



Development of a Popular Science Book on the Population Structure of Kapok (*Ceiba pentandra* Gaertn.) along the Banks of the Aluh Aluh River, Simpang Warga Village, Banjar District, South Kalimantan

Wulandari^{1*}, Dharmono, Luthfiana Nurtamara

¹Universitas Lambung Mangkurat, Banjarmasin, Indonesia

*Email: 2010119229023@hms.ulm.ac.id

Received: 8 Juni 2024 Revised: 20 Agustus 2024 Accepted: 1 Oktober 2024

Abstract

Teaching materials are a collection of books containing information or materials that are arranged in an orderly manner to support the learning process. The kapok plant found on the banks of the Aluh Aluh River, Simpang Warga Village, Banjar Regency, South Kalimantan, has the potential to be a source of learning based on local potential in the form of popular scientific books. This study aims to determine the population structure of kapok plants and determine the feasibility of popular scientific books on the structure of kapok populations as teaching materials for plant ecology. The method used is the 3-phase Plomp development method, namely preliminary research, prototype making phase, and assessment phase. The teaching materials in the form of popular scientific books that were developed have a validity score with very valid criteria and have a student readability score with very good criteria. So it can be concluded that the teaching materials of popular scientific books on the structure of kapok plant populations can be used as teaching materials in the learning process.

Keywords: *Ceiba pentandra*; plants; popular science book; population structure

INTRODUCTION

Teaching materials are a collection of books containing information or content systematically organized to assist learners in studying or seeking information, thereby facilitating the achievement of learning objectives, competency attainment, and the application of acquired knowledge in daily life (Ritonga *et al.*, 2022; Manurung *et al.*, 2023; Nurdin *et al.*, 2023). To facilitate learning, teaching materials are crucial in educational activities. There are two categories of teaching materials: local content materials and general content materials. Local content materials are designed to develop regional potential to improve educational standards, while general content materials provide information about general knowledge (Kusumam & Hasan, 2016; Riefani, 2020; Sarip *et al.*, 2022). Local content education aims to provide learners with knowledge to develop competencies in accordance with regional characteristics and potential, including regional advantages (Mutiara *et al.*, 2019; Alfi & Bakar, 2021; AJ *et al.*, 2024). Local content subjects address social and environmental issues and must include local cultural characteristics, skills, and the noble values of the local culture (Alfi & Bakar, 2021; Angraini *et al.*, 2024; Nazilah *et al.*, 2024).

Popular science books are one type of local content teaching material. Popular science books are books that use clear and straightforward language to present information scientifically based on research results (Fitriansyah *et al.*, 2018; Irianti & Mahrudin, 2021; Nurhana & Ita, 2023). Popular

science books can help students identify objects in the surrounding environment and can be used to connect science with society while improving the learning process. Because the research topics are relevant to everyday life, students will gain a deeper understanding of the material being studied (Irianti & Mahrudin, 2021; Setiana *et al.*, 2022; Banna *et al.*, 2023). Popular science books present information sourced from research results that are presented scientifically. Popular science books are arranged in a clear, concise, and basic manner so that they are easier to understand for students and the general public (Ummy *et al.*, 2021; Nurhana & Ita, 2023; Anggraini *et al.*, 2024).

The kapok tree (*C. pentandra* Gaertn.) is a plant that has many benefits for the community, including preventing soil erosion, preventing flooding and as a shade or protective plant. In addition to the kapok tree trunk being used as a building material, the young fruit is used for cooking and the fruit fiber is used as pillow, mattress, and bolster filling. The fiber from this plant is traditionally used as a mattress filler. Farmers also use the seed cake which has been processed into oil as animal feed (Pratiwi, 2014; Wirastuti *et al.*, 2018; Laksmi *et al.*, 2023). The kapok plant has its own appeal because it has many benefits and potential as a local resource for popular science books that are educational. To increase student awareness of the potential and efforts to conserve the flora of South Kalimantan, teaching materials are needed on this matter. The lack of examples of local plant population structures that can be used as learning resources makes it difficult for students to understand the concept of population (Setiono *et al.*, 2015; Fajrin *et al.*, 2021; Nurtamara *et al.*, 2023).

