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trn:oid:::1:3074459745

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MANAGEMENT ASPECTS OF FOOD BIODIVERSITY CONSERVATION EDUCATION IN FULFILLING SCHOOL-BASED NUTRITIONAL NEEDS AND FOOD SECURITY

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Article History:
Received:
Revised:
Accepted:
Published:

Abstract: The results of this study propose a conceptual model of "The triangle and five-pillar aspects of food biodiversity conservation management in schools" as a consideration for implementing policies to meet the nutritional needs of students and school-based food security in Indonesia. This study was conducted considering that the Indonesian government has plans to intervene to improve student nutrition in schools and improve the Global Hunger Index ranking, which ranks Indonesia as the third worst in Southeast Asia. The research was exploratory in nature using mixed methods. The research subjects were teachers, principals, non-teaching work teams and supervisors in schools that have implemented Food Biodiversity Conservation (FBC) for student nutrition. The sample was determined sequentially and gradually reduced according to the criteria. The instruments used were questionnaires, observation sheets and workshops. Data analysis and validation were carried out through triangulation methods, namely: surveys, interviews and three stages of workshops, namely workshops: screening, conservation actors and confirmation. Source triangulation included teachers, principals, non-teacher FBC working teams and school supervisors. The results of the study show that schools implementing FBC have three main aspects of management, namely philosophy, policy and implementation. Each aspect has sub-aspects and sub-sub-aspects. The three dominant aspects and sub-aspects are interrelated to form a triangular pattern. Conceptually, the triangle model of FBC in schools is new to conservation education research. Practically, this research is expected to assist policy makers in implementing programs to improve student nutrition, and communities and governments in their efforts to achieve national food security and independence.

Keywords: biodiversity, conservation, nutrition, food, students, management.

满足学校营养需求和粮食安全的粮食生物多样性保护教育的管理方面

摘要：本研究的结果提出了"学校食品生物多样性保护管理的三角方面"的概念模型，作为在印度尼西亚实施满足学生营养需求和学校食品安全政策的考虑因素。这项研究是考虑到印度尼西亚政府计划进行干预，以改善学生在学校的营养，并提高全球饥饿指数排名，使印度尼西亚在东南亚排名第三。 该研究是使用混合方法的探索性研究。研究对象为实施食品生物多样性保护（FBC）以满足学生营养的学校的教师、校长、非教师工作团队和主管。样品按顺序测定，根据标准分阶段减少。该工具使用问卷、观察表和研讨会。数据分析和验证采用三角测量方法进行，即：调查、访谈和三个研讨会阶段，即研讨会：筛选、保存和确认。同时，三角来源包括教师、校长、非教师FBC工作团队和学校督导人员。研究结果表明，

实施FBC的学校在管理上主要有3个方面，即理念、政策和实施。 每个方面都有子方面和子子方面。 这三个主要方面和次要方面相互关联，形成一个三角形图案。从概念上讲，学校中的 FBC 三角模型是保护教育研究中的新事物。 实际上，希望这项研究能够帮助政策制定者实施改善学生营养的计划，并协助社区和政府努力实现国家粮食安全和独立。

关键词：生物多样性、保护、营养、食品、学生、管理。

1. Introduction.

The 2024 Global Hunger Index report states that Indonesia is the third most hungry country in Southeast Asia. The report states that 7.2% of Indonesia's population is undernourished, 26.8% is stunted, 10.0% is wasted, and 2.1% of children under five are dying [1].

Hunger is an uncomfortable or painful condition of the body due to insufficient energy from food or malnutrition, so hunger is also called a state of malnutrition [2]. Hunger or malnutrition in children will cause various dangerous health cases. In addition to affecting body growth, it will also inhibit brain development, leading to reduced intelligence during childhood and into adulthood [3].

School age is a vulnerable age and determines the future of a person and a nation [4]. Indonesia has set a development goal of 2045 as a golden age called "Golden Indonesia". At that time, Indonesia will reach various peaks of development success, which will be obtained from the brilliance of thinking of the nation's children who are educated today.

Schools play a strategic role in building human resources. On the other hand, food biodiversity is a world treasure that plays a strategic role in providing germplasm for food, medicine, recreation and other purposes [5]. Indonesia is known as the world's second richest country in biodiversity after Brazil [6]. The problem is that until now, almost all schools in Indonesia have not played an active role in FBC to address the national problem of undernourished or hungry children [7, 8]. As an agricultural country, Indonesia currently imports a very large amount of vegetables to meet domestic needs.

