Research on the Optimal Allocation of Print Book Acquisition in University Libraries

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Abstract

Abstract: [Purpose/Significance] The construction of an appropriate allocation method facilitates the rational distribution of print book procurement quantities among various disciplines in university libraries. [Method/Process] In response to the allocation challenges of print book procurement quantities across different categories in university libraries, and incorporating circulation rates, funding assurance rates, and the ratio between discipline-specific and general-interest books, an appropriate allocation model was established for distributing the total procurement quantity between discipline-specific collection assurance volumes and reader demand assurance volumes; based on disciplinary and professional elements, an appropriate allocation model was established for allocating discipline-specific collection assurance volumes among professional disciplines; according to reader borrowing patterns, an appropriate allocation model was established for distributing reader demand assurance volumes among various disciplinary categories. [Results/Conclusions] Through the practical application of print book procurement decision-making at the Hunan University of Science and Technology Library, it was verified that the appropriate allocation model constitutes a complete and rational allocation method, which achieves fundamental assurance for discipline-specific collections, maintains relative balance in the provision of books for reader borrowing, and enhances the borrowing utilization rate of print books.

Full Text

A Study on the Moderate Allocation of Paper Book Procurement in University Libraries

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Abstract

[**Purpose/Significance**] This study constructs a moderate allocation method to facilitate rational distribution of paperback book procurement volumes across disciplines in university libraries. [**Methods/Process**] Based on the allocation dilemma of paperback book procurement across categories, we establish a moderate allocation model between procurement volumes for professional discipline support and reader demand support by integrating circulation rates, funding guarantee rates, and the ratio of professional to non-professional books. We further develop a moderate allocation model for professional discipline support books across disciplines based on disciplinary factors, and a model for reader demand support books across subject categories based on actual borrowing patterns. [**Results/Conclusion**] Through practical implementation at Hunan University of Science and Technology Library, the moderate allocation model proves to be a comprehensive and rational allocation framework that achieves basic guarantees for professional discipline books, relative balance in reader borrowing supply, and improved utilization rates of paperback book circulation.

Keywords: moderate allocation; procurement quantity allocation; paper books; university library

Introduction

With the proliferation of digital reading, university libraries face reduced budgets for paperback book procurement, making it impossible to purchase all needed titles. One of the most effective solutions is achieving balanced allocation of paperback book procurement across different disciplines. However, this remains a challenging problem. Currently, many university libraries still rely primarily on acquisition librarians' experience and subjective judgment for allocating procurement volumes. This subjective approach prevents libraries from establishing procurement arrangements that align with disciplinary development and reader needs, resulting in insufficient support for some disciplines while creating surpluses in others. Achieving symmetric allocation between supply and demand can not only meet the needs of different disciplines but also better manage and optimize procurement costs while improving paperback book utilization rates.

Therefore, investigating how to scientifically allocate paperback book procurement volumes in university libraries to ensure basic support for professional disciplines and relative balance in reader borrowing supply has become an important research topic. Scientific allocation of procurement volumes will help improve paperback book circulation rates and better satisfy reader demands.

1.1 Literature Review

The library science community has long focused on quantitative paperback book procurement and endeavored to address this challenge. Researchers have approached the quantification of book procurement funds from perspectives including collection evaluation, collection structure, and reader demand. Zhang Lin combined theoretical and practical utility of book evaluation to determine fund allocation [1]. Qiao Hong applied the economic principle of "diminishing marginal utility" using linear programming equations for fund allocation to ensure maximum acquisition efficiency [2]. Xiong Xiaoqin and Xu Wenxian developed a model for relatively fair book fund allocation using fuzzy mathematics classification and comprehensive evaluation [3]. Shen Si and Jiang Weihong established a comprehensive evaluation model for acquisition fund allocation by investigating influencing factors and their weights using fuzzy comprehensive evaluation methods [4]. Xie Yaofang allocated funds based on collection structure factors such as book varieties, copies, and average prices [5]. Song Wenfei et al. constructed a procurement fund allocation model using fuzzy bicriteria programming from the perspective of research, teaching, and book circulation utilization [6]. Cai Shilian quantified factors affecting book procurement using weights at different levels and established a fund allocation model based on these indicator weights [7].

