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Automation System for MARDI Research Information Dissemination

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ABSTRACT

Malaysian Agricultural Research and Development was established in 1969 to conduct study in every agricultural and food scopes except for rubber, palm oil and cacao or cocoa. Until 2020, most of the generated research information was distributed to the public in the form of hardcopy which limits the excess of it. Hence, along with the development of information technology, the information needs to be digitized for automation purposes in order to ensure the effectiveness of dissemination. This paper reports on the automation system for distribution of MARDI research information using a selected system known as Electronic Library System (ELIB). All hard copies of research information were undergone digitalization procedure using a dedicated scanner before being transferred to the system. Later, the produced data in the form of digital softcopy was further combined using Portable Document Format (PDF). The digital data was further converted to electronic publication (ePUB) format and uploaded to ELIB system that consist of several main technical features which include system overview, core functional modules, analytics and reporting engine, infrastructure and deployment, optional add-ons and custom modules. Since the system operated in the year 2021, until May 2025, more than 1500 visitors were recorded as registered users with total spending time up to 6,076 minutes and a total flip of 44,104 pages. The total borrowed books from the year 2021 until May 2025 were 1,239 which could represent 79% of registered users. Based on the data obtained, the automation system which contains MARDI research information has gained interest by the public and is useful for dissemination of it.

INTRODUCTION

Agricultural activity and food production have become a primary source of living for Malaysian since hereditary. The continued growth of its also has given significant effect to the economic generation for the country. Realizing the momentum of the growth, in the early 1905 Department of Agriculture Malaysia was established for the purpose of executing the government

policies regarding agriculture (Rahman, 2012). In order to optimize the agricultural and food production for living fulfillment and economic generation, research and development components need to be included along the chain. In 1969, Malaysian Agricultural Research and Development Institute (MARDI) was established under MARDI Act 1969 to carry out the research and development in every agricultural and food scopes except for rubber, palm oil and cacao or cocoa. Through the establishment of MARDI, the government has allocated long and short term funding in order to seek out new information regarding knowledge and technology for agriculture and food chain development. The long term allocation, the funding was included under government policy such as *National Agricultural Policy (NAP) 1* (1984-1991)*, NAP 2* (1992-1997)*, NAP 3* (1998-2010)*, National Agrofood Policy* (2011-2020) and *National Agrofood Policy* 2.0 (2021-2030) (Wahid Murad et al., 2008; Ministry of Agriculture and Food Industries, Malaysia, 2021). As for short term, the funding was allocated under *Rancangan Malaysia* which covered for five years research needs besides yearly budgetary.

MARDI has been involved in basic science and applied research activities which produced beneficial results in terms of output and outcome nationwide. All the findings were documented accordingly for record evidence and reference for future study. Starting from the establishment of MARDI, all research information was documented in hardcopy. The basic science findings were published under a dedicated journal known as Journal of Tropical Agriculture and Food Science (JTAFS). The first volume was published in 1973 and consists of eight articles. As for the applied science which is usually in the form of technology, the information was documented under MARDI Technology Bulletin and Manual Technology. Some general information which consists of basic and applied knowledge were also published as books and popular writing in the form of a magazine known as Agromedia.

Along with the development of information technology, in 2005 there was a need for digitalization of MARDI research information due certain factors such as physical space for storage, document safety, accessibility besides government policy. Furthermore, the suitable automation system which involved usage of Information and Communication Technologies (ICT) to replace physical manual operations, activities and operation services is needed in order to assist MARDI stakeholders with the information. As reported in many previous studies, automation for knowledge management is crucial in order to ensure the effectiveness of information dissemination (Ikegwuiro et al., 2023; Oinam and Thoidingjam, 2019). Criteria for an effective library automation system should focus on suitable software, hardware, trained personnel and sufficient financial support (Paul, 2023; Prajapati, 2020).

In order to fulfil a part of the MARDI Act 1969 under clause 3 (b) which state “to serve as a centre to collect and distribute information regarding science, technique and economic related to agricultural sector, agricultural related industry and food industry in any approach including publications, report, periodical publication and paper work”, a knowledge centre or commonly known as library was institutionally established in year 1972. To ensure the continuous effort in fulfilment of clause 3 (b) under MARDI Act 1969, this paper will report on the automation system for distribution of MARDI research information.

