UNDERSTANDING GLOBAL DIGITAL ERA TECHNOLOGIES AND TRANSFORMATIONS IN SOCIAL, ENVIRONMENT, PEACE & BUSINESS DEVELOPMENT PERSPECTIVES IN SOCIETY

Editors

Assoc. Prof. Dr. Muhammad Ali Tarar

Lawrence Walambuka

NCM Publishing

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Published by: NCM Publishing House

Publishing Date: 27.07.2024

ISBN: 978-625-98685-6-1

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Publication No: **23**

Editors	***Assoc. Prof. Dr. Muhammad Ali Tarar*** ***Lawrence Walambuka***
Cover Designer	***Mr. Kerim KARADAL***
ISBN	**978-625-98685-6-1**
Publisher Certificate No	**51898**
Publisher Type	International Publishing House
Release Date	2024

CONTACT

Phone: +90 505 965 4613
e-mail: ceocongress.info@gmail.com
www.ceocongress.org

LIBRARY INFORMATION CARD

Tarar, Muhammad Ali and Walambuka, Lawrence; Editor, 4, 2024. **Understanding Global Digital Era Technologies and Transformations in Social, Environment, Peace & Business Development Perspectives in Society**. NCM Publishing House, Bursa.
Language: English
Editors: Assoc. Prof. Dr. Muhammad Ali Tarar; Lawrence Walambuka
ISBN: **978-625-98685-6-1**

PREFACE

The edition of the Global digital era perspectives, just like it's previous editions , has been enriched by working together of various authors from different universities and counties across the globe. The authors and co-authors enriched this edition by considering feedback from the 9th CEO Congress publications, readers and audiences. The editors wish to thank all those who offered comments, commitment, advice and also thank NCM Publishing House for it's decision to publish this edition.

We would also like to thank all participants who made it possible through out the 9th CEO Congress presentations and all the universities for excellent research assistance throughout this edition of Global digital era, as well as help with online resources to gather different talents internationally.

As for the content, this edition includes chapters in technology, social, environmental sciences, public issues, green technologies, monetary policies, community well-being, law and society development, AI and multi-media creation.

The editors hope that, by collection of case studies from various and cross sectional fields around a common topic, Global digital era, the conditions for grouping, comparing, and analysis cases , countries and systems has been met.

All the chapters are new research which was scientifically and methodologically put together by authors who paid attention to global digital era technologies and perspectives in business and society.

The edited chapters, includes intealia: fresh new digital era technologies, educative content, illustrative diagrams, which encourage further research and reading. In terms of chapter arrangement, a logical order and a conscious effort has been followed to guide readers on fresh global digital era technologies and perspectives. More importantly, to impart knowledge to readers about the impact of ICT on society. The selection of authors was a conscious exercise that considered equality in gender parity and global outreach CEO Congress program of sourcing participants and authors.

Assoc. Prof. Dr. Muhammad Ali Tarar
Mr. Lawrence Walambuka
Bursa – July 2024

CONTENTS

CHAPTER 1

Significance of *Jengki* Architecture Preservation: A Public Perspective

Angga Sangka Boogie
Departement of Master Architecture, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
angga.s.boogie@gmail.com

Popi Puspitasari
Departement of Master Architecture, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
popi@trisakti.ac.id
Orcid: 0000-0003-4143-6807

ABSTRACT

In the post-independence era of Indonesia, around 1950-1960, the development of the Kebayoran Baru residential area in Jakarta was designed using the Jengki architectural style which became very popular at that time. This design then spread throughout Indonesia, adopted not only by Dutch engineers and architects, but also by local Indonesian architects, contractors and craftsmen, and was deemed appropriate to the local climate and culture. This research focuses on the Wisma Pantai Kilang Pertamina residential building in Balikpapan, which is the only Jengki style residential building in the city. The local government considers that the guest house has the potential to be abandoned but its significance has not been assessed by several parties. The aim of this research is to understand the perceptions of relevant parties regarding how significant the object under study has the potential to be preserved. The research method uses Quasi-Qualitative, in which case theory is used as a guide when researchers conduct exploration through interviews with informants representing users, owners, local communities and experts. The research results show that this building can be recommended as a suspected cultural heritage object. It is hoped that the results of this research will make an important contribution to the field of architectural conservation and inspire efforts to preserve architectural heritage in Indonesia in facing global challenges

Keywords: Jengki, Butterfly heritage, Architecture.

1. INTRODUCTION

The term "Jengki" is derived from the American term "Yankee" and represents the spirit of freedom from Dutch colonialism as expressed in architectural style (Prijotomo, 1996). This spirit of freedom can be seen in several cities such as Surabaya in the Putroagung area where there are Dutch colonial buildings and among them are buildings with Jengki architecture (Safeyah, 2006), as well as in Malang, Singosari and Lawang where these three cities are close together and on the main road corridor there are many rows of houses with Jengki architecture (Setyabudi et al., 2012).

The genesis of the Jengki style in the city of Bandung can be traced back to 1950, when Arinaka Trisuharno published a brief article. This was followed by the arrival of several American educators at ITB, who introduced the Yankee or Jengki style in accordance with the prevailing spirit of freedom in their homeland (Affandy, 2003). The development of Jengki architecture is not limited to the island of Java; it can also be observed on the island of Sumatra. One example is the city of Aceh in the Peunayong area, where there are Jengki and colonial Chinese Peranakan shophouses (Winarso & Dewi, 2005). Following the departure of the Dutch from Indonesia, numerous construction workers and engineers, in collaboration with Dutch architects, erected structures in the Jengki style along the principal thoroughfare of the city of Lampung (Lisa & Mardiyanto, 2021).

The jengki architectural style, which is characterised by its distinctive facades and interiors, is rarely found in modern house designs today. Even in residential houses in South Jakarta, precisely on Jalan Pakubuwono, many owners make changes to both the facade and interior, a practice which is also common and which reaps the pros and cons of observers of cultural heritage buildings (Purnamasari & Mildawani, 2011).

The object of research, the Pertamina Kilang Beach Houses, is located on the island of Kalimantan, specifically in the city of Balikpapan, East Kalimantan province. The city of Balikpapan began to develop following the commencement of oil drilling in this area in the 1900s, initiated by the collaboration between JH Menten and the Samuel & Co Firm, based in London. The first drilling operations were conducted on 10 February 1897, resulting in the discovery of oil resources in the area. This led to the establishment of the Mathilde mining concession, which comprised the transfer of a plot of land measuring 16,100 m2 in Balikpapan Bay from the King of Kutai, Moh. Alimoeding Adil Chalifatul Moekmin, to the Dutch East Indies Government. This land was to be used as an oil mine (ANRI, 2016). Urban planning at this time was part of the Bataafsche Petroleum Maatschappij N.V. (BPM) oil refinery area, where the beach house itself was the commercial and administrative area of the refinery (Tarigan et al., 2017) as shown in the figure 1.