Overall, current research on paperback book allocation models in libraries remains relatively limited and unsystematic. First, studies focus on fund allocation among book categories (specifically categories A, B, C···Z in the Chinese Library Classification) while neglecting significant price differences across categories, making effective quantity matching impossible. Second, allocation strategies built from reader demand perspectives fail to comprehensively consider allocation elements across categories and lack systematic investigation into how different elements affect procurement distribution. Third, most allocation methods are static, lacking frameworks for multiple modalities and scenarios—that is, they do not account for how different funding levels, circulation rates, and collection structures affect allocation proportions. Finally, existing methods have not considered paperback book obsolescence, basing allocation primarily on physical collection volumes, which cannot truly reflect supply-demand structure matching.

1.2.1 Research Purpose

This study aims to establish a moderate allocation model suitable for paperback book procurement in university libraries to achieve basic guarantees for professional discipline books, relative balance in reader borrowing supply, and improved utilization rates of paperback book circulation.

1.2.2 Research Approach

This research follows the logical sequence of "dilemma analysis—allocation orientation—model construction—model verification—result processing." First, we analyze current dilemmas and root causes in paperback book procurement allocation. Then, we determine allocation orientation and principles to guide model construction. Next, we develop a feasible model for allocating paperback book procurement volumes. During model construction, we address emerging challenges through thorough discussion. Finally, we process and analyze allocation results to evaluate model effectiveness and feasibility.

1.2.3 Research Methods

1. **Factor Analysis:** We systematically analyze allocation factors for university library paperback book procurement, including procurement funds, collection discipline structure, collection time structure, reader borrowing demand, book obsolescence, and professional program setup. We analyze how these factors differentially affect allocation results, using circulation rates, funding guarantee rates, and professional-to-non-professional book ratios to correlate otherwise incommensurable allocation factors and reduce allocation dimensions.
2. **Data Statistical Analysis:** We collect and organize paperback book procurement data from multiple university libraries, including annual procurement volumes and budget allocations by discipline. Using statistical software, we conduct descriptive statistics and multiple regression analysis to obtain information about relationships between paperback book procurement and disciplinary needs.
3. **Expert Consultation:** This study consulted several library science experts including Wen Tingxiao, Wang Xiezhou, Gong Jiaoteng, Dou Hongqing, and Xiao Jianping, who provided valuable input on scale design and weight allocation to enhance research reliability and accuracy.
4. **Case Study:** Using the 2024 paperback book procurement plan of Hunan University of Science and Technology Library as an example, we calculated procurement volumes for various book categories to verify the rationality of research results.

Through comprehensive application of these methods, this study aims to establish a moderate allocation model for university library paperback book procurement and provide corresponding decision-making support to promote rational utilization of library paperback books and balanced borrowing supply.

2. The Distribution Dilemma of Paperback Book Procurement in University Libraries

The ideal allocation model for libraries should meet requirements of goal consistency, fairness and objectivity, and economic rationality. In practice, however, university library paperback book procurement volumes are influenced by multiple factors, including diverse procurement objectives, funding uncertainty, book obsolescence, changing reader demands, and evolving disciplinary development, which affect allocation of total procurement volumes across book categories to varying degrees. Consequently, no deterministic relationship exists in the allocation of procurement volumes across categories; rather, it changes with specific circumstances.

2.1 Diversified Procurement Objectives Lead to Differentiated Allocation Orientations

University library paperback book procurement has multiple objectives. First, the fundamental responsibility is to meet the learning, research, and reading needs of faculty and students. Second, it provides support and guarantees for disciplinary development by carefully selecting and collecting the latest and most authoritative academic works and reference materials to help faculty and students deeply understand and research their fields. Additionally, procurement aims to build unique collection characteristics that provide distinctive and in-depth reading experiences. Meanwhile, procurement emphasizes academic quality and value, paying special attention to academic standards, author credentials, and publisher reputation. This academic orientation ensures that procured books provide reliable and rigorous academic information to meet university research and learning requirements. In summary, university library paperback book procurement aims not only to meet borrowing needs but also to promote teaching and research development, build characteristic collections, and enhance academic quality and value.