Research Problem

MARDI has produced a lot of basic knowledge and technology since its establishment. Although dissemination information and technology transfer of the research output have been conducted through hardcover publications and hands-on training, there is still limitation of access to targeted groups such as farmer, academician, student, and corporate. In line with the development of communication networks, there is a crucial need for it to be disseminated through online mediums.

Research Objective

The objective of this study is to create digital data for the automation system of MARDI research agricultural and food information in order to increase dissemination of MARDI generated research information. The evaluation of increment for dissemination was monitored based on registered user, total spending time, total page flip and finally total borrowed book.

METHODOLOGY

Collection of Information

All MARDI physical research data and information were collected and categorized within a cluster such as technical report (journal and manual technology), semi-technical (MARDI bulletin), annual report, popular writing (magazine) and coffee table.

Digitization and Digitalization

The selected and categorized physical data was converted to digital form using CZUR M3000 scanner. This process was carried-out by dedicated operator in order to produce uniform and high-quality digital data. The digital data produced was in form of Joint Photographic Experts Group (JPEG) and Portable Network Graphics (PNG). The digital data was further combined using Portable Document Format (PDF). The digital data was further converted to electronic publication (ePUB) format due to its versatility as reported by Eikebrokk, Dahl and Kesse (2014).

Hardware for library automation

Hardware is crucial for library automation, especially for user and client usage, system administration, monitoring and technical work (Prajapati, 2020). Hence, selection of hardware which include computer, server and printer for automation system of MARDI research information as summarized below:

Table 1: Computer, server and printer specification

Hardware type	Specification
Computer	Pentium IV 64 megabytes of ram, 150-megabyte pen drive, VGA Color Monitor
Server	TCP / IP internet IPV4
Printer	Sharp Laser printer

Software for library automation

The suitable software for MARDI automation system was selected based on certain factors such as user friendly, multiple platforms usage, connectivity, speed, security, and operating cost (Ogbomo and Ogo, 2020). The Electronic Library System (ELIB) was selected by MARDI due its ten major advantages which is i) offline peer to peer sharing, ii) content distribution control, iii) digital rights management (DRM) for content protection, iv) hardware independent to allow it to function in any platform (Windows, macOS, Linux, Android and iOS), v) dynamic cross platform and responsive design, vi) comprehensive analytics inventory, vii) intuitive admin dashboard for library management, viii) cost effective, xi) easy to operate and x) low maintenance cost. The software selected name and technical features involved system overview, core functional modules, analytics and reporting engine, infrastructure and deployment, optional add-ons and custom modules, and the detail as follows:

System Overview

Table 2: System descriptions

Feature	Description
System Name	ELIB (Electronic Library System)
Design Principles	Modularity, Extensibility, Performance

Core Functional Modules

Table 3: eBook Format and Delivery Engine

Feature	Details
Supported Formats	EPUB 2/3, HTML5, MP3 (audiobooks)
Rendering Engine	Adaptive, device-aware, responsive front-end framework
Offline Capability	Service worker caching, Local storage for authorized sessions
DRM Features	Lending period enforcement, Restricted access, Secure content delivery

Table 4: Licensing and Publisher Integration

Feature	Details
Licensing Integration	API and secure XML feed for third-party publishers
License Enforcement	Encrypted
Access Control	Time-limited access tokens

Analytics and Reporting Engine

Table 5: System Dashboard

Feature	Details
Data Visualization	Real-time & scheduled
Technologies	Node.js (backend), PostgreSQL (data warehouse), React (front-end dashboard)

Table 6: eBook Analytics

Metric	Description
Inventory Tracking	Total titles, Borrowed/Reserved counts, Historical trends
Popularity Metrics	Most borrowed/ reserved by month

Table 7: User Behavior Monitoring

Metric	Description
Page Interaction	Time-on-page, Page flips, Session durations
Personalized Views	Custom library per user
Reading Pattern Analytics	Timeline-based reading behavior

Infrastructure and Deployment

Table 8: Hosting Models

Option Type	Details
Hosting	Cloud (AWS, GCP, Azure), On-Premise
Content Delivery	CDN for static and dynamic content

Table 9: Database and Bandwidth Management

Feature	Details
Database Technologies	MySQL (primary), S3-compatible object storage
Data Sync	Real-time jobs with delta replication
Bandwidth Optimization	gzip compression, Smart chunked loading

Table 10: eSecurity Compliance

Feature	Description
Encryption	TLS 1.2+
Security Best Practices	OWASP Top 10 mitigation strategies
Access Control	Role-Based Access Control (RBAC)
Logging & Auditing	Centralized SIEM-compatible log store