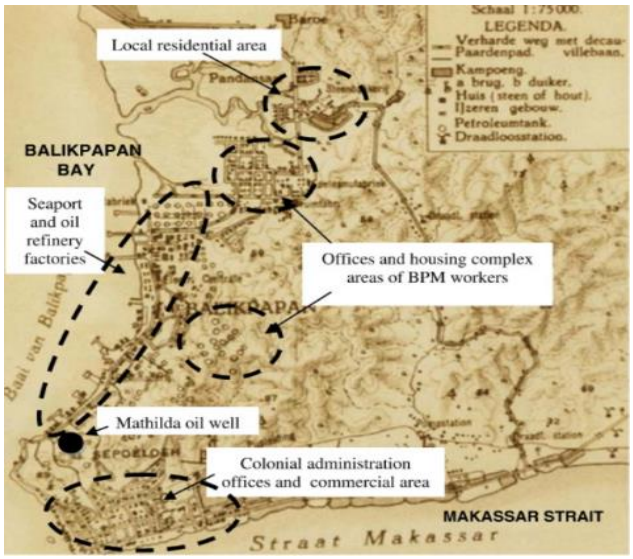


Figure 1. Indonesia pre-independence map of Pertamina's Kilang Beach House. (Tarigan et al., 2017)

The architectural style of Jengki, as exemplified by buildings in Balikpapan, is discussed in the scientific book entitled Architecture of the Archipelago by Obbe Norbuis. In this publication, it is stated that Ger Boom was appointed as the architect responsible for the construction of the Bataafsche Petroleum Maatschappij N.V. (BPM) area. Additionally, the book documents Ger Boom's contributions to the Indonesian architectural landscape, including his work on residential buildings in the Kebayoran Baru area of Jakarta (Norbruis, 2022). The establishment of regulations regarding cultural heritage buildings requires the participation of the owner, PERTAMINA, and the government as the local authority. In this case, the involvement of cultural heritage organisations in Balikpapan city, namely the Balikpapan community of the past, is also essential. The owner's role is to facilitate the process by providing access to the building, while the government's responsibility is to establish regulations that protect the building's cultural heritage value. The government plays the most significant role in determining the fate of cultural heritage buildings at the provincial level, with the East Kalimantan Cultural Heritage Preservation Centre assuming the primary responsibility. At the municipal level, the Balikpapan City Culture and Tourism Office is the primary authority.

The research object comprises six two-storey buildings, five of which continue to function as residential properties leased by the stakeholder, while one building is used as a café. The residential building is commonly referred to as the Kilang Beach House, due to its location on the beach of Balikpapan city, PERTAMINA refinery, as illustrated in Figure 3.

Figure 2. Map of Balikpapan and the location of the kilang beach house in 1932 (https://digitalcollections.universiteitleiden.nl/view/item/57596)

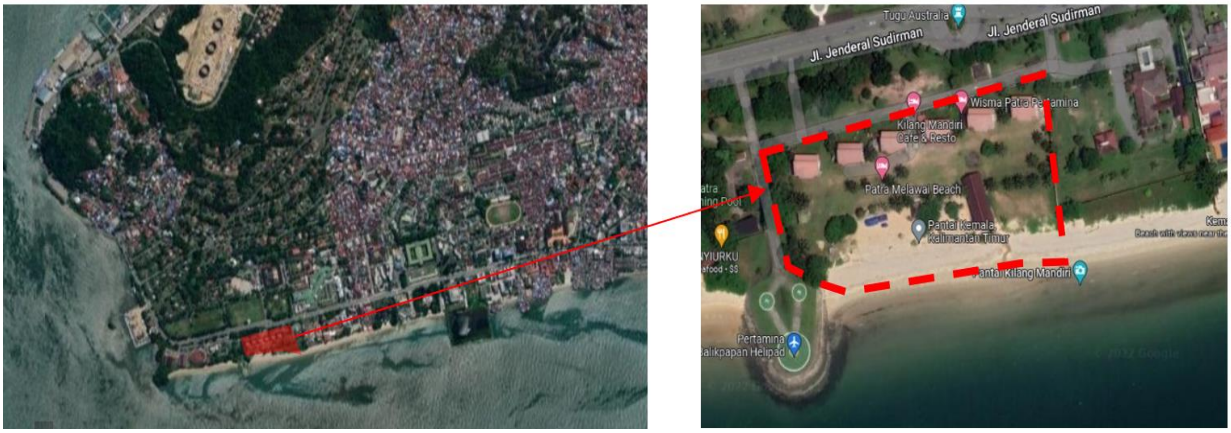


Figure 3. Google Maps of Balikpapan and kilang beach house area (https://goo.gl/maps/oao1w3rtdAqPdJJ79)

This edifice is the property of PERTAMINA RU V Balikpapan, situated within a residential zone and serving as a supporting facility for the PERTAMINA Balikpapan oil refinery. In the past, the Balikpapan preservation community has expressed the view that the object may possess historical and architectural value, yet no determination or identification of significant components of the existing building has been made thus far. Furthermore, the object is the sole remaining example of the Jengki architectural style in Balikpapan city, situated on the waterfront and a well-known local tourist attraction. In accordance with Presidential Regulation No. 01 of 2022, Article 3, any individual, group of individuals, or specific institution is entitled to register or propose a presumed object of cultural heritage. In light of the Balikpapan conservation community's considerations and the stipulations of the

regulation, it is imperative to conduct this research. In addition to this research, data collection and review of a number of cultural heritage buildings in Balikpapan is being conducted by the Balikpapan City Government. In order to recommend the Kilang Beach House building to become a presumed object of cultural heritage in this case, it is necessary to determine the significance value of the building by referring to the method used by the modern Asian Architecture Network (mAAN).

2. LITERATURE REVIEW

In his research on Indonesian cultural heritage, Rahmanu examined Sullivan's perspective on Jengki architecture. Unlike colonial-era architectural styles, which often feature elaborate decorations, the Jengki style is characterised by simplicity and purity. This minimalist approach to design is a defining feature of modern architecture (Rahmanu Widayat, 2006). In order to ascertain the heritage significance of a cultural heritage object, it is essential to identify and define the attributes of the object in question and to determine how the object expresses that meaning. One of the most fundamental tenets of the Burra Charter is the assertion that the cultural significance of a place is embodied in its materials, environment, contents, related documents, and uses. Additionally, the Charter posits that the preservation principle can be determined through an assessment of architectural aesthetic significance, historical significance, scientific significance, and socio-cultural significance (Sell, 2005).