This diversity of objectives leads to different allocation strategies and orientations for each goal. These divergent orientations make it difficult to adopt uniform allocation rules and strategies for distributing paperback books across categories.

2.2 Funding Uncertainty Leads to Changing Allocation Proportions

Annual funding for paperback book procurement in university libraries often varies significantly between years. Funding levels directly determine procurement volumes, which in turn determine allocation proportions across categories. With adequate funding and larger procurement volumes, all categories can be sufficiently purchased, increasing the proportion of general education books (such as categories G, H, I, J, and K). Conversely, with insufficient funding and smaller procurement volumes, procurement gaps for professional books in various disciplines increase, reducing the proportion of general education books.

Funding fluctuations significantly impact paperback book procurement, particularly affecting the procurement proportion of general education books.

2.3 Category Attribute Differences Lead to Non-Uniform Allocation Standards

Universities are comprehensive systems encompassing multiple disciplines. Based on professional attributes, university libraries classify paperback books into non-professional and professional books. Non-professional books are suitable for all or most faculty and students, typically covering categories A, B, C, D, E, F, G, H, I, J, K, O, TP, and Z. Professional books serve specific majors, such as TU category books for architecture and civil engineering students. Professional and non-professional books are relative concepts without clear boundaries; for some minority majors, non-professional books may be considered professional (e.g., category J books for art majors). These two types lack commensurability: non-professional book quantity standards are primarily determined by reader borrowing demand, while professional book standards are determined by both borrowing demand and disciplinary development support needs. Therefore, quantity standards for non-professional and professional books cannot be consistent. Even ignoring disciplinary development factors and allocating procurement volumes solely by borrowing demand, uniform quantity standards are impossible due to different existing collection scales, varying scale effects, and significant differences in borrowing frequencies across categories.

2.4 Book Obsolescence Requires Converting Physical Collection Volume to Effective Collection Volume

Fair allocation of paperback book procurement requires that categories with greater demand but larger existing collections receive smaller procurement volumes, and vice versa. Collection volume is typically understood as physical collection volume—a concrete quantitative indicator. However, book obsolescence affects supply capacity. Book obsolescence refers to the process by which literature gradually loses value as a scientific information source and is increasingly less utilized as it "ages" [8]. Bernal' s negative exponential obsolescence model from 1958 [9] typically uses the function: C(t) = Ke^(-at), where C(t) represents citation counts of literature published in year t, K is a constant, t is publication age, and a represents the obsolescence rate. This model describes how citation counts generally decrease over time.

A considerable number of paperback books have lost their use value or become extremely limited; physical collection volume cannot truly reflect supply capacity. Allocating procurement volumes based on physical collection volume is meaningless, as it neither reflects fairness nor achieves efficiency. To facilitate scientific and rational allocation, this study introduces the concept of "effective collection volume," which represents the true supply capacity of paperback books. Effective collection volume equals physical collection volume minus book

obsolescence volume. However, obsolescence rates vary across disciplines, making it difficult to measure obsolescence volume using uniform time standards, thus complicating rational allocation across categories.

Furthermore, significant differences among various allocation factors make unified quantification extremely difficult, posing substantial challenges to precise allocation of paperback book procurement in university libraries.

3. Allocation and Positioning of Paperback Book Procurement in University Libraries

3.1 The Concept of Moderate Allocation

As discussed above, university libraries cannot achieve precise or optimal allocation of paperback books, yet effective allocation of total procurement volumes across categories is crucial. Therefore, we propose the new concept of "moderate allocation." Moderate allocation is a limited but rational allocation model that distributes resources within certain bounds to ensure quantities or degrees remain within reasonable limits, avoiding excess or deficiency. It emphasizes achieving optimal balance under specific constraints.