This is a development contradiction between the possession of high biodiversity wealth and the reality of poverty, malnutrition and hunger [6]. In contrast, Brazil is the richest country in terms of biodiversity, but its government is able to implement a good school feeding program. The community is involved in sourcing healthy food, including biodiversity community groups [9].

Saylan and Blumstein [7] stated that current education has failed to provide students with the opportunity to develop food resources and live in harmony with nature in a sustainable manner. Food biodiversity conservation (hereinafter abbreviated as FBC in this paper) for the provision of healthy food in a sustainable manner in schools in many countries, including Indonesia, has not been widely practiced [6, 5]. Conservation activities in schools are mostly focused on learning activities [7].

Given the very strategic position and role of schools in overcoming the food and nutrition crisis, strengthening schools in implementing FBC management will directly help students, communities and governments to overcome the problems of malnutrition and hunger. It will also improve the quality of education [7, 8, 10].

The problem is that there is no research that specifically examines aspects of FBC management in Indonesian schools. The existing literature still provides information on learning and conservation education techniques in schools [11, 12, 13].. Recent research conducted in Berlin, Germany [14], focused on plant-based foods, but did not cover biodiversity as a whole, such as fish as a source of protein. Another study, conducted in the United Kingdom [15], emphasized student diets as a consideration for policy making in the school food system.

Biodiversity conservation activities require implementation strategies and management that are appropriate to the location and stakeholders [16, 17, 5]. Conservation management will differ from one institution in one location to another [17]. Similarly, FBC in one school will be different from FBC in another school. However, from these differences, there may be important management aspects that are common and determine the success of these activities.

It is hoped that this research will provide an important overview of the management aspects of FBC in schools and the relationships between these aspects and sub-aspects of management to help improve student nutrition and build school-based food security.

2. Theoretical Basis

2.1 School Food Systems and Management

The most recent research on school food systems was conducted by Maria Bryant in the United Kingdom [15]. The research explores and explains in detail about the foods that students like, then explores what things are related to the student food system at school. The research aims to inform policy-making on student food in schools.

The study uncovered 202 factors that exist in the student food system at school. The factors were grouped into 27 nodes. The factors were analyzed thematically and four main themes were identified: leadership-curriculum, children's preferred foods, home environment, and school food environment. The factors were qualitatively analyzed for their relationships. The results showed that the related factors were school resources, initiatives, students' preferred foods, feasibility of free meals, family conditions, eating behavior, friends, priorities of the principal and senior leaders. The conclusions of the study indicate the need to consider student and school factors when developing school food policies [15].

Previous research by Leonie K. Fischer [14] on the role of plant biodiversity in school gardens in providing healthy food to students in Germany. The results showed the importance of biodiversity in school gardens to support students' dietary health and to maintain food biodiversity, especially local foods in urban areas, which are disappearing and are increasingly unknown to students.

These two studies are examples of the importance of FBC for the health and future of students. Local biodiversity should be part of students' lives where they live. This understanding is important so that students can survive and contribute to the world through the local food they grow. Instead, students become dependent people from childhood to adulthood. Even more tragic is that the food biodiversity they have will be extinguished before it is used.

The destruction of biodiversity in a region and in the world is caused by irresponsible human behavior [18, 19]. Meanwhile, building behavior is done through educational activities, including building friendly behavior toward biodiversity [9]. Thus, biodiversity conservationists are people who are given the opportunity to educate and learn about biodiversity [7]. Inadequate knowledge and attitudes will produce people who behave badly and irresponsibly, causing damage in the short term and destruction in the long term [12].

The Indonesian government has a voluntary policy for schools to implement an environmentally friendly school program called the Adiwiyata School Program. This program prioritizes conservation and sustainability efforts in environmental aspects, including biodiversity [20]. The Adiwiyata Program has defined the steps of environmental education management in a school. Schools that already have experience in environmental education management will find it easier to implement the FBC program in the school because it is considered a form of Adiwiyata program development.

2.2 Reference to FBC Management in Non-School Educational Institutions in Indonesia

Indonesia is known to have three models of educational institutions recognized by the government, namely; the school education model or called formal educational institutions, and non-school educational institutions in the form of pesantren called informal educational institutions, as well as courses called non-formal educational institutions [21].

Food biodiversity conservation activities are known to have been going on for a long time and are considered to be integrated into the pesantren educational institution [22, 23]. This is due to the history of the establishment of the pesantren itself, whose establishment and operation cannot be separated from two main things, namely religious education and agricultural life skills. Students called "santri" learn religion from a teacher called "kya" without having to pay fees, but by helping the kya plant, tend, and harvest food crops and manage other agricultural enterprises [24]. In this way, Santri learn and master two sciences at the same time, namely religious science and agricultural science [23].