The development of architecture in Indonesia can be divided into two distinct periods: pre-independence and post-independence. These periods can, in turn, be further subdivided into vernacular and colonial architectural styles. An analysis of architectural buildings in the Old Town area reveals that the development of architectural styles after transcending different periods resulted in hybrid architectural styles, although originality elements are still evident. (Puspitasari & Handjajanti, 2016). According to Roosmalen, jengki architecture is an architectural style that developed during the post-independence period of Indonesia (van Roosmalen, 2016). The Jengki style is a category of modern architecture that incorporates vernacular elements and is characterised by a simplicity that distinguishes it from the classical forms found in other colonial buildings. Modern and vernacular styles share certain similarities, including the concept of golden section proportions, which has been instrumental in the technological advancement of vernacular buildings in the modern era (Puspitasari & Lakawa, 2020).

In order to ascertain the literacy of researchers, a division into categories of Jengki buildings was established based on the research location. This analysis reveals that a significant proportion of research on Jengki buildings is concentrated on the island of Java. This is consistent with the development of the city in the post-independence period, which was concentrated on the island of Java. Meanwhile, the research object is situated on the island of Kalimantan, and there are only two studies on the Jengki building, as illustrated in the figures 4.

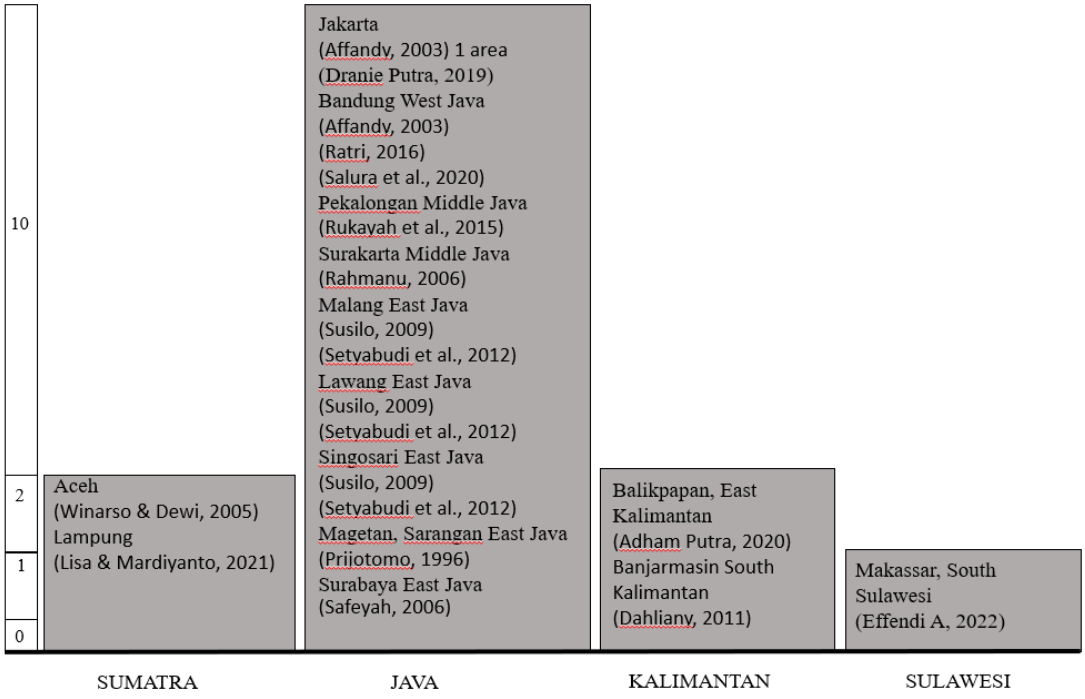


Figure 4. Research diagram of Jengki architectural buildings in Indonesia referring to location (Angga, 2023)

In terms of architectural forms and elements, Jengki and colonial architecture are markedly distinct. While colonial architecture is characterised by horizontal and vertical planes and geometric shapes with intricate details, Jengki architecture is generally defined by a play on asymmetrical planes. Figure 5 illustrates the processing of Jengki building forms in general.

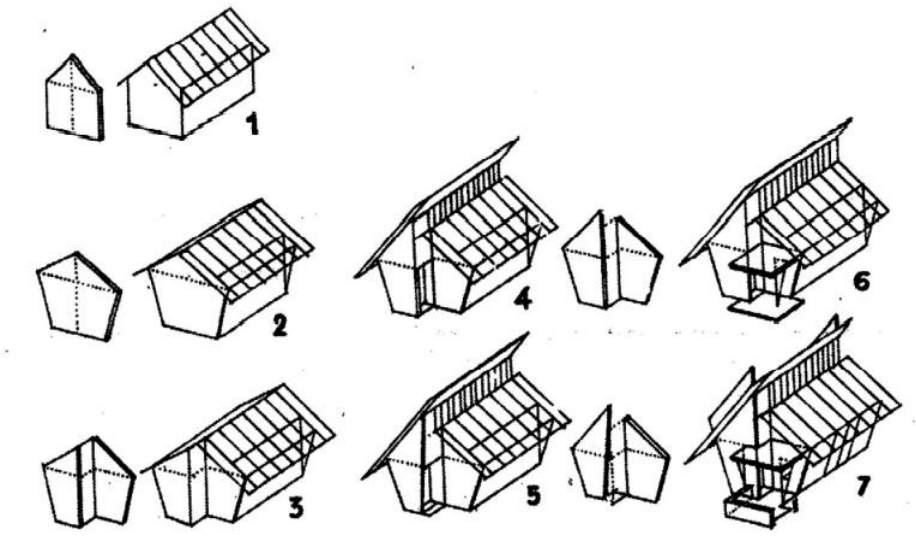


Figure 5. Mass studies stage of jengki Architecture (Rahmanu, 2006)

Morphological processing of the jengki form occurs in seven stages. The first stage starts from the simplest form, namely a square wall surface plane with a gable roof, then in the second stage the square wall shape is converted into a trapezoidal shape so that it forms a fifth

plane when combined with the roof wall plane. The third stage is that there are variations in the subtraction of the fifth wall so that differences in the surface of the wall are formed, then in the fourth stage the gable roof is also varied by adding height so that there is a difference in the height of the roof and wall height difference is made as a lattice for air flow inside the roof. in the fifth stage processing the field in the wall area where there are differences in the surface of the field to be used as a marker of the entrance area. The sixth and seventh stages are the stages of adding ornaments to the entrance area such as the addition of flat canopies and wall protrusions on the roof.