The results of the needs assessment survey of students in the Biology Education study program, ULM who took the Plant Ecology course showed that the topic of population structure is a challenging topic and students have difficulty in understanding it. Students need additional learning resources, such as popular science books, to improve their understanding of population structure. This need is supported by the results of the survey which showed that 80% of students considered it very necessary and 20% considered it necessary. Based on this, research on the population structure of kapok plants along the Aluh Aluh River in Simpang Warga Village, Banjar District is feasible to conduct. In addition, it is important to ensure that the knowledge and information obtained are well documented, complete, and accurate. Based on this, this study aims to determine the population structure of Kapok Randu and the results will be used as teaching materials based on Popular Science Books in the plant ecology course.

METHOD

This study was conducted along the Aluh Aluh Riverbank in Simpang Warga Village, Banjar Regency to obtain data on the Population Structure Study of Kapok Plants. Sampling used the total exploration method by exploring the environment around the lake. The samples in this study were all Kapok Plants found on the banks of the lake. Observations of the morphology of Kapok plants include: roots, stems, leaves, flowers and fruits. Observations of plant morphology were carried out on adult plant samples using the available plant description format. Then the calculation of samples found at each point includes the pre-productive phase, reproductive phase, and post-reproductive phase based on the individual. The limitations of the three phases are such as, the pre-productive phase has the characteristics of not flowering and fruiting or still budding, the reproductive phase has the characteristics of flowering and fruiting, large and branched stems, and the post-reproductive phase with the characteristics of growing from cut stems. Furthermore, the data is entered into the observation table of the population structure of Kapok Plants.

After knowing the population structure of the Kapok Plant, the data was used in making teaching materials, namely the Popular Scientific Book (PSB). The method used in making teaching materials is the Plomp Research and Development model which consists of three stages, namely preliminary research, prototype making stage, and assessment stage (Ploomp & Nieveen, 2013). The preliminary analysis stage or initial investigation was carried out to collect and analyze information about kapok plants in the pre-reproductive, reproductive, and post-reproductive phases. In addition, at this stage, an analysis of the needs of the kapok plant PSB was also carried out through a user survey. The second stage, namely the prototyping stage, was carried out to compile materials, design, and

create a popular scientific book about the population structure of kapok plants. Then at the assessment stage, validity and readability tests were carried out. The validity test was carried out by two experts, where validator 1 was a lecturer in the Plant Ecology course and validator 2 was a lecturer in the teaching materials development course. The data analysis technique in the PSB developed was that the development process data was analyzed descriptively using relevant literature. The validity formula is:

$$\text{Validity score} = \frac{\sum \text{Validation results}}{\sum \text{Validators}}$$

Before using the validity formula, the number of scores from validators 1 and 2 must be calculated first. The validity results are matched with the validity criteria presented in Table 1.

Table 1. Validity criteria

Score	Validity statement	Information
3.26 – 4.00	Very valid	No need for revision
2.51 – < 3.26	Valid	Minor revisions
1.76 – < 2.51	Less valid	Major revisions
1.00 – < 1.76	Invalid	Total revisions

(Source: Putri *et al.*, 2020)

The results of the readability test were obtained from individual tests by 5 students who received an A in the Plant Ecology course, with the calculation formula, namely:

$$\text{PK} = \frac{\text{Total score of data collection result}}{\text{Criteria score}} \times 100\%$$

Information:

PK as readability percentage (%) and Criteria score as total maximum score readability

The results of the readability test are compared with the criteria presented in Table 2.

