



Development Handout about *Bambusa vulgaris* Population Structure in the Lake Sari Embun Region, Kalimantan Selatan as Supporting the Plant Ecology Course Material

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Received: 15 Maret 2024 Revised: 31 Maret 2024 Accepted: 15 April 2024

Abstract

Learning activities can not be separated from the involvement of teaching materials, the use of teaching materials is one effort to create meaningful and quality learning. The students' environment and the surrounding area are rich in local potential, especially the diversity of animal and plant species. This potential can be used as an alternative to support the learning process. Plant population structure is the composition of plant populations that exist in a place. The Yellow Bamboo Plant has the potential to be a source of learning, so the results of the population structure study were made in the form of a locally based handout. The aim of this research is to determine the population structure of Yellow Bamboo (*Bambusa vulgaris*) in the Danau Sari Embun area, Tanah Laut Regency and to determine the suitability of *Bambusa vulgaris* population structure handout in the Danau Sari Embun area, Tanah Laut Regency as supporting material for Plant Ecology courses. The method used is the research and development method of the 5 phase Plomp model. The research results show that the population structure of *Bambusa vulgaris* in the Danau Sari Embun area shows that the *Bambusa vulgaris* population is in critical condition. The handout regarding the population structure of *Bambusa vulgaris* was declared very valid, while the readability test by students obtained very good criteria. It can be concluded that the Handout regarding the population structure of *Bambusa vulgaris* is worthy of being used as teaching material.

Keywords: bambu kuning; *Bambusa vulgaris*; handout; population structure

INTRODUCTION

Education has an important role in forming human resources who have intelligence, peace, openness, a democratic spirit, and the ability to compete in the era of globalization. However, the response in Indonesia to this matter is still less than responsive. However, competitiveness challenges continue to grow, demanding changes in competencies in the world of work. Students' ability to absorb lessons is greatly influenced by the teacher's role as facilitator. Teachers play a major role in the process and results of education, because they fail to translate more operational material in the form of syllabus or open materials. Teaching materials are all forms of material that are arranged systematically to enable students to learn independently and are designed in accordance with the applicable curriculum (Kusumam & Hasan, 2016; Magdalena *et al.*, 2020; Farhana *et al.*, 2021).

Learning activities cannot be separated from the involvement of teaching materials, the use of teaching materials is one effort to create meaningful and quality learning. The right teaching materials will increase students' interest and understanding. Teaching materials can be written and unwritten.

Making teaching materials is based on theories such as learning theory, communication theory, teaching theory, and considers several factors such as changes in situations to enable successful learning. The systematic method of delivery is adjusted to the characteristics of the students. Good teaching materials are arranged from easy to concrete material, there is positive feedback so that it strengthens students' understanding, and can motivate students to learn highly. With teaching materials, the learning process will be more effective because teachers are not only teachers but also facilitators who are able to guide students in understanding the material. And the role of students from listeners is to become active and independent students so that they will get used to directing themselves in learning (Manurung *et al.*, 2023; Nurdin *et al.*, 2023; Puspitasari *et al.*, 2023).

One example of printed teaching materials is handouts. Handouts are summaries of learning materials that contain concept mapping, brief descriptions, and are supported by attractive images and designs so that the learning process will be more enjoyable. Handouts can help students avoid taking notes, complement educators' explanations, serve as student references, motivate students to work harder, remind the main points of the material being taught, provide feedback, and evaluate students (Muliawati *et al.*, 2016; Afrilia *et al.*, 2020; Roesmawati *et al.*, 2022). In the learning process teachers can utilize the resources available in the student's environment to guide the learning process by observing, classifying, predicting and setting goals. Local knowledge can be used as a source of material and an effective tool for collecting information, analyzing, integrating, rearranging material, and reaching relevant conclusions in solving problems that exist in the student environment (Fitria *et al.*, 2017; Gultom *et al.*, 2022; Roesmawati *et al.*, 2022).