Moderate allocation differs from rational allocation. Rational allocation focuses on fairness, justice, and efficiency to ensure each individual or organization receives its due share while maximizing overall benefits. Moderate allocation ensures quantities or degrees remain within reasonable ranges to prevent resource waste or shortage. Rational allocation emphasizes "how it should be," while moderate allocation pursues "this works effectively." Rational allocation requires complete understanding of relationships among all allocation elements and quantities, whereas moderate allocation emphasizes operational feasibility without requiring exhaustive understanding of these relationships. Thus, moderate allocation is more easily achievable than rational allocation.

Based on allocation results across disciplines, paperback book procurement allocation can be categorized into four types: precise allocation, benign allocation, tolerable allocation, and intolerable allocation. Moderate allocation controls procurement volumes between tolerable and benign allocation. Implementation requires considering three aspects: moderate allocation quantity, moderate allocation method, and moderate allocation results. [Figure 1: see original paper] illustrates these three aspects. First, allocation quantities should remain moderate within a certain range, meeting demand while avoiding over-procurement. Second, selecting appropriate allocation methods is crucial, requiring consideration of characteristics and demands of various book categories to ensure results match reality. Finally, allocation results should be moderate.

3.2 The Necessity of Moderate Allocation

First, moderate allocation is necessary to overcome allocation obstacles. Differentiated allocation orientations, non-uniform standards, dynamic proportion

changes, and book obsolescence are major obstacles to rational allocation, making it difficult to meet requirements of goal consistency, fairness, and economic rationality. The most effective way to overcome these obstacles is using moderate allocation to control procurement volumes of various book categories within reasonable ranges.

Second, moderate allocation is necessary to balance fairness and efficiency. Moderate allocation across disciplines emphasizes equal opportunity and symmetrical input-output relationships [10]. On one hand, it ensures all categories receive some paperback book supply; on the other hand, it prevents resource surplus in some disciplines while others lack resources. This ensures rational utilization and allocation of library resources, avoiding waste and imbalance.

Third, moderate allocation is necessary to balance cost and benefit. Theoretically, an optimal allocation structure exists where procurement volumes for all categories are neither excessive nor insufficient—that is, university libraries achieve structural balance under constant conditions. However, this optimal structure represents an ideal cost-benefit equilibrium state that constantly changes in dynamic environments, making it difficult to determine.

3.3 Defining Key Concepts for Moderate Allocation

To achieve moderate allocation of paperback book procurement, we can establish two quantity packages based on procurement objectives: a professional discipline development support package and a reader demand support package. The professional discipline development support package refers to the number of paperback books that should be procured annually to promote disciplinary development. The reader demand support package determines paperback book quantities based on actual reader needs to guarantee borrowing demand. Establishing these two packages helps achieve moderate allocation by providing new book guarantees for professional development while fully meeting reader needs.

Although the two packages overlap to some extent, the impact on allocation is minimal because professional discipline development support involves numerous disciplines, with relatively small allocation quantities for any specific discipline.

3.4 The Moderate Allocation Process

University library paperback book procurement moderate allocation involves two levels and three distributions, as shown in [Figure 2: see original paper]. First, determine the annual total procurement volume S based on annual funding and historical procurement patterns. Second, allocate total volume S between the reader demand support package S1 and professional discipline support package S2 using appropriate methods based on circulation rates, funding guarantee rates, and collection structure ratios. Finally, allocate S1 across categories according to faculty and student borrowing patterns to ensure borrowing demand satisfaction, and allocate S2 across categories according to professional discipline needs to ensure disciplinary requirements are met.

4. Moderate Allocation Calculation Model

4.1 Allocation Between Professional Discipline Support and Reader Demand Support Packages

Let X represent the circulation rate, Y the funding guarantee rate, and Z the professional-to-non-professional book ratio, with corresponding allocation weights a_1, a_2, a_3. Let α be the allocation equivalent for reader demand support based on circulation rate X, β the equivalent based on funding guarantee rate Y, and γ the equivalent based on professional-to-non-professional ratio Z. Then the reader demand support allocation proportion is expressed as:

$$= a_1\alpha + a_2\beta + a_3\gamma$$

where represents the allocation proportion for the reader demand support package. The reader demand support quantity is $S_1 =$ S, and the professional discipline support package quantity is $S_2 =$ (1-)S.