Mobile Application Support

Table 11: Mobile Platform descriptions

Platform	Features
Android (Kotlin)	Native app, Offline sync, Push notifications
iOS (Swift)	Native app, Offline sync, Push notifications

Optional Add-Ons and Custom Modules

Table 12: Add-Ons and Custom descriptions

Feature	Description
Multi-language Support	i18n framework integration
Institutional Analytics Integration	LMS, ERP plugin compatibility

Custom Dashboards	Tailored analytics feeds and dashboards

Results and Discussions

Digitization and Digitalization

Digitization process revealed the advantage for each format as shown in Table 1. The JPEG format was found to be suitable for digitization of research data and information in form of publication. The digitization output within this form was found to be smallest compared to PNG which could minimized the size of storage. As for PNG format, it is found to be suitable for complex digital image or picture although it resulted in larger of output compared to JPEG as supported by previous report by Shukla (2023) in study of efficient and optimized usage of various image formats. In additions, PNG format also could retain the image or picture originality compared to JPG which usually decrease the image data in order to achieve the high comprehensive level.

Table 13: Digitization advantages of output format based on MARDI research

Format	Advantage
Joint Photographic Experts Group (JPEG)	Could produce smallest size of digital output
Portable Network Graphics (PNG)	Could produce moderate size of digital output and suitable for complex image digitization

Hardware

The hardware features for executing MARDI library automation management comprising of computer brand Pentium IV 64 megabytes of ram, 150-megabyte pen drive, VGA Color Monitor and Transmission Control Protocol (TCP) or Internet Protocol type IPV4 which useful for connecting devices to internet and networks. As reported in many studies, TCP is responsible for sending or receiving packet in order (FIFO). It resends the missed packet and handles error which important for correct delivery of data (Machora, 2024; Rana et al., 2024: Vadhawana and Yadav, 2024).

Software

The selected software for automation MARDI Research Information known as Electronic Library System or ELIB (Figure 1) generally capable in digital lending, robust analytics and responsive multi-platform ecosystem**.** To date, the software also has been used by other knowledge-based institution throughout Malaysia such as Perpustakaan Negara Malaysia, Perpustakaan Kuala Lumpur, Perbadanan Perpustakaan Awam Melaka, Perbadanan Perpustakaan Awam Pulau Pinang, Perbadanan Perpustakaan Awam Selangor, Perpustakaan Tun Abdul Razak, Universiti Teknologi MARA and many more. All institution has their own focus in utilizing the software for knowledge management. As for MARDI, the utilization specifically focusses on research output for agricultural and food. The system could operate and support various format such as EPUB 2 and 3, HTML5 and MP3 for audiobooks. The system also consists of Mobile

Application Support for Android and iOS besides computer, which made it more versatile. The user application could be browser in two languages either in Malay or English.

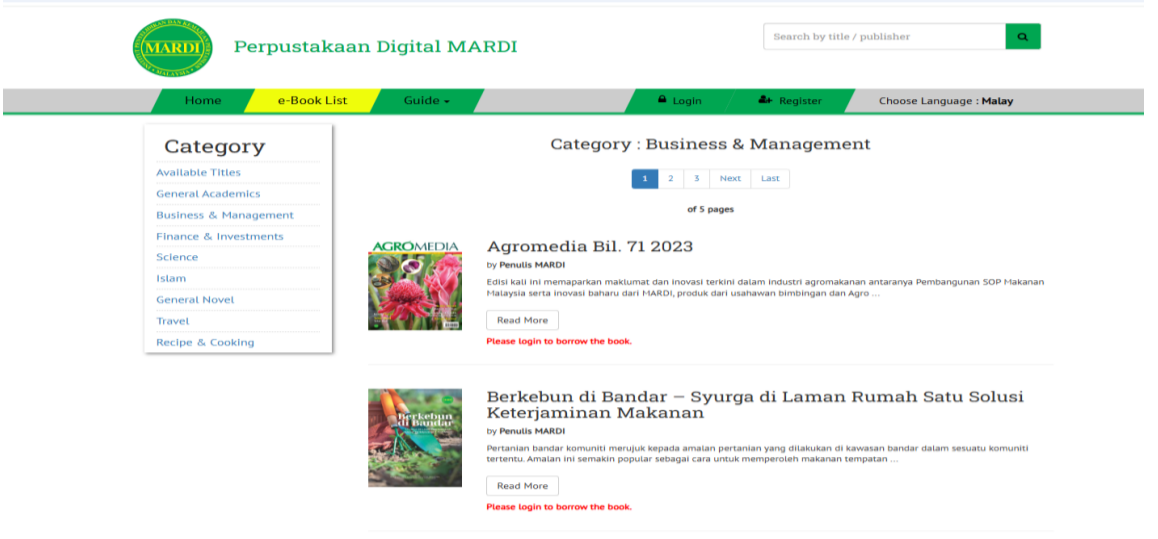

Figure 1. Interface of Electronic Library System (ELIB)