A plant that is often found in the community is yellow bamboo (*Bambusa vulgaris*). Bamboo plants generally form clumps and group together in one habitat. Ecologically, bamboo is able to maintain environmental balance because it has a root system that is able to prevent erosion, maintains the hydrological system because it has the ability to bind water, so it can be used as a soil and water conservation plant). *Bambusa vulgaris* grows at an altitude of 742 m above sea level-828 m above sea level, it also was found growing on river cliffs. It usually grows along damp rivers and lakes. People often use it as an ornamental plant and is also a riverside plant with soil and water conservation functions. One of the distributions of it is in the Lake Embun Sari area of South Kalimantan (Sujarwanta & Zen, 2020; Nurdianti & Cahyanto, 2021; Rumahorbo *et al.*, 2022). Population is defined as a group of individuals who are able to mate and occupy a certain cavity. Groups of individuals that form a community come from morphologically and genetically similar species. Population structure consists of density and distribution patterns, plant demography, stage and age, fertility, age structure and stage structure. Sometimes, fast-growing communities keep their average age young. Population structure is important to study to determine the state or condition of a habitat (Ismail *et al.*, 2015; Syarifah & Maulana, 2016; Raihani *et al.*, 2023). It has the same point with animal (Pertiwi & Lathifah, 2019; Ratih *et al.*, 2021; Triacha *et al.*, 2021; Fatonah *et al.*, 2023; Mufida *et al.*, 2023; Putri *et al.*, 2023).

Based on the initial survey, teaching materials are still rarely used in the learning process, students need interesting learning resources in the Plant Ecology course on the topic of population structure which they consider difficult. Seeing the facts in the field that the students' environment and the surrounding area is rich in local potential, especially the diversity of animal and plant species, this potential can be used as an alternative to support the learning process. Based on this, the aim of this research is to determine the population structure of *Bambusa vulgaris* in the Lake Sari Embun area, Tanah Laut Regency and to determine the feasibility and suitability of *Bambusa vulgaris* population structure Handout in the Lake Sari Embun area, Tanah Laut Regency as Plant Ecology course supporting material.

METHOD

This research was conducted in the Danau Sari Embun Area, Tanah Laut Regency to obtain data regarding the study of the structure of the *Bambusa vulgaris*. The Telaga Sari Embun area has an area of 50 Ha with a circumference of 2 km. Sampling was taken using the total roaming method by exploring

the environment around the lake. The samples in this study were all yellow bamboo found on the edge of the lake with a width of 10 meters from the water's edge. Observation of the morphology of *Bambusa vulgaris* includes: roots, stems, leaves, flowers and fruit. Plant morphology observations were carried out on adult plant samples using the available plant description format. Then the sample calculation at each point includes the pre-productive phase, reproductive phase and post-reproductive phase based on the individual. Next, the data is entered into the *Bambusa vulgaris* population structure observation table.

After knowing the population structure of *Bambusa vulgaris*, this data was used in making teaching materials in the form of handouts. The method used in making teaching materials is R&D (Research and Development). The process of making handouts follows the steps of the 5 phase Plomp model. Product creation begins at the second stage, namely the design stage, designing the framework which consists of arranging handout materials and creating handout designs (title page, copyright work, foreword, table of contents, table list, list of images, competition to be won, introduction, literature review, review of Sari Embun lake, population structure of *Bambusa vulgaris*, conclusion/summary, evaluation, bibliography, glossary and author biography), followed by the realization stage to realizing the product (designing the cover, compiling the contents of the handout, preparing the endout and printing the handout), then the stage test, evaluation and revision, at this stage expert tests and individual tests are carried out, the research subjects are 2 experts or experts as validators consisting of 2 supervisors and 3 students as examiners. The final stage is the implementation stage to socialize the product to the media.