Table 2. Content readability criteria

No.	Score	Information
1.	> 80%	Very Good
2.	70 – < 80%	Good
3.	60 – < 70%	Worth
4.	50 – < 60%	Deficient
5.	< 50%	Not Good

RESULT AND DISCUSSION

The taxonomy of kapok plant (*C. pentandra* Gaertn.) as follows:

Kingdom : Plantae
 Divisio : Magnoliophyta
 Classis : Magnoliopsida
 Subclassis : Dilleniidae
 Ordo : Malvales
 Familia : Malvaceae
 Genus : *Ceiba*
 Spesies : *Ceiba pentandra* Gaertn

Based on the results of research on kapok plants on the banks of the Aluh Aluh river, Simpang Warga Village, Banjar Regency. Morphological observations that include plant characteristics as follows. The rooting characteristics of kapok plants can be seen from the shape of the roots, namely the banir roots which are shaped like a board. Banir roots that are shaped like a board function to

strengthen the establishment of a large tall tree trunk. According to the literature, banir roots are shaped like a board, functioning to strengthen plant stands (Apriliani *et al.* 2016; Wirastuti *et al.*, 2018; Laksmi *et al.*, 2023). The kapok plant observed has a stem with monopodial branching, namely the main stem is clearly visible because it is larger and longer. The shape of the kapok stem is round and has thorns. Then, for the kapok plant flower was not found in the observation area, because the research was conducted in February, which is not the time for the plant to flower. According to the literature, kapok flowers have a white to light pink colour and flowering time in August-September (Pratiwi, 2014; Gómez-Maqueo & Gamboa-Debuen, 2022; Laksmi *et al.*, 2023). The kapok leaf is a seven-leafed rayed compound leaf. Fingered compound leaves are compound leaves in which all the leaflets are arranged scattered at the end of the thumb of the stalk like the location of the fingers on the hand. The fruit of the kapok plant has a light green colour in mature plants and dark brown in old plants. Inside the kapok fruit are seeds that are dark brown-black in colour, round in shape and small in size. According to the literature, the kapok fruit is shaped like a capsule with pointed ends at both ends. It measures 5-8 cm in diameter and 10-25 cm long. While the young fruit is green in colour, the ripe fruit is brown in colour. The ripe fruit secretes white fibres (Apriliani *et al.*, 2016; Kuruvilla & Anilkumar, 2018; Gómez-Maqueo & Gamboa-Debuen, 2022). The morphology of the kapok plant can be seen in Attachment 1.

After observing the morphology of kapok plants, then count the number of individuals and calculate the population structure of kapok plants in each growth phase. Individual kapok plants are found in an area of 0.14 km² is the reproductive phase. The results of the calculation of kapok plants on the banks of the Aluh Aluh river, Simpang Warga Village, Banjar Regency are presented in Table 3.

Table 3. Population structure of kapok plants on the banks of the Aluh Aluh river, Simpang Warga village

No.	Growth phase	Total Ind/0,14 km ²	Ind/km ²	Ha (Ind/Ha)
1.	Pre-reproductive	10	71,43	0,71
2.	Reproductive	24	171,43	1,71
3.	Post-reproductive	3	21,43	0,21

The results of the study showed that the pre-reproductive phase was found less than the reproductive phase, while the reproductive phase was found more than the post-reproductive phase. It can be concluded that the individuals that were found in the area of 0.14 km² were the reproductive phase. The research data on the population structure of kapok plants on the banks of the Aluh Aluh River were used to create teaching materials in the form of popular scientific books. The creation of teaching materials was carried out in several stages, the first stage, namely the preliminary analysis stage or initial investigation, was carried out to collect and analyze information about kapok plants in the pre-reproductive, reproductive, and post-reproductive phases. At this stage, a study of the population structure and Plant Ecology RPS was carried out on the population structure material in the Biology Education Study Program, Curriculum 2020. In addition, at this stage, an analysis of the needs of the kapok plant PSB was also carried out through a user survey, by distributing a needs questionnaire to 5 students who had completed the Plant Ecology course with an A grade. The second stage, namely the prototyping stage, was carried out to compile materials, design, and create popular scientific books on the population structure of kapok plants. The developed PSB systematics consists of title, copyright, foreword, preface, table of contents, list of figures, summary, description of kapok plant population structure, cover, bibliography, author biography, and synopsis. The results of the PSB design can be seen in attachment 2.