The robustness analytic mainly was monitored by eBook Analytics tools under inventory tracking involving borrowed counts, total titles and historical trends. The system option for this menu also containing popularity metrics which could give interesting information such as most borrowed for certain period. The user usage control or monitoring operation was also equipped in this system. The features involved user page interaction, personalized views and reading pattern analytics.

Since the system operated from 2021 until May 2025, more than 1500 visitors were recorded as registered user. The increasing trend of registered from 2021 to 2025 are shown in Figure 2. In year 2022 to 2023 marked the highest increased of registered user which up to 200%. This could due to awareness of public to spread disease, especially involving human contact such as Covid-19 which burst globally and caused death in large number of populations.

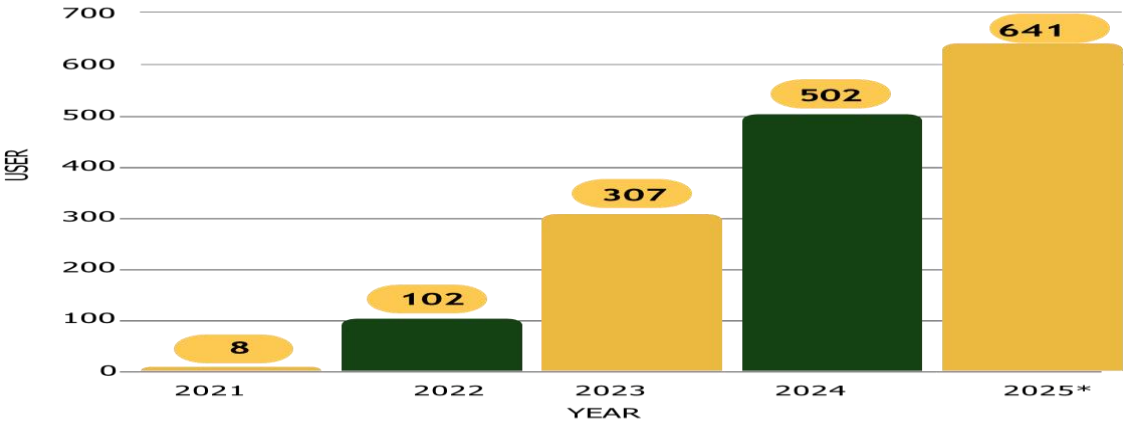

*Figure 2. Registered user by year (2021-2025(*May))*

Monitoring of user behavior such as page interaction, personalized views and reading pattern was also equipped in ELIB system. The page interaction consisting of certain component such as time-on-page, page flips and session durations. As shown in Figure 3, from year 2021 to May 2025, a total of 44,104 flips were recorded. The year 2023 exhibited the highest flips compared to others and these data supported the highest increased of registered user up to 200% within year 2022 to 2023.