In Indonesia, the determination of cultural heritage buildings is set forth in Law Number 11 on Cultural Heritage, enacted in 2010. Article 5 of this law specifies the criteria that must be met for a building to be classified as cultural heritage. (1) The building must be at least 50 years old, (2) the style period must be at least 50 years, (3) the building must have special historical, scientific, educational, religious or cultural significance, (4) the building must have cultural value for strengthening the nation's personality. These criteria can be used as a benchmark for establishing the refinery beach guesthouse building as a cultural heritage building. Therefore, data that can support this process is needed. This legislation is further reinforced by Government Regulation No. 01 of 2022, which concerns the national register and preservation of cultural heritage. This regulation outlines the procedures for registering cultural heritage buildings, which can be conducted through discovery, research, or search, as outlined in Article 3. In 2003, UNESCO initiated the implementation of conservation practices and policies that integrate cultural and value-based considerations into the assessment of preservation perceptions. One of the methodologies employed is the mAAN butterfly heritage method (Widodo et al., 2017), as illustrated in the figure 6. The evaluation of the criteria was conducted by MAAN through a survey and interviews of community groups. The results were divided into two categories: emotional opinions from the general public and scientific opinions from the expert community.

Comprehensive Survey -Evaluation-

Standards for Evaluation of the Urban Cultural Heritage & Property		
	A. Those large number of People except experts	B. Experts
1.Value in terms of Memory (Past)	■Memory of those who exist there ■Memory of the humanity	■Value in the Study of History
2.Value in terms of Future Happiness (Future)	■Possibility for the establishment of value in the future ■Generating happiness for the humanity	■Proper condition of preservation ■Possibility for revitalization
3.Value in terms of the Object (Object)	■Loved by the public ■Valuable to the daily livelihood of the people ■Giving a great degree of inspiration to the humanity	■The fact of being "Old" ■Rarity ■Evidence of the regional characteristics ■Giving inspiration to experts

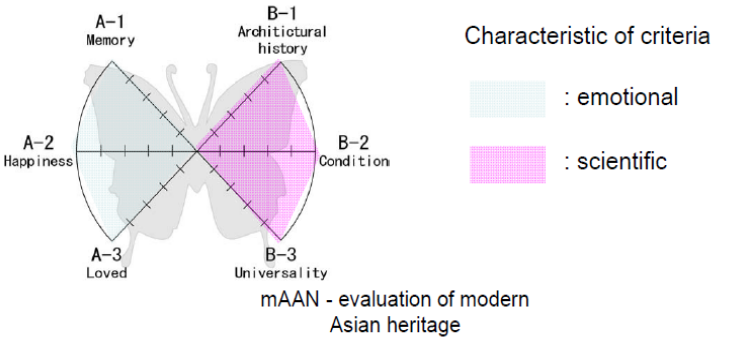


Figure 6. Butterfly heritage diagram (Widodo, 2010)

3. RESEARCH METHOD

The research employs a quasi-qualitative approach, wherein theory serves as a guiding framework for fieldwork. However, it is not intended to be used as a basis for proof. Should the field findings diverge from the theory, the aim is to enhance the theory in question. Due to the intrinsic nature of qualitative research, activities are conducted in an exploratory manner, with the objective of uncovering intangible or invisible phenomena, thereby strengthening the insights that can be derived through the five senses. The ultimate objective of quasi-qualitative research is to develop conceptual frameworks. In this research, the final outcome is presented in the form of theme categorisation and recommendations or proposals for improvement for relevant stakeholders in the context of cultural heritage policies.

This quasi-qualitative research employs an inductive approach, with the objective of identifying and grouping themes that reinforce statements about the significance of the object of research. However, this approach also presents a limitation, in that the determination of themes may not necessarily align with the concept as illustrated in the figure 7.

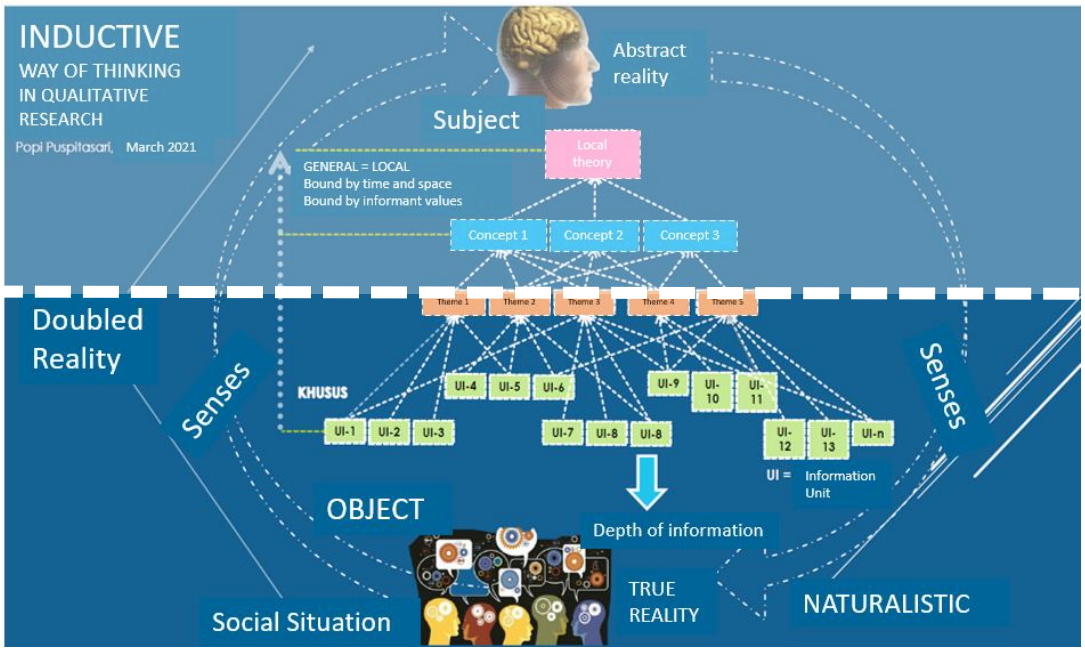


Figure 7. Inductive way of thinking diagram
(Popi Puspitasari, 2023)

The inductive approach to understanding the depth of information is traced through the value components of informants who are constrained by space and time and influenced by social situations or phenomena occurring in the field. The research method is a description of the concept, the planning of the research, and the methods or steps of the research that have been completed. This is specific and largely depends on its characteristics. Research methods are largely determined by the resulting research paradigm. In conducting research, it can be divided into three levels of order, namely: the philosophical level concerning the research paradigm, research methods and research implementation approaches (Creswell, 2013).