Motivasi pengelola pesantren dalam FBC tidak hanya didasari oleh kebutuhan, akan tetapi juga karena didasari pemikiran yang bersifat filosofis [24]. Lembaga Pendidikan pesantren merupakan lembaga sumber keilmuan yang bersifat filosofis. Dengan demikian maka sangat wajar jika sikap dan perilaku hidup para pengasuh pesantren dalam mendidik dan melakukan konservasi juga didasarkan atas pemikiran-pemikiran dan pengetahuan yang bersifat filosofis [25]

Beberapa filsafat penting yang dianut oleh pesantren dalam FBC adalah keyakinannya bahwa manusia hidup memeiliki tugas sebagai *Khalifah* atau wakil Tuhan yang harus bersikap adil, peduli, melindungi dan bertanggungjawab terhadap lingkungannya [25, 24]. Mengingat Pendidikan di Indonesia yang tetap mengutamakan aspek agama sebagai bagian dari pembangunan Pendidikan, maka kemungkinan besar budaya-budaya pesantren juga bisa menjadi bagian dari budaya Pendidikan di sekolah [26].

The motivation of pesantren leaders in FBC is not only based on need, but also on philosophical thinking [24]. The pesantren educational institution is a philosophical-scientific source institution. Therefore, it is very natural that the attitude

and behavior of pesantren managers in education and conservation are also based on philosophical thoughts and knowledge [25].

Some important philosophies adopted by pesantren in FBC are the belief that human beings have a duty as *Khalifah* or representative of God who must be fair, care, protect and be responsible for their environment [25, 24]. As education in Indonesia continues to prioritize religious aspects as part of educational development, it is likely that pesantren cultures can also be part of the culture of education in schools [26].

3. Research Methodology

This study aims to identify the aspects of FBC management that meet the nutritional needs of students and build school food security. The research is exploratory in nature using mixed methods (qualitative-quantitative) to explore aspects of FBC management and to qualitatively examine the relationship between aspects and sub-aspects.

3.1 Research Design

The exploratory research was conducted in several stages of data collection activities. Participants were selected using the *sequential sampling* method [27] by gradually reducing the number of participants during the research process. Participants were selected based on the criteria that schools had implemented FBC activities to meet the nutritional needs of students. The selection of participants was determined after observing the development of data from each research process. Data that were estimated to meet the criteria were selected for the next stage of the research [27].

3.2 Data Collection Instruments

The research instruments were open and closed questionnaires, survey sheets and workshops [27]. The screening workshop instrument was used to select schools that had implemented FBC and those that had not. The FBC practitioner workshop instrument was conducted to explore more in-depth data on the implementation of FBC in schools from teachers, principals, non-teaching work teams and school supervisors. Oral data from presentations and discussions were transcribed into text using *voice to text* software. Open-ended interviews were conducted with participants during the site visit. The tools for the confirmation workshop were mapping sheets and flip charts for mapping aspects and relationships between aspects and sub-aspects of FBC in schools.

3.3 Phases of Research Activities

3.3.1 Workshop-I: Screening

The initial participants were identified as 107 schools in the greater Malang area (consisting of 2 cities and 1 district). The participating schools consisted of 47 public and private elementary schools, 33 public and private junior high schools, and 15 senior high schools and 12 public and private vocational high schools.

Selection activities were carried out through workshops to obtain an agreed understanding of FBC management in schools, and then after the workshop activities were completed, initial data collection was carried out by sending questions via Google Form about whether the participating schools had conducted FBC activities as described in the workshop. If they had, they were asked to explain the activities. If not, the participant was excluded from the next stage of the research.

3.3.2 Workshop-II: FBC Actors in Schools

Based on the results of the screening workshop, participants were identified who had conducted FBC under different conditions, a total of 32 schools. The Workshop of FBC Actors in Schools was identified as necessary to answer questions and validate data. Participants included teachers, principals, non-teacher FBC implementation teams, and school supervisors.

The workshop speakers were teachers, principals and supervisors who were considered to have implemented FBC in schools well. The materials and discussions presented by the workshop participants constituted the research data, which were recorded for analysis using the Voice to Text program.

3.3.3 Field visits

Field visits were conducted to validate the data presented in Workshop-II. Unstructured interviews were conducted during the visits. The resulting data was recorded in the form of photographs and interview transcripts.