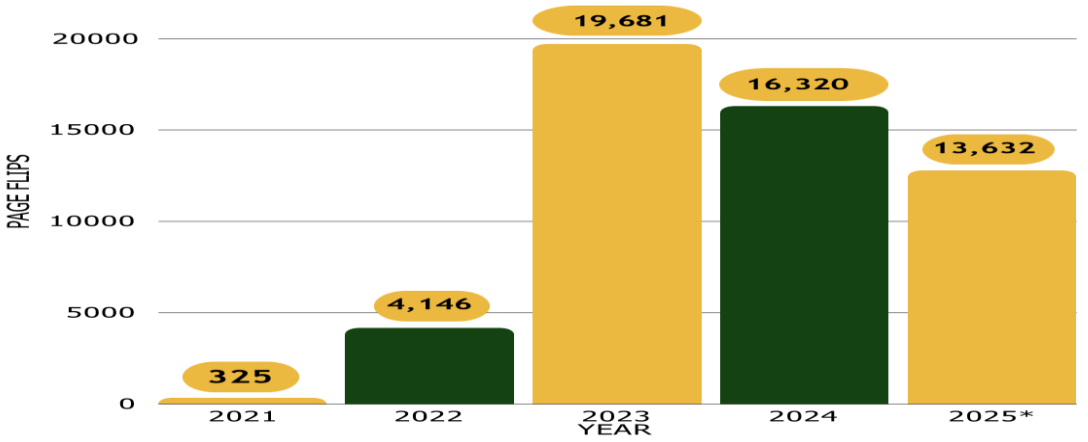

*Figure 3. Distribution Number of Page Flips By Year (2021-2025(*May))*

The total time spend on ELIB application by registered user for year 2021 till May 2025 was found to be 6,076 minutes as shown in Figure 4. Based on the data, 2023 exhibited the highest time spending by registered user with value of 1,591 minutes compared to year 2021, 2022 and 2024. Although the total spending time slightly decrease in 2024 compared to 2023, surprisingly in 2025 until May the value increase tremendously up to 2,660 minutes. The unexpected increasing of total time spending by registered user could be due to promotion of online MARDI book during MAHA 2024. Another factor which has increased the intensity of time spending are the additions of 23 MARDI new collection of publications into the ELIB collection (Figure 5).