The quasi-qualitative research method employed was augmented by quantitative data to reinforce the rationale and considerations/opinions of the informants. In this instance, quasi-qualitative research utilised the mAAN criteria to guide the investigation of whether the Kilang Beach Guesthouse building is preserved or proposed as a cultural heritage building. The assessment criteria, as defined by the MAAN version, encompass the following elements, as illustrated in the significance evaluation table 1. With regard to the aforementioned table, the criteria for identifying informants are established. These criteria are divided into two categories: public informants, or the general public, who are visitors to tourist sites and pay attention to the construction of the research object; and expert informants, who are professionals working in fields related to architecture, cultural heritage, and government authorities. These categories are illustrated in Table 2.

The data was gathered through field surveys and interviews with members of the public and expert informants, in accordance with the themes of memory, care and fondness towards the public, and the themes of historical data, physical conditions and universality for expert informants. Subsequently, a perception level scale was employed to quantify the data so that it could be represented as a heritage butterfly diagram and used to determine the position of the high or low-ranking scale of statements pertaining to the theme. The results will be represented graphically as a heritage butterfly wing, as figure 8.

Table 1. Standard evaluation table Heritage Butterfly data diagram

Standards for Evaluation of the Urban Cultural Heritage and Property			
		A (Public)	***B (Experts)***
		The large number of people except experts	*Experts*
1 Past	Value in terms of Memory	- Memory of those who exist there - Memory of the humanity	- Value in the study of history
2 Future	Value in terms of Future Happiness	- Possibility for the establishment of value in the future - Generating happiness for the humanity	- Proper condition of preservation - Possibility for revitalization
3 Object	Value in terms of the Object	- Loved by the public - Valuable to the daily livelihood of the people - Giving a great degree of inspiration to the humanity	- The fact of being "Old" - Rarity - Evidence of the regional characteristics - Giving inspiration to experts

Table 2. A categorisation of assessment groups for informants

no	Public	Description
1	Visitor and also citizen of Balikpapan city that have been lived for 5-20 years	Age range : Above 17 years Gender : All Occupation: All kind
2	Building User	
	Expert	
1	Professional and certified Balikpapan Architects	Member of IAI Balikpapan
2	Balikpapan Heritage Organization	Jurnalis, member of Balikpapan heritage organisation
3	Regulation Maker	Government / city council
4	PERTAMINA building management	PERTAMINA BM Employees

Angga, 2023

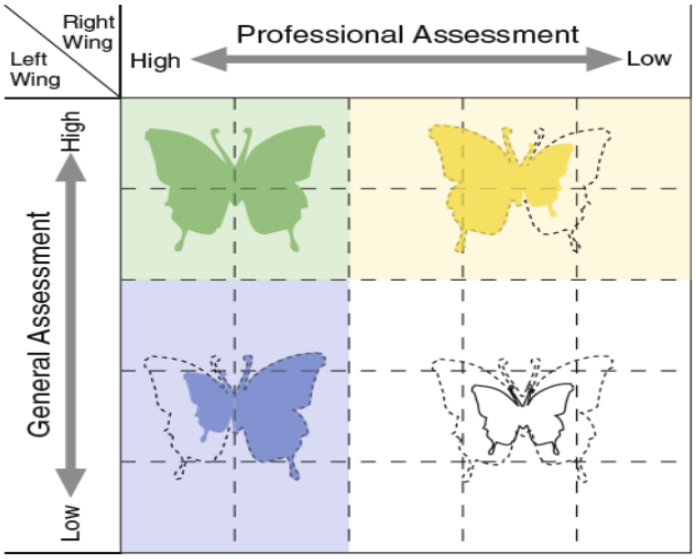


Figure 8. Perception scale of Heritage Butterfly diagram
(Widodo et al., 2017)

The statements obtained from the informants through interviews are used to represent the two wings on the butterfly, with the left wing being representative of the general public and the right wing representative of the significance values of the community. Finally, experts will determine the shape of the heritage butterfly wings. The diagram above illustrates the relationship between the shape of the butterfly wings and the informants' perceptions. If the informants perceive the value of the heritage butterfly to be low, the wings will be smaller. Conversely, if the informants perceive the value to be high, the wings will be larger. Furthermore, if both informants perceive the significance value to be low, the overall shape of the butterfly will be shrinking.

The data gathered by the building observation unit was coded using a system of letters (A, B, C, D, E, and F) based on the position of each building, as illustrated in Figure 9.

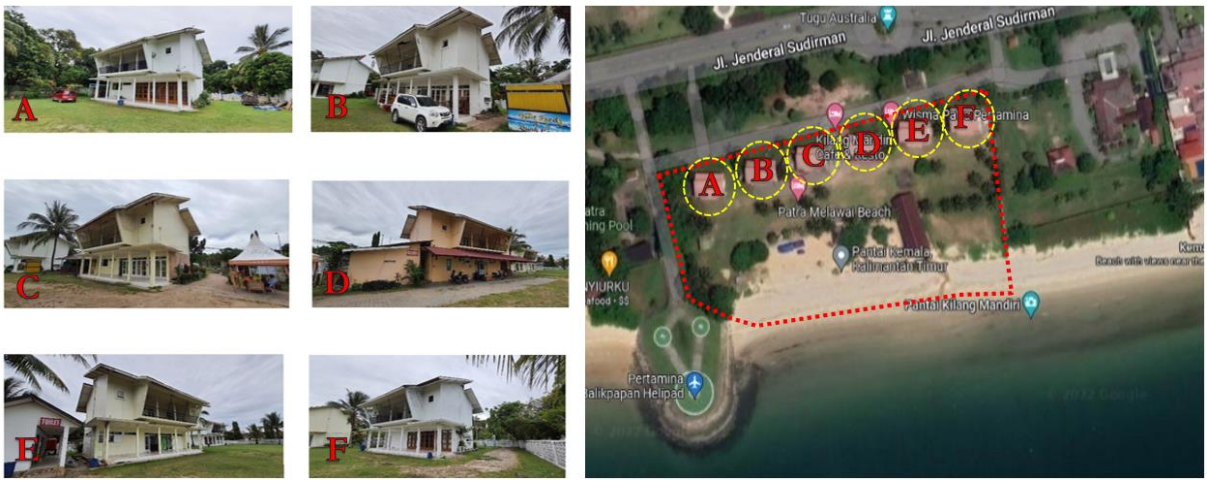


Figure 9. Google maps and picture of 6 research object
(https://goo.gl/maps/oao1w3rtdAqPdJJ79 , downloaded in May 2023 and Angga 2023)

The six research objects are being coded and then identified and determined to have architectural and cultural significance value for each building through informant perception. The mAAN method is being employed to conduct interviews with informants, who are divided into two categories: public and expert. Each category will be asked to provide their perceptions about the value of memory, happiness, and the object of research. The significance value was obtained through the use of the mAAN method, which involved conducting interviews with informants to ascertain their perceptions of the six buildings in question, which serve as the subject of this research.