The validation instrument was used to obtain data on the validity of the *Bambusa vulgaris* population structure handout in the Danau Sari Embun Area, Tanah Laut Regency, including aspects of suitability of content, aspects of material presentation from the readability aspect. The student readability instrument was used to obtain data on the readability of the content validity of *Bambusa vulgaris* population structure handout in the Danau Sari Embun Area, Tanah Laut Regency including aspects of understanding parts, contents, sentences and images as well as a student user survey instrument used to obtain analysis data on the need for the Plant Population Structure handout. *Bambusa vulgaris* in the Danau Sari Embun Area, Tanah Laut Regency covers aspects of the handout needs of students taking the Plant Ecology course. The final stage is the implementation stage to socialize the product to the media.

RESULT AND DISCUSSION

Based on the results of research on *Bambusa vulgaris* in Lake Sari Embun, Bati-Bati District, Tanah Laut Regency, which was carried out using total exploration methods and morphological observations which included the following plant characteristics. The results of observations of the roots of *Bambusa vulgaris* are that the roots have lots of fibers and the rhizome roots are brownish white. *Bambusa vulgaris* has a fibrous root system, each rhizome root has shoots which will then develop and grow into new rhizome roots, which ultimately become parts that grow upwards to form bamboo shoots which then become reeds, roots. The rhizome is rust colored (Hastuti *et al.*, 2018; Sujarwanta & Zen, 2020; Sarmila *et al.*, 2022). The root morphology can be seen in Figure 1



Figure 1. Root morphology of *Bambusa vulgaris* plants

Based on data from observations, the morphological form of the leaves is in the form of a single leaf with a lancet-shaped layout, flat leaf edges, the upper (adaxial) surface of the leaf has rough hairs while the lower (abaxial) has fine and dense hairs, the color of the edges, the base is pointed with a tapered tip, texture like parchment and a length of around 16 -28 cm and a width of around 1.5 – 4.5 cm. The morphology of *Bambusa vulgaris* leaves is as presented in Figure 3 below. *Bambusa vulgaris* leaves have single leaves, about 15-30 cm long and about 3-6 cm wide. With a spread out shape, the shape of a slender shape, the upper surface of the leaf has rough hair, the color of the leaf is green, the edge of the leaf is flat, the base is pointed with a pointed tip, the texture is like parchment (Sujarwanta & Zen, 2020; Heriadi *et al.*, 2022; Ruma *et al.*, 2022). *Bambusa vulgaris* leaves can be seen in figure 2.



Figure 2. Morphology of *Bambusa vulgaris* leaves

Based on observations, this *Bambusa vulgaris* was found growing around the edge of Lake Sari Embun with the following characteristics: habitus includes trees around 10-15 m tall, has one branch larger than the others, round shape, smooth surface, green color with yellow stripes, smooth surface, has an upward direction of stem growth, green shoots, at the lower stem nodes there are several aerial roots and has erect reed fronds that shed easily. *Bambusa vulgaris* has slender, triangular shoots, green midrib, rounded ears, erect shoot midrib. The surface of the stem is smooth, the color of the stem is yellow with green stripes. The stem height is estimated to reach 10-20 m from the ground surface to the top of the stem, the length of the segments is 20-40 cm, the thickness of the stem is 4-5 cm. One branch is bigger than the other branches. The surface of the stem frond is covered with black hairs, the fronds are easily separated from the stem, the shape of the fronds is upright, triangular in shape and easily sheds (Sakmar & Susilawati, 2020; Sujarwanta & Zen, 2020; Sarmila *et al.*, 2022). So the morphology of *Bambusa vulgaris* stem is as presented in Figure 3 below.



Figure 3. Stem Morphology of *Bambusa vulgaris*

At the time of the research, flowers and fruit were not found in the Lake Sari Embun area. This is because the flowering bamboo plants in the reproductive phase are old and the stems are starting to rot, whereas in the research area a lot of young bamboo has been cut down, this is what causes there to be no flowers. *Bambusa vulgaris* also flowers once in its life and then dies. *Bambusa vulgaris* flowers every 7-20 years. One generation does not necessarily flower because bamboo plants flower very rarely, that is, they occur over a very long period of time (Hastuti *et al.*, 2018; Heriadi *et al.*, 2022; Ruma *et al.*, 2023). The results of research on the population structure of *Bambusa vulgaris* plants in the Danau Sari Embun area, which are displayed in 3 phases, can be seen in table 1.