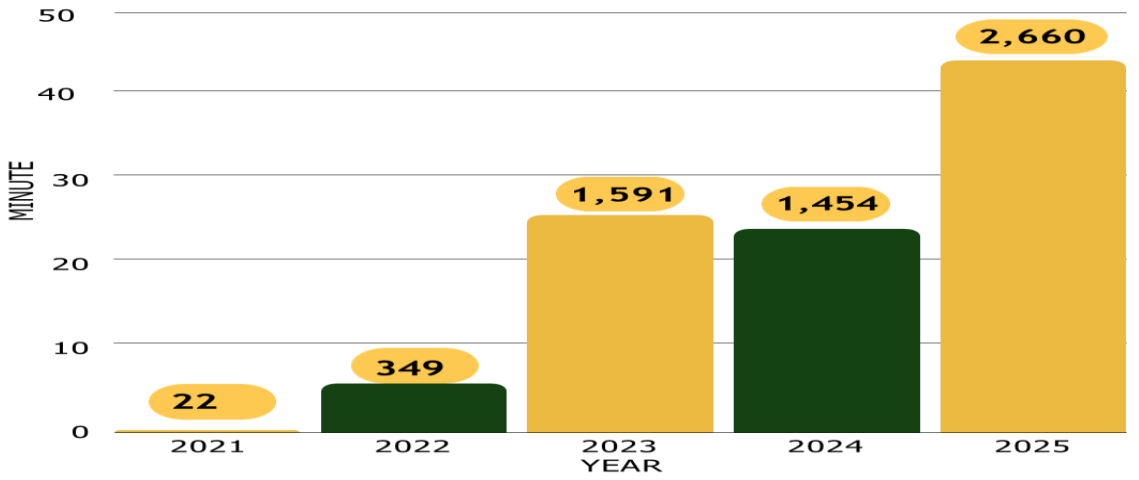

*Figure 4. Total Minute Spend By Year (2021-2025 (*May))*

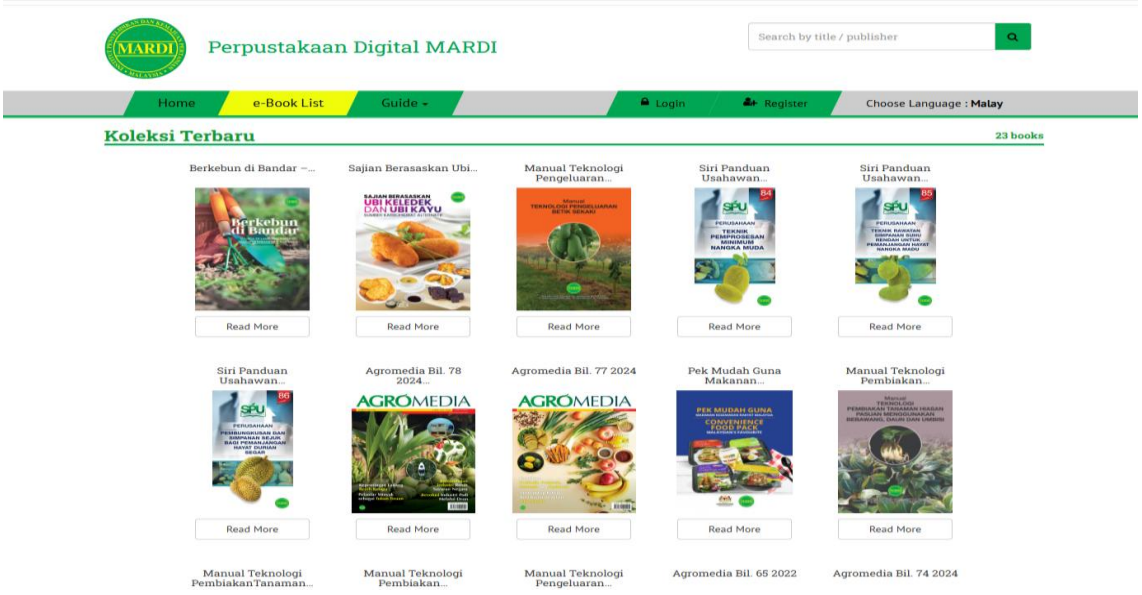

Figure 5. New Collection of Publications Consist of 23 Books

Figure 6 exhibited number of borrowed books from year 2021 till May 2025. A total of 1,239 books were borrowed by registered users with year 2024 marked the highest number with value of 433. As reported same as number of register user, within year 2022 to 2023 recorded the highest trend increasing of borrowed books. The percent increase of it was recorded more than 200%. Based on these data, the increase number of the borrowed books could be due to the increase of registered user.

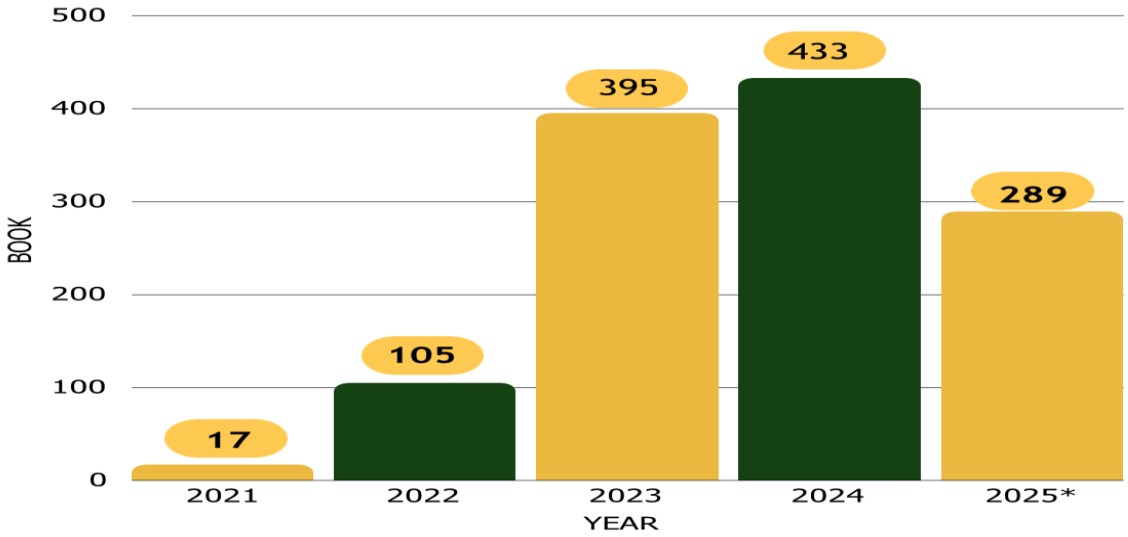

*Figure 6. Distribution number of books borrowed by year (2021-2025(*May))*

CONCLUSION

The automation system known as Electronic Library System (ELIB) has revealed its capability as dissemination tools in distributing MARDI research information based on number of registered users, number of page flips, time spend and number of books borrowed. More than 1500 visitors were recorded as registered user since the system operated with a total of 44,104 flips. The total time spent by registered user was found to be 6,076 minutes. Resulted from the number of registered users, the number of page flips and time spend, a total of 1,239 books were borrowed. These findings also prove that, the system could facilitate continuous effort in fulfilment of clause 3 (b) under MARDI Act 1969 which focus on the distribution of research information. Although the system has attracted a significant number of users, its usage of it could be vitalized through promotion and by adding more collections of information based on agricultural and food research generated by MARDI in the future.

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