The final stage, namely the assessment stage, is carried out to obtain data on the validity and readability of the developed PSB. Validity data was obtained from 2 experts, namely a lecturer of plant ecology and a lecturer of teaching material development. Readability data was obtained from 5 students who had completed the Plant Ecology course with an A grade. Then the PSB was published to the public via the Instagram page without any evaluation. Documentation of the assessment stage can be seen in attachment 3. Observing the plant and animal on their natural habitat like forest, lake, beach, mountain will give a great experience for students (Mufida *et al.*, 2023; Laurenza *et al.*, 2023; Al Khairina *et al.*, 2024).

Popular scientific books on the population structure of kapok on the banks of the Aluh Aluh river need to be validated and tested for readability so that they can be used as teaching materials in plant ecology courses on population structure material. The validation test is important so that the author can find out the weaknesses and shortcomings of the book developed, by asking for an assessment from experts or experts. One of the development research activities is to conduct a validation test. With input from validators, researchers can identify any deficiencies or weaknesses in the product that has been made (Astuti *et al.*, 2021; Maisyura *et al.*, 2021; Ramadhan *et al.*, 2024). Based on the results of the validity test that has been carried out by 2 experts, the results of the validation of popular scientific books are obtained as in Table 4.

Table 4. Validation result of popular scientific book

Assessment Indicator	Validators		Average
	1	2	
A. Coherence			
1. Each paragraph in a popular science book has one main idea.	4	4	4
2. Connecting between sentences using conjunctions.	4	3	3,5
3. The ideas are presented in order.	4	3	3,5
4. Sentences have directed the reader to understand the content of the book	4	3	3,5
B. Readability			
5. The content of the text is appropriate for the age/education level.	4	3	3,5
6. Sentences and word counts can gauge the level of the reader.	4	3	3,5
C. Vocabulary: expressions, verbs, choices, redundancy			
7. The use of expressions is limited	3	3	3
8. The words or expressions used do not emphasize a lot of vocabulary.	4	3	3,5
D. Active and passive sentences			
9. Use active and passive sentences.	4	4	4
E. Format			
10. Take the form of scientific writing that displays evidence in the form of data or images that are systematically organized.	4	4	4
F. Writing method			
11. Simplicity and attractiveness of writing.	4	4	4
G. Application, implication			
12. Using real-world problems to attract readers.	3	4	3,5
H. Explanatory definition			
13. Uses, descriptions, examples, analogs or metaphors to facilitate reader understanding.	3	3	3
I. Other style devices: narrative, humor, analogy			
14. Uses analogies to explain complex ideas.	3	3	3
15. Uses narration to explain the ideas presented.	4	3	3,5
Total Score	56	50	53
Average Score		53	
Total Score Content		3,54	
Validity Criteria		Very Valid	

Based on the validity test from 2 validators, out of 9 aspects that have an average value of the maximum value of 4 are aspects of coherence in the assessment indicator of each paragraph in a popular scientific book has one main idea, aspects of active and passive sentences, format, and writing

methods. Other aspects get scores ranging from 3 - 4 which are included in the valid and very valid criteria. Based on the average results of the validity test, the results of the criteria are very valid, with a total score of 3.54. So it can be concluded that the popular scientific book developed has a very valid category. However, the popular scientific book developed still has shortcomings such as expression sentences that are still found, so improvements need to be made. After the validity test was carried out, it was continued with the readability test.