Model (1) is a multi-dimensional calculation model including these basic processes:

1. **Calculate effective collection volume:** First, count physical collection volumes by publication year. Then, calculate borrowing rates for books published in the same year over the past five years, compute discount rates for various categories, and calculate effective collection volume using monetary discounting methods. Alternatively, count borrowing patterns of books published in the same year across different years, reasonably determine depreciation periods, and calculate effective collection volume using depreciation methods.
2. **Calculate effective collection volumes for professional and non-professional books:** Use collection big data to count physical collection volumes by publication year for each type, then calculate effective collection volumes using the discounting method from step (1).
3. **Calculate professional course numbers** (see Section 4.3).
4. **Calculate circulation rate (X):** X = reader borrowing volume / total effective collection volume. Typically, larger X values lead to larger reader demand support allocation proportions.
5. **Calculate funding guarantee rate (Y):** Y = annual total procurement volume / equivalent number of professional courses. Larger Y values indicate more sufficient procurement and larger reader demand support allocation proportions.
6. **Calculate professional-to-non-professional ratio (Z):** Z = effective collection volume of professional books / effective collection volume of non-professional books. Larger Z values indicate insufficient reader demand support books, requiring increased allocation proportion.

7. **Construct allocation scales for X, Y, and Z values:** Different value ranges correspond to different allocation equivalents, as shown in through .

8. **Determine allocation weights for X, Y, and Z values:** Use Analytic Hierarchy Process or other methods to determine weights a_1, a_2, a_3.

4.2 Allocation of Reader Demand Support Package Across Book Categories

Based on effective collection volume V , reader demand support package S_1, average borrowing proportion P for category i, and effective collection volume V for category i, calculate the allocated procurement volume Q for category i based on faculty and student borrowing demand:

$Q = (S_1 + V) \times P - V$

Through Model (1) calculation, S_1 is known. This calculation only requires the average borrowing proportion P for category i, calculated as: P = annual borrowing volume of category i / total annual library paperback book borrowing volume. To objectively reflect borrowing proportions, we use averages from the past 5 or 10 years.

Allocation Model (2) is built on supply-demand structure fairness, which can be expressed as: (effective collection volume of category A + annual procurement volume of category A) / borrowing volume of category A = (effective collection volume of category B + annual procurement volume of category B) / borrowing volume of category B. In university library paperback book development, collection configuration across disciplines should approach reader demand, making collection ratios tend toward circulation ratios [11].

4.3 Allocation of Professional Discipline Support Package Across Book Categories

Based on professional discipline support package S_2 and professional course number Q, calculate the support book volume Q that should be allocated to each professional course j: $Q = S_2 \div Q$.

Through Model (1) calculation, S_2 is known. This calculation only requires professional course quantity Q, determined through four steps: First, count professional courses from undergraduate programs by "course–enrollment–major," merging identical courses at the same level. Second, count professional courses from master' s or doctoral programs by "course–program level," merging identical courses. Third, organize a team comprising student representatives, faculty representatives, and library acquisition staff to determine program level substitution coefficients (undergraduate, graduate, doctoral), enrollment coefficients, and new course coefficients. Finally, calculate weighted professional course numbers using the formula: Weighted professional course number = Σ(course num-

ber × (1 + program level coefficient + enrollment coefficient + new course coefficient)).

Allocation Model (3) is also based on fair allocation: each discipline receives equal professional discipline development support. Considering we cannot accurately understand relationships among disciplines and that discipline bases are generally small (typically under 100), allocating support using factors like scale, level, development positioning, and establishment time could introduce significant errors. Therefore, we use professional course equivalents to allocate professional discipline development support volumes.

4.4 Adjustment of Allocation Results

The moderate allocation in this paper is based on general fairness while considering special circumstances, representing a multi-factor, scenario-based allocation model that is relatively comprehensive, scientific, and rational. However, three issues remain: First, qualitative elements are quantified, and decision-maker subjectivity during quantification may introduce bias. Second, while the allocation between professional discipline support and reader demand support includes faculty-student enrollment coefficients, reader demand (though not linearly stable with enrollment) typically increases with more faculty and students, potentially causing over-allocation for some categories. Third, existing collection structure imbalances lead to huge variations in calculated procurement needs, with some categories requiring large purchases while others need minimal or even negative procurement. Therefore, calculations must be adjusted based on reader demand, professional development allocation, and total annual procurement volume.