4. RESULT AND DISCUSSION

The initial stage of discussion is identifying the Jengki shape of the Wisma Pantai building. This can be achieved through the observation of the architectural form through the use of photographic data and re-drawings, which are then studied on the architectural form of the Jengki with other research. The characteristics of the architectural style of a Jengki building should be visible from the pentagonal shape on the walls and gable roof (Rahmanu Widayat, 2006). This is to demonstrate the architectural significance of the six factory beach guesthouse buildings. Meanwhile, the cultural significance can be determined by collating perception data according to stakeholders (PERTAMINA, Regional Government and the

community or visitors) by referring to the mAAN version of the Cultural Heritage significance criteria.

In order to determine the architectural significance of the Balikpapan refinery beach guest house, it is necessary to identify the architectural style based on form. Therefore, field data collection on style began with measuring the dimensions and proportions of the six buildings under study. Based on the results of interviews with one of the informants, who was the guards of the research object area, it is known that the shape of the building has undergone changes. These changes occurred starting from the site plan, form and function of the building. The most frequent change in building form is that of Building D, which is currently undergoing a transformation into a café. This will enable visitors to the refinery beach area to order food and drinks there. In contrast, the five research object buildings have experienced few changes in form and function. Only the site plan has undergone modification. A depiction of the changes to the site plans of the six buildings based on this informant is as shown in figure 10.

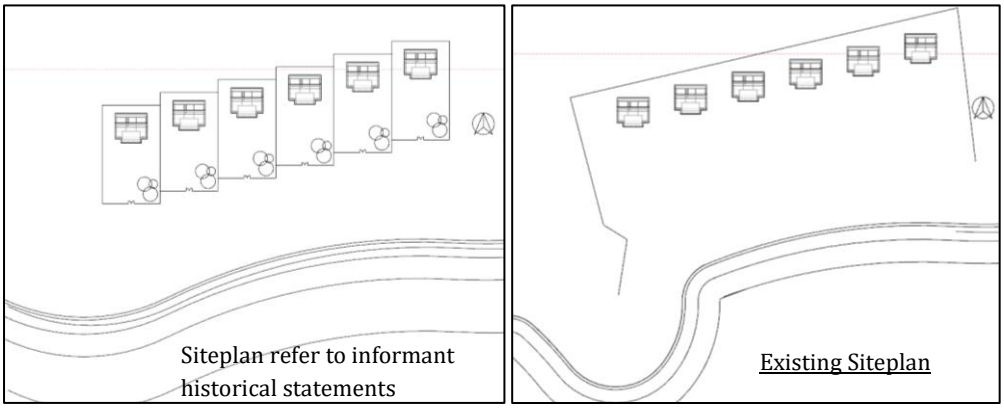


Figure 10. Informant perception and existing Siteplan (Angga, 2023)

The site plan indicates that each building is equipped with a fence constructed from iron materials and has an entrance from the beach. This is consistent with field observations, which revealed that the primary entrance of these six buildings faces the beach or south in the cardinal direction. Based on measurements and field observations that describe the shape of the mill beach guesthouse building, a typical shape and dimensions were obtained. The architectural plans of several buildings have been preserved in their original form, as illustrated in figure 11.

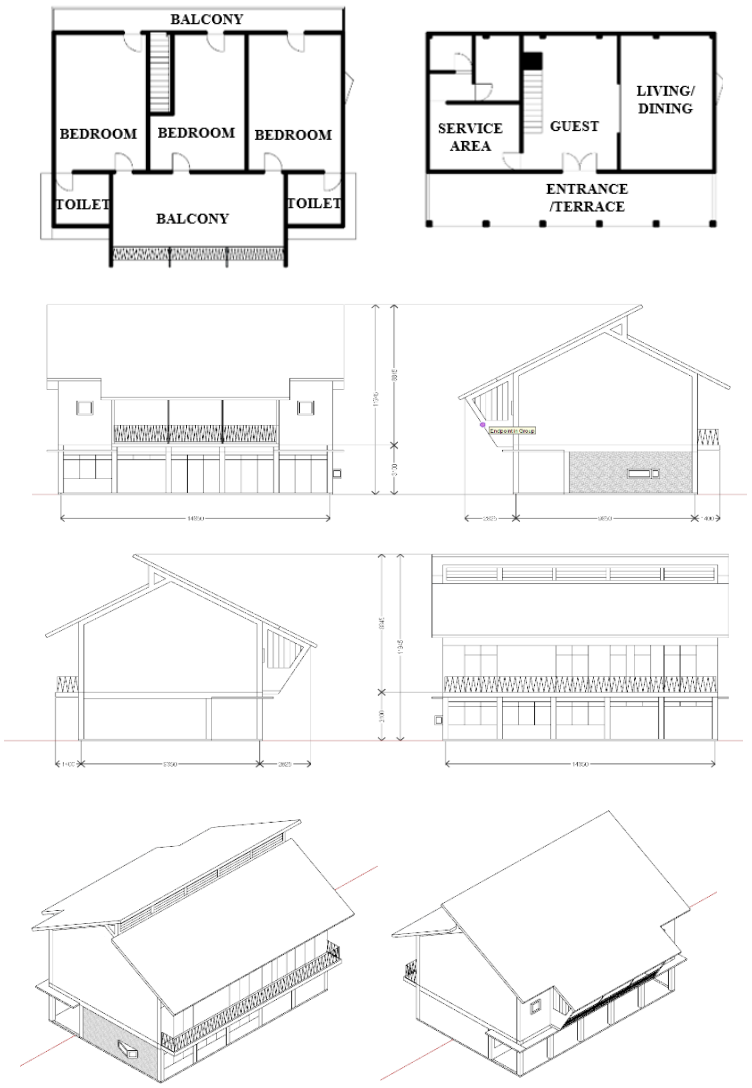
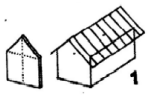
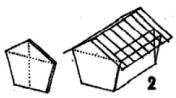
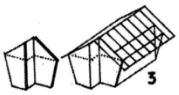
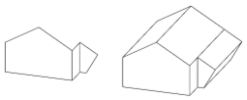
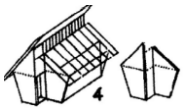
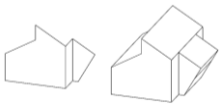
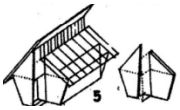
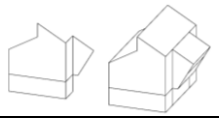
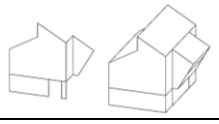
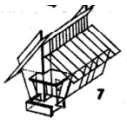
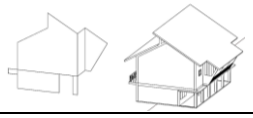