Table 1. Features of Population Structure

Parameters	Phase Characteristics		
	Prereproductive	Reproductive	Postreproductive
Height (m)	<2.7	2.7 – 8.4	≥8.4
Rod diameter (cm)	<3.82	3.82 – 6,69	± 6.69
Other features	Not yet flowering/fruiting	Large stem, Flowering/fruiting	The stem grows from a felled stem

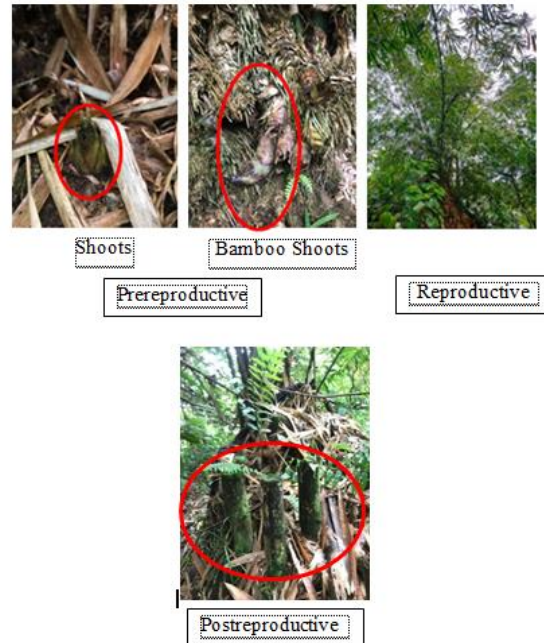


Figure 4. *Bambusa vulgaris* plants at each age phase

After doing the calculations, the results are found as in Table 2.

Table 2. Population Structure of *Bambusa vulgaris* in Lake Sari Embun Area.

No.	Phase	Total Number Ind/2.5 Ha	Ind/Ha	Km 2 (Ind/km ²)
1.	Prereproductive	84	33,6	3.360
2.	Reproductive	259	103,6	10.360
3.	Postreproductive	271	108,4	10.840

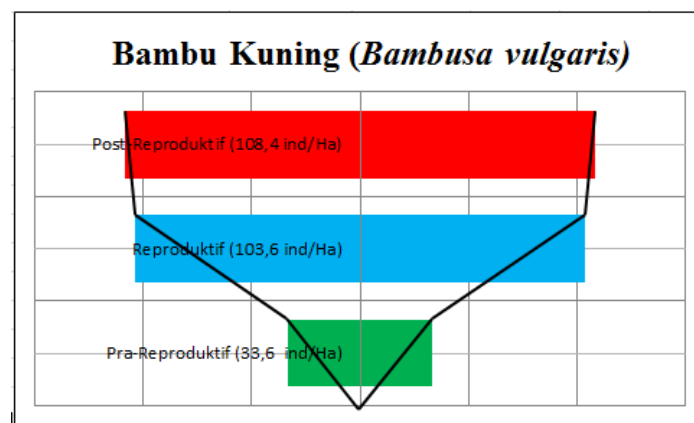


Figure 5. Plant Population Structure Pyramid

The data in table 2 shows that the number of individual *Bambusa vulgaris* plants in the DSE Area consists of the pre-reproductive phase, reproductive phase and post-reproductive phase, where many individuals are found on 2.5 hectares of land. The pre-reproductive phase was 33.6 Ind/Ha, the