5. Verification of the Moderate Allocation Model

This paper uses the 2024 paperback book procurement plan of Hunan University of Science and Technology Library as a case study to calculate procurement volumes for various book categories.

In 2024, Hunan University of Science and Technology Library had a paperback book procurement budget of 1.7 million yuan. With an average price of 52 yuan per volume in 2023, the 2024 procurement volume was approximately 32,000 volumes. Using the above method, we allocated these 32,000 volumes across categories to complete the procurement plan.

5.1 Allocation Between Professional Discipline Support and Reader Demand Support Packages

(1) Determine professional course numbers
For allocating 2024 professional book procurement across majors, the library set course level substitution coefficients (undergraduate, graduate, doctoral), enrollment coefficients, and new course coefficients as shown in , , and . Course-

related enrollments were weighted as: undergraduate = 1, graduate = 1.5, faculty/doctoral = 2.

Based on the curriculum plan for 87 majors, we identified 3,157 courses after deleting duplicates (with enrollments aggregated for duplicate courses). After applying program level, enrollment, and course age coefficients, the weighted professional course count was 3,547.

(2) Establish allocation scales for X, Y, and Z values
Allocation team members independently determined scales for X, Y, and Z values. After removing extremely unreasonable scales and averaging, we obtained the final scales shown in , , and .

(3) Determine allocation weights for X, Y, and Z values
Based on the relative importance of X, Y, and Z to allocation proportion (A), we assigned weights a_1, a_2, a_3 using the Analytic Hierarchy Process. The judgment matrix for A is shown in . Using the eigenvalue method, the weights for X, Y, and Z were determined as 0.40, 0.34, and 0.26 respectively.

(4) Calculate effective collection volume
Based on publication year distribution of borrowed books, we set effective periods at 30 years for arts and sciences books and 25 years for engineering books. From 2019-2023, books published over 30 years ago in arts/sciences were borrowed only 747 times (0.16% circulation rate), and engineering books published over 25 years ago were borrowed only 146 times (0.015% rate). Effective collection volumes by category are shown in .

The effective collection volume for professional books was 572,022 volumes (929,310 - 357,288).

(5) Predict 2024 borrowing volume and calculate X, Y, Z values
Based on 2019-2023 annual borrowing data, we predicted 2024 borrowing volume at 71,000 instances. We then calculated: X = 71,000 ÷ (929,310 + 32,000) × 100% = 7.39% Y = 32,000 ÷ 3,547 = 9 Z = 572,022 ÷ 357,288 = 1.6

(6) Calculate professional discipline support and reader demand support quantities
Reader demand support allocation proportion = 0.4 × 40% + 0.34 × 40% + 0.26 × 50% = 42.6%
Professional book allocation proportion = 1 - 42.6% = 57.4%
Reader demand support allocation = 32,000 × 42.6% = 13,632 volumes
Professional discipline support allocation = 32,000 - 13,632 = 18,368 volumes

5.2 Allocation of Professional Discipline Support Volumes Across Categories

Professional books per course = 18,368 ÷ 3,547 = 5 volumes. Summarized by classification number, we obtained showing procurement volumes by professional discipline.

5.3 Allocation of Reader Demand Support Volumes Across Categories

(1) Predict reader demand for various book categories
From 2013-2022, Hunan University of Science and Technology Library recorded 1,677,907 paperback book borrowings, with subject distribution shown in .

(2) Calculate and adjust procurement volumes
Based on total effective collection volume of 929,310 volumes, reader demand support procurement of 13,632 volumes, effective collection volumes by category (), and borrowing proportions by category (), we calculated reader demand procurement volumes for each category. After adjusting based on borrowing demand proportions and professional discipline allocation results, adjusted procurement volumes are shown in .

(3) Merge professional discipline and reader demand allocations
Combining allocations from and , we obtained final 2024 procurement volumes by category shown in .