Figure 11. Research object Floor Plan, Elevation and Acsonometric views (Angga, 2023)

The image above provides a more detailed view of the research object building, including its shape and size. The architectural style of the building is evident from the shape and ornaments, which appear to be inspired by Jengki architecture. To reinforce the assertion that the Jengki style building form is architecturally significant, the results of observations of the research object were then compared with Rahmanu's research on the Jengki building (Table 3).

Table 3. Morphological comparison of jengki style with reseach object

No	Rahmanu's Jengki Morphological Theories	Research object	Description
1			Massing stage 1 shaping the wall and gable roof

No	Rahmanu's Jengki Morphological Theories	Research object	Description
2			Massing stage 2 shaping the pentagram wall
3			Massing stage 3 shaping wall surface
4			Massing stage 4 shaping elevated gable roof surface
5			Massing stage 5-7 research object have an elevated floor and more simple design at entrance area
6			
7			

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A comparison of the shapes of the two buildings reveals that the research object building has the Jengki architectural style as described by Rahmanu. However, there is a significant difference between the two buildings in stage 5, where the research object building becomes a two-story building, while Rahmanu's theory discusses a one-story building. The results of the interviews regarding the perceptions of the six research object buildings were obtained in digital form sheets from Google. These form sheets pertained to the perceptions of experts regarding historical data, physical condition, and universality themes. The interviews were conducted on the six research object buildings, as table 4,5, and 6

Table 4. Expert perception of historical data interviews result

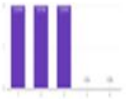
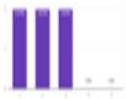
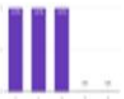
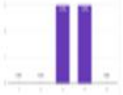
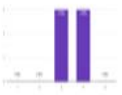
A	B	C	D	E	F
					
					
scale 1-3 low	scale 1-3 low	scale 1-3 low	scale 1-3 low	scale 1-3 low	scale 1-3 low

Table 5. Expert perception of physical condition interviews result

A	B	C	D	E	F
					
					
Scale 3-4 middle	Scale 3-4 middle	Scale 3-4 middle	Scale 3-4 middle	Scale 3-4 middle	Scale 3-4 middle

A review of the statements from the informants' perceptions revealed that the most unique forms, namely buildings B and C, received the highest ratings on the scale of universality. These findings are pertinent to the overarching theme of the physical condition of the building. Indeed, the perception theme pertaining to the condition of buildings B and C was ranked the highest in comparison to the other buildings.

The results of the interviews with the general public regarding their perceptions of the six research object buildings were also obtained from digital Google Form sheets, starting from the themes "perception of memory", "perception of happiness" and "perception of love", as shown in the table 7.

Table 6. Expert perception of Universality interviews result

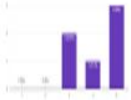
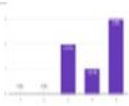
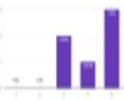
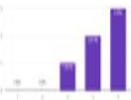
A	B	C	D	E	F
					
					
Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high

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Table 7. Public perception of Memory interviews result

A	B	C	D	E	F
					
					
Scale 2-4 middle to high	Scale 3-4 middle to high	Scale 3-4 middle to high	Scale 3-4 middle to high	Scale 3-4 middle to high	Scale 3-4 middle to high

Table 8. Public perception of Happiness interviews result

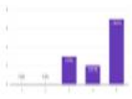
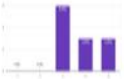
A	B	C	D	E	F
					
					
Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high

Table 9. Public perception of Love interviews result

A	B	C	D	E	F
					
					
Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high	Scale 3-5 high

Angga, 2023

The results from the general public's perception of the theme of love and happiness indicate a high level of positive sentiment. The majority of these perceptions reflect a positive evaluation of the research object, with informants expressing high levels of satisfaction and happiness with the building's design and suitability for its beachside location, as well as its role in supporting local tourism destination areas. The following step is to combine all perceptions of the themes regarding statements regarding the research object building. The shape of the wings will show the direction of the greater assessment of the general public's assessment or the expert community's assessment. In the table below you can see the shape of the wings after combining all the perception values.

