortcomings in theory, content, and method were identified and the future trends were anticipated and summarized. A mutual promoting relationship can be assumed for the first level. In other words, while research deficiencies reflect future research direction, the latter

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signifies the practical insufficiencies of research.

(2) On the other side, the research framework of land resource assets was set forth, which can be divided into three aspects:

- The first aspect was the performance of physical quantity statistics based on the land resources and land resources owned by the whole people as the mainline.

- The second aspect concerns taking value quantity accounting under the economic, social, and ecological values.

- The third and the last aspect was the construction of the "trinity" system for land resource asset assessment research, which includes the following three steps:

➢ The first was the three dimensions of the assessment system, namely, the local government's "assessment-supervision-accountability".

➢ After that, the establishment of a dynamic and bidirectional assessment system was based on "effect-feedback-improvement". Consequently, it can be carried out in accordance with the direct effect of asset accounting, resultant feedback, and dynamic improvement.

➢ And lastly, the content system of assessment and evaluation should be established which includes the improvement and optimization of quantity, quality, and the value of land resource assets.

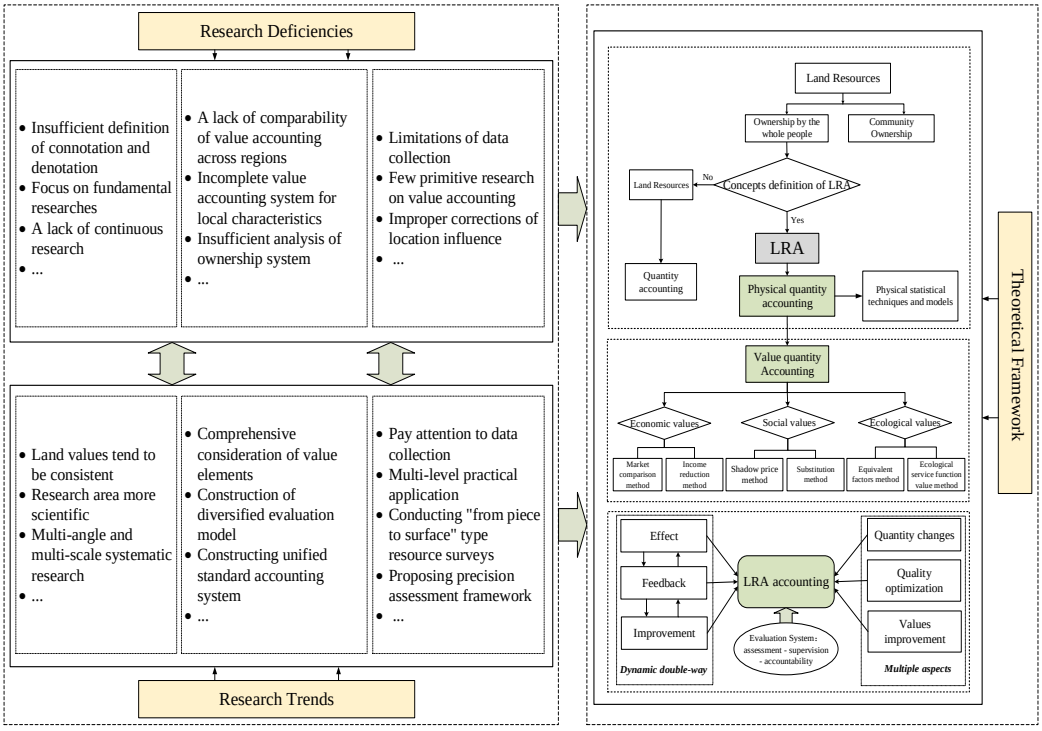

Fig 5: the general paradigm in this paper

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IV. CONCLUSION

Recently, research hotspots were mainly focused on the concept, value accounting, and assessment methods of land resource assets. However, a number of shortcomings can be mentioned such as disunity of theoretical concepts, imperfect accounting system, and relatively single methods of accounting. This directly affects the accuracy and comparability of the results obtained by assessment. In this paper, the visual network atlas analysis tool CiteSpace was utilized to systematically analyze 227 articles on land resource assets that were published by CNKI and Web of Science from 2001 to 2021. As the result, the development stages and dynamic evolution characteristics of the research topics were described. To be more precise, the concepts, content, and methods of the research were systematically identified. Moreover, the research hotspots and evolution process were analyzed for nearly 20 years and the representative scholars and research results in the field were introduced. Besides, research deficiencies and future trends were also summarized. Finally, a theoretical framework for land resource assets was proposed. The main conclusions of this study were as follows:

Currently, research on land resource assets in China was mainly carried out in line with political documents in 2001-2021. Moreover, the research is not well systematic, the unified standard value accounting system is not completely established and the accounting method is relatively simple. Additionally, land-use intensity, values, and property rights have not been fully integrated into the accounting process. In general, studies on land resource assets have evolved from a unitary to multi-scale and multi-dimensional research, and from theoretical to practical applications. Focusing on land resource assets and physical quantity statistics, value accounting, and assessment, the proposed paradigm in this study incorporates the three aspects of research defects, trends, and framework. Moreover, the established "trinity" of land resource asset assessment research proposed in the present study, can be fundamentally adapted to that of China's "ownership by the whole people" under the present stage. Hence, the obtained results are expected to act as a reference for conducting future research, constructing a comprehensive and systematic assessment system of natural resource value, as well as providing strong support for the reform and practical exploration of the land resource asset system.

ACKNOWLEDGEMENTS

This research was supported by the Natural Resources Science and Technology Project of Anhui Province in China (Grant No. 2021-K-2).

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Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 1847-1862
Article History: Received: 02 April 2022, Revised: 15 April 2022, Accepted: 24 April 2022, Publication: 04 May 2022

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Forest Chemicals Review
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2022 Page No. 1847-1862
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