3.3.4 Workshop-III: Confirmation

The participants in the validation workshop were identified as five schools with stricter criteria of schools that had actually implemented FBC, although under different conditions. The confirmation workshop participants from each school consisted of the principal, two teachers, a non-teaching work team representative, and the supervisor.

The workshop was conducted to confirm the findings of Workshop-II. This is the stage of analysis, further validation and saturation of the analyzed data as suggested by Patton [27]. The data saturation process was carried out until the participants felt that there was enough data and no more needed to be added.

3.4 Data Validation and Analysis

Data validation and analysis used method and source triangulation methods. Method triangulation was conducted through interviews, surveys, workshops and questionnaires. While source triangulation: teachers, principals, non-teaching work teams and supervisors.

Thematic data analysis was conducted by grouping the data obtained into certain themes and sub-themes agreed upon by the researchers and participants. Furthermore, in this study, themes and sub-themes are referred to as aspects and sub-aspects. The steps of thematic analysis were as follows [28]: 1) understanding qualitative data; 2) coding; 3) identifying codes into codes and sub-codes; 4) validating codes and sub-codes; 5) determining codes as aspects and sub-codes as sub-aspects; 6) writing up results and visualizing thematic maps of FBC aspects in schools.

MAXQDA-2020 software was used for further data analysis. This software is very helpful in conducting integrated data analysis, i.e. qualitative and quantitative at the same time, and in presenting the results of the analysis visually. The stages of analysis are the same as thematic analysis by coding qualitative data, then the program will convert it into quantitative or visual data as needed [29]. The results of the analysis will be presented in the form of quantitative tables and figures that will provide information about the dominant aspects and their relationship with the aspects and sub-aspects of FBC in schools.

3.5 Limitations of the study

This study has limitations, namely the number of participants who fit the criteria is still limited because of the limited number of schools conducting FBC activities in Greater Malang area. To test the resulting model, it is expected to be conducted with a larger number of schools with national coverage.

4. Results and Discussion

The results of data validation found 3 aspects with 27 sub-aspects of FBC management in schools. The three aspects are philosophy, policy, and implementation. The philosophy aspect has 10 sub-aspects, the policy aspect has 11 sub-aspects, and the implementation aspect has 6 sub-aspects and 52 sub-sub-aspects. The frequency of the application aspect is most often given with a more detailed explanation, so it must be given in the form of sub-aspects. There are sub-aspects that are part of two or three aspects. The explanation of each aspect with its sub-aspects is as follows:

4.1 Philosophical Aspect

The Philosophical Aspect describes the results of deep thinking about the phenomena and meaning of the participants' lives. This aspect is built on the self-awareness of the participants as fellow human beings and God's creatures who have responsibilities to fulfill. Thus, the philosophical sub-aspects are often the answer to the background and purpose of FBC in schools.

The philosophical aspect has 11 sub-aspects, namely: food and nutrition safety, responsibility, sustainability, educator duties, curriculum, academic achievement, food independence, intelligence and health, SDGs, worship, and motivation. The highest sub-aspects are: 1) the importance of food safety and nutrition for students (18.75%). While the other sub-aspects have almost the same percentage, namely responsibility (11.2%), sustainability (11.2%), and duty as an educator (10.00%). The data on the percentages of the philosophical sub-aspects are listed in the following table:

Table 1. Philosophical sub-aspect (source: Own research data, 2024)

No	Sub-Aspects	Segments	Percentage
1	Nutritional Food Security	15	18.75
2	Responsibility	9	11.25
3	Sustainability	9	11.25
4	Educator	8	10.00
5	Curriculum	7	8.75
6	Achievement School	7	8.75
7	Food Independence	6	7.50
8	Health Intelligence	6	7.50
9	SDG'S	5	6.25
10	Worship	5	6.25
11	Motivation	3	3.75
	TOTAL	80	100.00

Thoughtful consideration of food safety and student nutrition ranked highest. Participants understand that food safety today affects the health and intelligence of students now and in the future. Likewise, food safety in the future is the responsibility of students. It was recognized that making improvements and maintaining sustainability is a human duty, especially as an educator. Realistic thoughts that arise, such as curriculum implementation, food independence, student health and intelligence, SDG's are still based on long-term thinking and a form of worship (devotion to God).