reproductive phase increased to 103.6 Ind/Ha, and the post-reproductive phase increased again to 108.4 Ind/Ha. Polygon pyramid shape or bell shape with the development of the number of young age groups in balance with the older age groups. That if deaths occur at sufficient sequential levels, to mature the age level, the population size will be stable if the number of individuals and the population distribution remain the same (Syahdi *et al.*, 2016; Syarifah & Maulana, 2016; Raihani *et al.*, 2023). Based on the results of calculations regarding the population structure of *Bambusa vulgaris* in the Lake Sari Embun area, it was found that the number of adult individuals was greater than the number of young individuals, making it an inverted pyramid. The shape of the age pyramid consists of a pyramid with a wide base, a bell-shaped polygon and a vase or jug shape. The research results obtained do not match the existing shape of the age pyramid, so the researchers are of the opinion that the population structure with a greater number of adult individuals has an age pyramid in the form of an inverted polygon. This shows a high percentage in the adult age group compared to the young age group, which means that the *Bambusa vulgaris* is in decline or threatened (Ismail *et al.*, 2015; Setiono, Dharmono *et al.*, 2015; Syahdi *et al.*, 2016). Plants that are able to survive environmental factors and compete with each other will continue to develop and species that cannot will become extinct. This proves that an organism cannot be separated from environmental influences, including *Bambusa vulgaris*. Population structure in plants is influenced by several factors, namely: 1) mortality, 2) natality, 3) habitat, 4) human activity. The role of these factors in the population structure of *Bambusa vulgaris* in the Danau Sari Embun Area, Tanah Laut Regency (Setiono *et al.*, 2015; Syarifah & Maulana, 2016; Raihani *et al.*, 2023).

The data that has been obtained is then used as teaching material in the form of handouts. The handout is adapted to the curriculum in the plant ecology course. The handout contains the title page, copyrighted work, foreword, table of contents, list of tables, list of images, competition to be won, introduction, literature review, review of Sari Embun lake, population structure of *Bambusa vulgaris*, conclusion/summary, evaluation, bibliography, glossary and author biography. Handouts are made attractive with various colors and images so that they are expected to increase student motivation in learning. The handouts created are then validated by 2 experts. Product validation is very important so that the weaknesses or shortcomings of the teaching materials being developed can be identified for their relevance, accuracy, language and learning. Expert testing and validation conducted with expert respondents is useful for reviewing initial products and providing input for improvements (Warti, 2018; Astuti *et al.*, 2021; Eliana *et al.*, 2022). Based on the results of 2 validators as well as lecturers in the Plant Ecology course, revisions were made to the handout developed. So the results obtained can be seen in Table 3.

Table 3. Results of scientific book validation by 2 validators

ASSESSMENT INDICATORS	VALIDATORS		Average
	1	2	
1. Aspects of Feasibility of Teaching Material Content			
A. Conformity of material with SK and KD	3	3	3
B. Accuracy of Material	3,5	3,5	3,5
C. Supporting Learning Materials	3	3,5	3,25
D. Update of Material	3,25	3,5	3,375
Validity Score			3,28
Validity Criteria			Very valid
2. Aspects of Assessment of Teaching Material Discussion			
A. Straightforward	3	3,67	3,335
B. Communicative	3	3,5	3,25
C. Dialogic and Interactive	3	3,5	3,25
D. correspondence to the level of development learnes	4	3	3,5
E. Luck and the Integration of Thought Flow	3	4	3,5
F. Use of Terms, Symbols, and Icons	3	4	3,5
Validity Score			3,39
Validity Criteria			Very valid
3. Feasibility Aspects of Presenting Teaching Materials			
A. Presentation Techniques	3	4	3,5
B. Serving Population	3,5	3,75	3,625
C. Learning Presentation	3	3	3
D. Material Completeness	3,33	4	3,665
Validity Score	3,18	3,565	3,45
Validity Criteria	Valid	Very valid	Very valid
Total Validity Average Score			10,12
Total Validity Criteria			3,37 (Very valid)