Readability is related to the legibility of reading material by readers. The readability of a text can be used to determine how quickly and easily the text can be understood, as well as how well the main idea can be remembered (Saroni & Mudiono, 2016; Irianti & Mahrudin, 2021; Sarip *et al.*, 2022). The readability test aims to determine whether the use of sentences/language, presentation of material, layout and interaction between texts in the textbook can be used by students to understand the material in it. Readability testing is important to reduce errors that can lead to misunderstandings between the author's intention and the reader's understanding (Dewi & Arini, 2018; Yulianto, 2019; Riefani, 2020). The readability test of teaching materials is carried out to find out the reader's point of view regarding the developed popular scientific book. In addition, from the results of the readability test the author can find out the advantages and disadvantages of teaching materials in the form of popular scientific books developed, so that constructive suggestions and input are obtained for the author before publication. The readability of the contents of popular scientific books is obtained based on individual tests conducted on 5 Biology Education students who have taken and passed the plant ecology course with the condition of obtaining an A grade. The test was conducted to obtain readability data from 5 students. The individual test results obtained are presented in Table 5.

Table 5. Readability test results

No	Statement	Student Assessment Score				
		M1	M2	M3	M4	M5
1.	Every part learned is easy to understand	3	4	4	3	3
2.	The entire content of the PSB is complete (Cover, editorial, preface, table of contents, introduction, main content, references, index, glossary)	3	3	4	4	3
3.	The words used are easy to understand.	4	4	4	3	3
4.	Image quality is good and the meaning can be understood.	4	3	3	3	4
5.	There are no typographical or grammatical errors.	3	3	4	2	2
6.	The photo on the cover is clear and can be understood.	4	4	3	3	3
	Sum	21	21	22	18	18
	Score (%)	87,50	87,50	91,75	75,00	75,00
	Average (%)	83,35				
	Validation criteria	Very good				

The results of the readability test that can be seen in Table 5 show that the popular scientific book that was developed obtained a readability score of 83.35% with a very good category. The popular scientific book that was developed is in accordance with the expected criteria. However, there is no aspect of the readability test that obtained the maximum score because in each part of the popular scientific book there is an explanation that is still not understood, the systematics of the popular scientific book are not yet appropriate, the language in the book is still not understood, there are several unclear images, typos were found, and the photo on the cover is not clear. From the shortcomings in the BPS, suggestions and input are provided for the author, in order to improve the BPS that was developed so that it becomes a better book so that it can help improve students' process skills and increase insight into their local environment (Putri *et al.*, 2020; Noorannisa *et al.*, 2022; Setiana *et al.*, 2022).

CONCLUSION

Based on the results of the research on the Development of Popular Science Books on the Population Structure of Kapok (*Ceiba pentandra* Gaertn.) Along the Banks of the Aluh Aluh River, Simpang Warga Village, Banjar Regency, South Kalimantan, it can be concluded that the population structure of kapok plants on the banks of the Aluh Aluh River has a density value in the pre-productive phase of 71.43 ind/km², the reproductive phase of 171.43 ind/km², and the post-reproductive phase of 21.43 ind/km². The data obtained were then developed as teaching materials developed using the Plomp model. Based on the results of the validity of the PSB teaching materials, the average validity score was 3.54 with the criteria of very valid or feasible to be developed and the student readability test was 83.35 with the criteria of very good so that the Popular Science Book on the Population Structure of Kapok (*Ceiba pentandra* Gaertn.) Along the Banks of the Aluh Aluh River, Simpang Warga Village, Banjar Regency, South Kalimantan is feasible to be used as teaching materials. This research is useful for the nation, especially teachers, because it can be a reference for making teaching materials in the learning process. As well as for researchers as one of the information for further research.

ACKNOWLEDGMENTS

Thank you to all those who have participated in assisting this research. Their support and contributions, both direct and indirect, have been invaluable to the progress and success of this research. Without their help, we could not have achieved the results we have today.

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