The teacher sub-aspect ranks fourth after sustainability thinking. Participants felt that teachers are useless if they are not concerned about the food and nutrition security of current and future students, and if they do not have a sense of responsibility and sustainability thinking. It does not matter who the teacher is as long as they have these philosophical thoughts. A visual representation of the relationship between philosophical aspects and sub-aspects is shown in the following figure

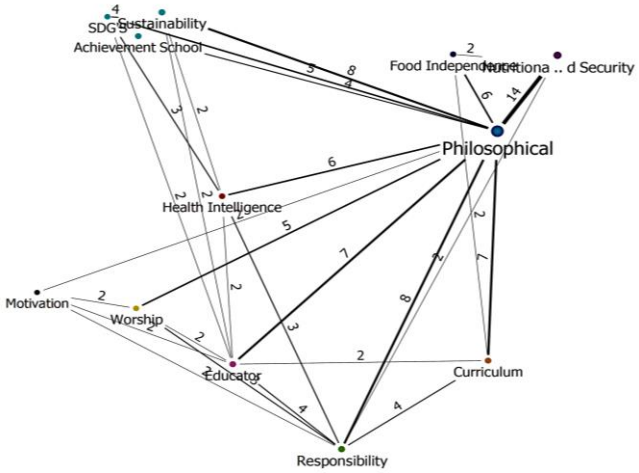

Figure 1. Relationship Between Philosophical Aspects and Sub-aspects (source: Own research data, 2024)

This philosophical paradigm is the same as that of the pesantren educators who have been conducting FBC activities in educational institutions for much longer [21]. Participants' statements quoting religious teachings (e.g. about worship) show the influence or similarity of aspects adopted by pesantren and schools [22]. The existence of philosophical aspects is the main foundation of schools implementing FBC. Conservation efforts are carried out seriously because they have a strong philosophical foundation [24, 23, 25].

4.2 Policy Aspect

The policy aspect consists of 13 sub-aspects. The three aspects with the highest percentage are: Working team (19.74%), curriculum (14.47%), and Adiwiyata or environmentally friendly school (13.16%). The other sub-aspects with smaller percentages are; Principal, Decree and SOP, Government, Sustainability, Healthy Canteen, Food Chemistry, Collaboration, Budget, Work motivation, and supervision.

Table 2. Policy sub-aspects (source: Own research data, 2024)

Sub-Aspects	Segments	Percentage
Team Work	15	19.74
Curriculum	11	14.47
Adiwiyata	10	13.16
Headmaster	8	10.53
Government	7	9.21
Decree&SOP	7	9.21
Sustainability	5	6.58
Healthy Canteen	4	5.26
Food Independence	3	3.95
Collaboration	3	3.95
Budget	2	2.63
Supervisor	1	1.32
TOTAL	76	100.00

The sub-aspect of the existence of a "work team" formed by the principal has the highest percentage. This indicates that the principal must have a high level of commitment to the program. Without the commitment of the principal, the program will not be implemented.

For schools that have participated in the Adiwiyata program, the curriculum sub-aspect is the same as the Adiwiyata sub-aspect because the implementation of the FBC program is the same as the implementation of the development or innovation program in Adiwiyata. Thus, the Adiwiyata sub-aspect can be displaced by the Principal sub-aspect. The relationship between aspects and sub-aspects of the policy can be seen in the following figure

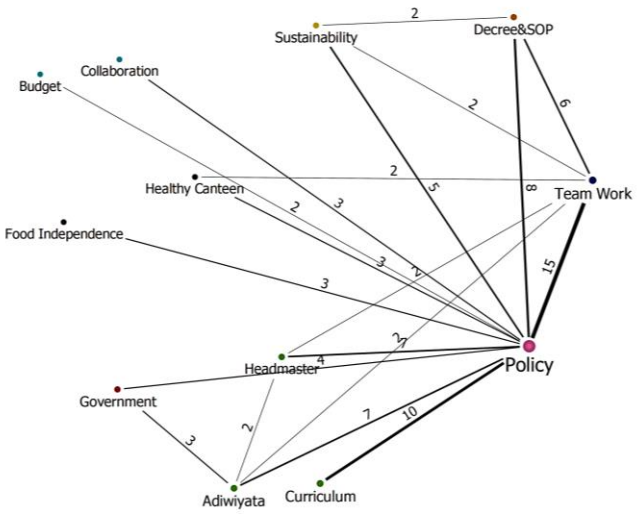

Figure 2. Relationship Between Aspects and Subaspects of the Policy (source: Own research data, 2024)

The FBC program in schools must be approved and supported by the school principal and be integrated into learning innovations. Thus, the provision of food in schools is not only to meet the nutritional needs of students, but also for learning activities, improving knowledge, attitudes and good behavior towards food, which will be very useful for students in the future.