In the aspect of assessing the appropriateness of presentation, it is divided into indicators, namely presentation technique, presentation support, learning presentation and completeness of presentation. In the type of handout for practical subjects, the composition of the handout has provisions, namely the main material for practical activities, consisting of steps or process activities that students must carry out. The style of the text should be consistent and harmonious with other visual elements, the size and

spacing should be adjusted for readability, and the color of the text should contrast with the original background color. This language suitability aspect assessment is intended to assess the language of the handouts that will be developed by paying attention to linguistic aspects so that the language in the handouts is good in terms of expert validator assessment. The average validation of the two assessors for the handout teaching materials they created obtained an average score of 3.37 with very valid criteria, the development of teaching materials received linguistic validation with a good predicate so they are suitable for use (Muhammad, 2016; Hanifah *et al.*, 2020; Siregar *et al.*, 2022). Based on the results of individual tests on students, there are 3 students who have completed the Plant Ecology course and received an A. Individual test scores can be seen in table 4

Table 4. Student Individual Test Result

No.	Aspect	Student 1	Student 2	Student 3
1.	The cover design is good and shows the contents	5	5	5
2.	The images in the Handout are good and fit the topic	5	4	5
3.	Images presented in the Handout are clear/not blurry	5	5	5
4.	The writing in the Handout uses clear letters, a mixture of letters, colors and images	5	4	4
5.	The sentences in the Handout are easy to interpret	5	5	5
6.	The images in the Handout are clear and easy to interpret	5	5	5
7.	The terms in the Handout are easy to interpret	5	5	5
8.	The material in the Handout is neatly arranged	5	5	5
9.	No sentence has the same meaning	5	5	5
10.	Plant Ecology material can be interpreted	5	5	5
	Amount	50	48	49
	Validity Score (%)	100%	96%	98%
	Average (%)		98%	
	Criteria		Very good	
	Criteria		Very good	

Based on the results of the student readability test in table 4 above, students stated that this handout was very good to use. A readability value of >80% is declared as very good teaching material (Arikunto, 2016; Nurfazillah, 2018; Partono *et al.*, 2021). This shows that the teaching materials are easy to understand and easy for students to apply in everyday life. In this test, students provide assessment criteria from the lowest, namely 2 (fairly good) with a score of 1, namely in the aspect "The writing on the handout uses clear letters, a combination of letters, colors and images that are harmonious." Meanwhile, other aspects range from a score of 3 (good) to a high score of 4 (very good). This readability test is important to carry out so that the teaching materials developed are appropriate to the conditions of students who will use them in the real field. Apart from that, teaching materials that are appropriate to students' characteristics enable students to learn independently, thus adding to

students' learning experiences. The development of teaching materials that are prepared must be contextual, meaning that they come from the closest environment and are familiar with everyday life (Bahri *et al.*, 2017; Fajrin *et al.*, 2021; Nurfitri *et al.*, 2022). This thing will be beneficial to human like these research products (Istiana *et al.*, 2019; Saputri *et al.*, 2020; Pertiwi & Saputri, 2020; Saputri & Pertiwi, 2021).

CONCLUSION

Based on research results in the Danau Sari Embun Area, Tanah Laut Regency, the population structure has a density value in the pre-reproductive phase of 336 ind/km², in the reproductive phase of 1,036 ind/km², and in the post-reproductive phase of 1,036 ind/km² and phase 1,084 ind/km² with an inverted polygon pyramid, according to IUCN calculations *Bambusa vulgaris* population is in critical condition because the number of adult individuals in 1 km² is less than 25 individuals. *Bambusa vulgaris* population structure handout teaching material in the Danau Sari Embun Area, Tanah Laut Regency has an average validity score of 3.37 with very valid criteria or worthy of development and a student readability test of 98% with very good criteria. This research is useful for the nation, especially researchers and teachers because it adds new knowledge and insight regarding the population structure of the *Bambusa vulgaris* and also adds information for making teaching materials in schools.

ACKNOWLEDGMENTS

The author expresses his gratitude to the head of the Biology Education Study Program at Lambung Mangkurat University, Dra. Hj. Sri Amintati, M. Si and Dr. Dharmono, M.Si as Supervisor, the entire Lake Sari Embun research team, and to PT. Bridgestone Kalimantan Plantation has supported this research.

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