5.4 Validation of the 2024 Procurement Decision

Verification through the 2024 moderate allocation model revealed: (1) Over the past two years, the procurement plan received positive feedback from the university's literature resource construction committee, with no objections from discipline heads. (2) The model significantly reduced procurement anomalies compared to previous years, with individual results better reflecting reality. (3) It ended the previous pattern of erratic year-to-year fluctuations in category procurement proportions, ensuring structural stability. (4) Compared with 2022 new book circulation rates, utilization rates for 2023 and 2024 new purchases increased by 7.56% and 8.03% respectively. (5) The moderate allocation model has been adopted by multiple university libraries in Hunan Province for 2025 procurement practice. The model achieves basic guarantees for professional discipline books, relative balance in reader borrowing supply, and improved paperback book utilization rates.

Based on these results, we will propose policy recommendations to provide university library management with specific strategies. These recommendations will focus not only on optimizing literature resource investment but also on exploring pathways to enhance overall university disciplinary levels and strengthen core competitiveness in education and research, thereby promoting comprehensive library service improvement and sustainable development.

6. Research Conclusions and Prospects

The moderate allocation model is a comprehensive framework consisting of Allocation Model (1), Allocation Model (2), and Allocation Model (3). Its goal is to achieve rational allocation of total procurement volume, balancing circulation rates, funding guarantee rates, and professional-to-non-professional book

ratios between professional discipline support and reader demand support. Allocation Model (1) distributes total procurement between professional discipline support and reader demand support based on circulation rates, funding guarantee rates, and professional-to-non-professional ratios, ensuring both disciplinary needs and reader demands are met. Allocation Model (2) distributes reader demand support volumes across subject categories based on borrowing demand, improving reader satisfaction and reading effectiveness. Allocation Model (3) distributes professional discipline support volumes across disciplines based on disciplinary factors, ensuring balanced satisfaction of different disciplinary needs and promoting disciplinary development.

The moderate allocation methodology integrates and extends the fuzzy bicriteria method [6], weight analysis method [7], and Analytic Hierarchy Process [12-14]. During allocation, it controls procurement volumes within appropriate ranges, maintaining consistency with moderate allocation and fuzzy bicriteria concepts while relying on weight analysis and AHP to determine allocation weights, such as those for circulation rate, funding guarantee rate, and professional-to-non-professional ratio.

The moderate allocation model represents an innovation in university library paperback book procurement. First, it focuses on allocating book quantities rather than funds, establishing a balance between demand and supply while avoiding price differences' impact on procurement quantities. Second, it fully considers literature obsolescence by establishing effective collection volumes, making allocation more realistic and scientifically sound. Third, it integrates multiple key allocation elements including collection structure, procurement funds, reader borrowing, disciplinary layout, and literature obsolescence, ensuring rigor and scientific validity. Additionally, it creates a dynamic allocation model that adjusts with changes in circulation rates, funding guarantee rates, and collection structure ratios, featuring multi-modal, multi-scenario, and multi-elasticity characteristics. Finally, the moderate allocation method is highly operational in practice, with clear and straightforward procedures.

The moderate allocation model enables scientific and rational allocation of total procurement volumes to meet both disciplinary and reader needs, improving library service quality and effectiveness. It also provides quantitative references for library management decisions, promoting sustainable development. Implementation at Hunan University of Science and Technology Library verified its scientific rationality, achieving basic guarantees for professional discipline books, relative balance in reader borrowing supply, and improved paperback book utilization rates.

The model has limitations: first, the professional discipline support allocation does not consider reader demand, focusing only on disciplines; second, it requires pre-establishing allocation scales for circulation rates, funding guarantee rates, and collection structure ratios. Future research will focus on: (1) refining these allocation scales, as their reasonableness largely determines allocation accuracy—we will improve construction strategies and iterate based on testing

results; (2) establishing a quality evaluation system for university library paperback book development, incorporating allocation balance as a key component; (3) expanding application domains by developing domain-specific moderate allocation models tailored to different university library characteristics.

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Note: Figure translations are in progress. See original paper for figures.