The principal's policy is set in the form of a decree with SOP (Standard Operational Procedure), for example, on the work team, healthy canteen, cooperation, etc. The existence of this decree and SOP is necessary for the work team to carry out FBC activities in the school.

4.3 Implementation aspects

The implementation aspect of the FBC program received the most attention from participants. This is because most of the program activities are implementation activities. The implementation aspect of the program consists of three dominant sub-aspects, namely curriculum (38.10%), innovation (33.33%), and collaboration (22.92%). The smaller sub-aspects are evaluation (3.27%) and budget (2.38%), as shown in the following table

Table 3. Implementation sub-aspects (source: Own research data, 2024)

Sub-Aspects	Segments	Percentage
Curriculum	128	38.10
Innovation	112	33.33
Collaboration	77	22.92
Evaluation	11	3.27
Financial	8	2.38
TOTAL	336	100.00

The amount of information about the implementation of FBC in schools leads to the breakdown of the implementation sub-aspects into sub-sub-aspects. The results of tracking the codes and sub-codes of program implementation aspects using MXQDA-2020 are listed in the matrix as shown below.

Figure 3. Code Matrix Browser for Implementation Aspects and Sub-Aspects (source: Own research data, 2024)

Code System	Perf...	Conf...	SUM
Implementation			79
Curriculum			41
Attitude			7
Behaviour			3
Character			8
Fish Pond			1
Habituation			4
Innovation			7
Integrated			6
Introduction to Technology			4
Knowledge			7
Local Food			12
Planting-Growing			18
Policy			2
School Garden			2
Sustainability			2
Waste management			4
Collaboration			33
Budget			2
Community Health Centers			4
Decree & MoU			1
Department of Environment			2
Drinking Water Company			2
Farmers			5
Fisherman			6
Food Handler			1
Parents of Students			9
Sustainability			3
Technollogy			5
Universities			4
Evaluation			11
Financial			8
Innovation			49
Breakfast together			1
Budget			2
Healthy Canteen			24
Local Food			15
Policy			2
Sustainable Agriculture			8
Technology process			9
Water&Energy Conservation			2
SUM	160	255	415

The three dominant sub-aspects: curriculum, innovation and collaboration are interrelated and mutually reinforcing. Innovation and collaboration should strengthen the implementation of curriculum development. If teachers, principals and FBC teams are not able to design and implement innovative programs, then collaboration is needed. Collaboration will bring new nuances to the activities. The relationship between the sub-aspects and sub-sub-aspects of implementation is shown in the following figure

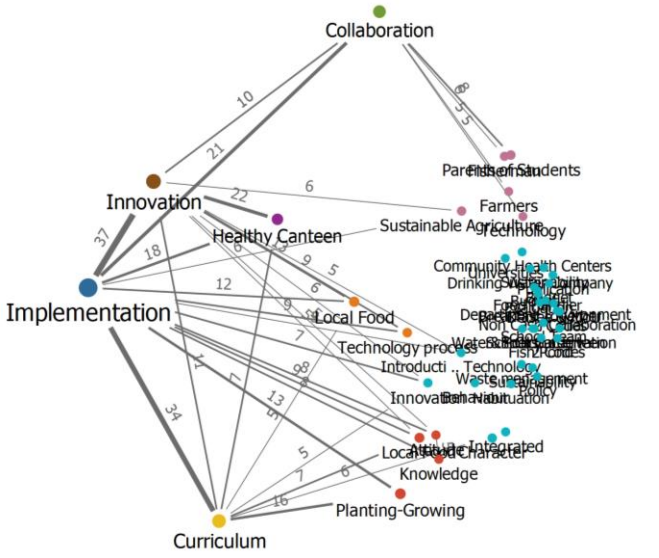

Figure 4: Relationship between aspects and sub-aspects of FBC program implementation in schools (source: Own research data, 2024)

The "healthy canteen" is the innovation activity that is considered to determine the success of the FBC program implementation. The healthy canteen is a new canteen or a modification of the existing canteen. The Healthy Canteen is very helpful in the implementation of healthy eating for students in accordance with the direction of the FBC work team. The Healthy Canteen does not interfere with the teacher's duties because it is carried out by the vendor. The process of eating and learning in the canteen is going well. However, the students have to pay for it because there is no financial support from the government.

The existence of a healthy canteen is very helpful for the implementation mechanism of nutritious meals for students. Students' meals are more controlled in terms of nutrition, including eating habits. The menu served by the vendor must meet the standards and SOPs of the FBC working team formed by the school principal. The local food consumption program can be implemented. For example, based on the school's observation that students are experiencing a fish-eating crisis, the healthy canteen is required to provide seafood three days a week. For example, "chicken soup" is changed to "fish soup," "beef meatballs" is changed to "fish meatballs," "chicken soup" is changed to "fish soup," "beef nuggets" is changed to "fish nuggets," and so on. Sea fish sources are provided by the FBC work team in cooperation with parents of students who work as fishermen and fish auctions. The condition of the fish must be clear on its health and freshness. All are inspected by the school's FBC work team.

The canteen must be free of prohibited ingredients such as preservatives, flavorings, sweeteners, dyes and thickeners. Likewise, drinks and snacks must try to make use of local biodiversity, for example, the use of Moringa leaves (*Moringa oleifera*), known to be very rich in vitamins, for pudding, cendol, fresh drinks, juice, peppers, chips, and the like. These innovations never stop and become teaching materials for students about the processing of the wealth of local biodiversity for food.

The Healthy Canteen must be plastic-free. All food containers must be washable and reusable. Students are required to tidy up or wash all eating utensils immediately and store them in the designated area. Students must also line up for food in an orderly manner. Thus, the healthy canteen is also a place where students learn to queue, be patient and respect others.

The sub-aspect of budget has not been raised much by schools that have implemented FBC. The budget is no longer perceived as a problem because it is supported by the principal's policies and SOPs in the use of canteen profits and cooperation. In fact, the funds generated by FBC business activities are able to finance co-curricular and extra-curricular learning activities.

4.4 Relationship between Aspects and Sub-aspects of FBC Management in Schools

The results of the Code Relation Browser analysis using the MAXQDA-2020 program show the relationship between aspects, sub-aspects and sub-sub-aspects. The strength of the relationship can be seen from the thickness of the line showing the frequency (frequency ≥5) between aspects and between sub-aspects as follows:

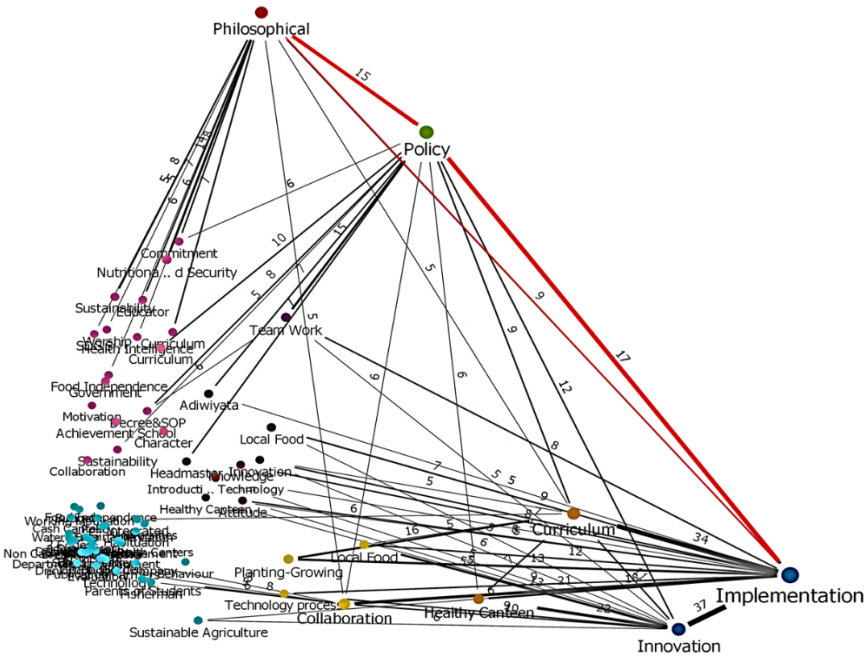

Figure 5. Association between aspects, sub-aspects, and sub-sub-aspects of managing food biodiversity to meet students' nutritional needs and school food security. Numbers indicate frequency of association ≥ 5. (source: Own research data, 2024)

The three main aspects of FBC management in schools show relationships with each other. This is also the case between aspects and sub-aspects and sub-sub-aspects. The philosophical aspect is the basis for the policy and implementation aspects. This pattern of relationships forms a triangle: Philosophy - Policy - Implementation.

The philosophical aspect has only one dominant sub-aspect, student food safety, while the other sub-aspects are small and almost equally prevalent. In contrast to the policy and implementation sub-aspects, the average has three aspects with a high frequency. The policy aspect has three dominant sub-aspects, namely working team, curriculum, and Adiwiyata. Since all participating schools have implemented the Adiwiyata program, the curriculum is the same as Adiwiyata. Thus, the principal occupies the third position in the policy aspect. The implementation aspect consists of three dominant sub-aspects, namely curriculum, innovation, and collaboration. Thus, the curriculum sub-aspect becomes a sub-aspect of the policy and implementation aspects.

The results of the qualitative-quantitative analysis of the relationships between these dominant aspects and sub-aspects show the triangular shape of the aspects at the top and the five-column shape of the dominant subaspects at the bottom, as shown in the following figure:

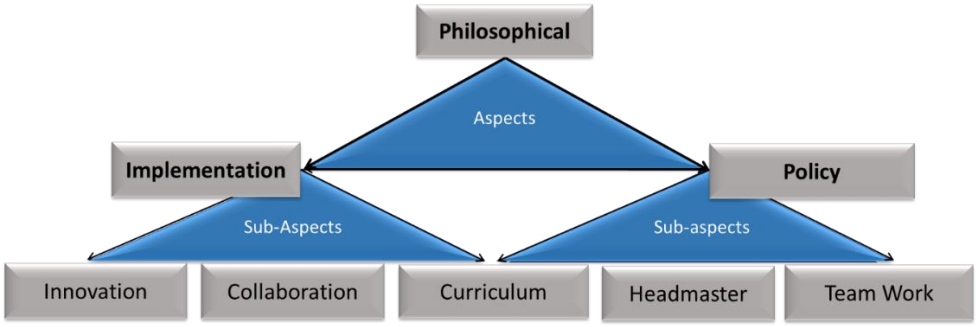

Figure 6. "The Triangle and Five-Pillars of the Management Aspect of Food Biodiversity Conservation in Schools" to Meet Students' Nutritional Needs and School-Based Food Security. (source: Own research data, 2024)

Based on this model, for the purpose of making it easier to understand and remember the relationship between these aspects and *sub-aspects*, we propose a model called "*The triangle and five-pillars of the Management Aspects of Food Biodiversity Conservation in Schools*" or more briefly called: "*The Triangle and Five-Pillar Management of FBC in Schools*".

The philosophical aspect of management plays an important role and will be the starting point of thinking about a movement in educational institutions [30, 31]. The philosophy adopted by educators in Indonesia is influenced by various backgrounds of knowledge, thoughts and experiences of the perpetrators [24]. In addition to the national philosophy contained in the Indonesian state constitution, namely Pancasila, religious knowledge as a source of philosophy is used as a basis for thought and action by FBC actors in schools as well as by FBC actors in pesantren [24, 23].

Research in the UK and Germany [17, 15] suggests the importance of innovation and collaboration in curriculum development. Recent research in Saudi Arabia [32] also emphasizes the same, prioritizing innovation, collaboration, financial support, and student awareness. The government of Saudi Arabia Hal has a strong vision and philosophical thinking to develop a surface green program, empowering schools to reduce operating costs and promote sustainable living.

5. Conclusion

The results of this study concluded two main points as follows:

1) FBC management to meet nutritional needs and food security in schools has three main aspects, namely: philosophical, policy and implementation. These three aspects have several sub-aspects. The philosophical aspect consists of the dominant sub-aspects of thinking about nutritional safety in student meals, responsibility and sustainability. The policy aspect has dominant sub-aspects: work team, curriculum, and principal. The sub-aspects of Adiwiyata (environmentally friendly school) and decree and SOP are considered as aspects that are integrated into the principal's policy. The program implementation aspect consists of three dominant sub-aspects: curriculum, innovation, and collaboration. The curriculum sub-aspect is part of the policy and implementation aspect. The program implementation sub-aspect has more detailed sub-aspects, including sub-aspects that are considered significant to the success of program implementation is the existence of a "healthy canteen".
2) The relationship between the dominant aspects and sub-aspects of FBC management in schools shows a distinctive pattern. The relationship pattern is proposed by the researcher under the name of "*The triangle and five-pillar aspects of food biodiversity conservation management in schools*" to meet students' nutritional needs and school-based food security.

This triangle and five-pillar model of FBC management in schools is new in conservation research in Indonesian schools, so it is expected to help researchers and practitioners of FBC conservation in schools to meet students' nutritional needs and help the government and society to achieve national food security.