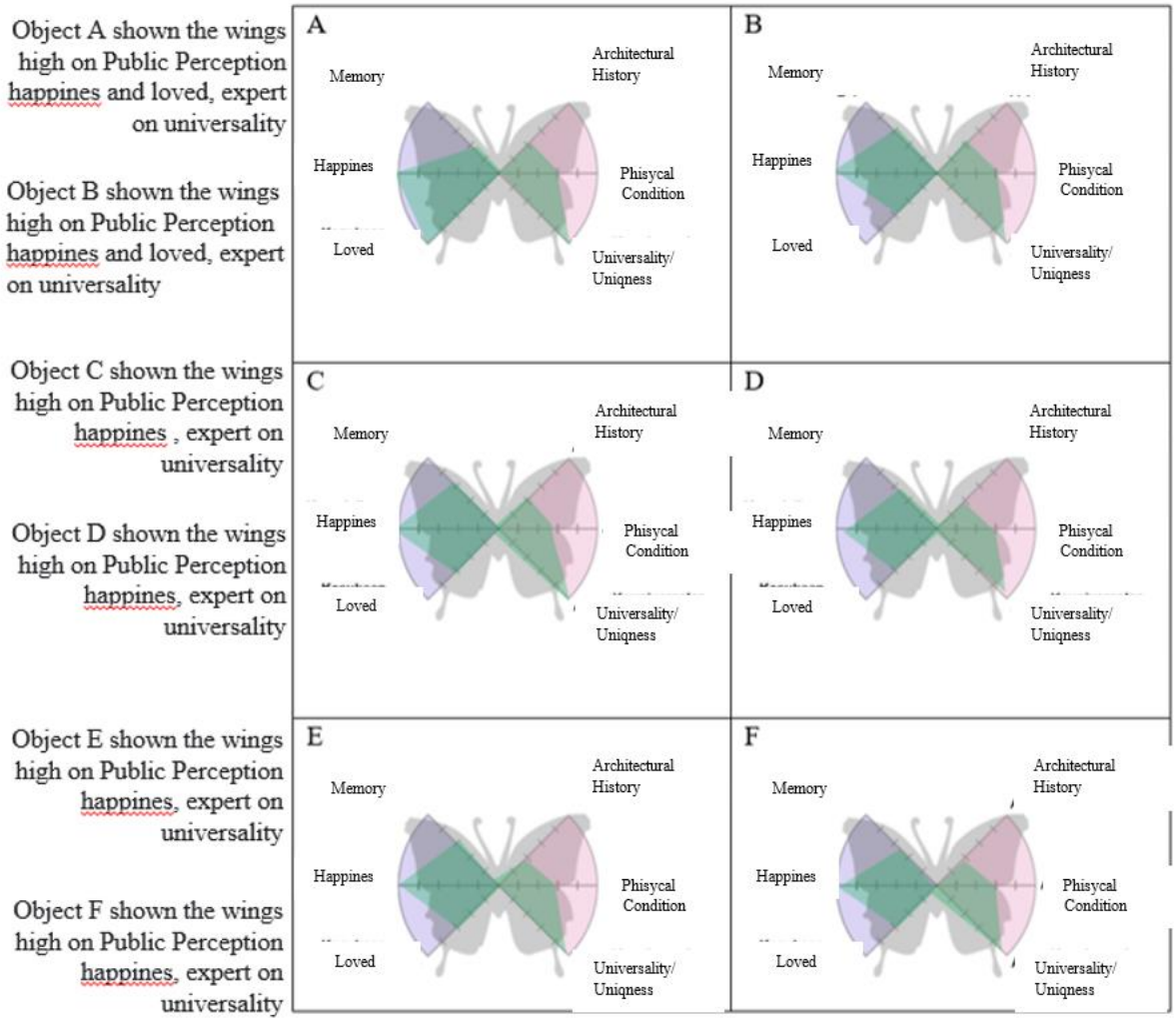


Figure 12. Research object Heritage Butterfly diagram result (Angga, 2023)

The results of the Butterfly Heritage Diagram were obtained by combining all perceptions. As can be seen from the diagram above, the left wing, which represents the general public informants' perceptions, is larger than the right wing, which represents the expert informants' perceptions. In the historical data and physical condition sections of the diagram, wing sections with low ratings are indicated. The theme with the highest rating scale from the expert community is universality, which means that this building has unique architectural significance. Meanwhile, the theme with the highest value scale from the general public is about concern. The majority of the general public appreciates the research object building and considers it to have become an important part of the refinery coastal area. This also proves that there is architectural and cultural significance value of this building.

From the theme categories above, there are themes which are perceptions of the general public that can complement or have connection with the category of expert society and vice versa. This is in accordance with the quasi-qualitative method with deductive thinking where this theme is influenced by existing community perceptions and then this theme becomes a component that determines the significance value of the method used by mAAN. The form of influence of perception on the theme can be seen in the figure 12.

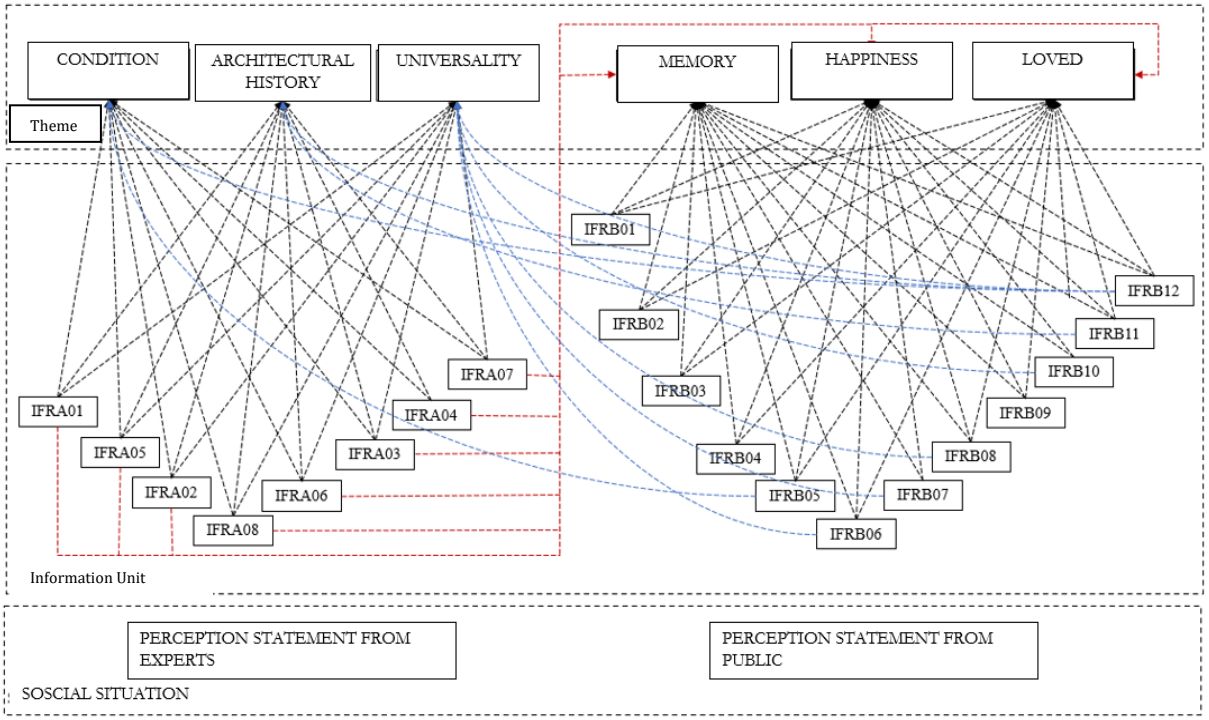


Figure 13. Theme connectivity perception diagram
(Angga, 2023)

The red and blue diagram relationship dotted line is a statement from an expert informant which is also included in the theme of perceptions regarding caring and liking memories. Where all expert informants through their statements fall into these three theme categories. Meanwhile, for general informant statements, only a few of the statements about their perceptions fall into the expert community theme category.

5. CONCLUSION AND RECOMMENDATIONS

By utilising a perception scale derived from the heritage butterfly diagram, it is possible to draw conclusions regarding the perceptions of informants from the general public and experts from the six research object buildings. The cognitive statements from the first two categories of informants were categorised under the Memory theme. The majority of public informants stated that they did not remember much about this building, as it was only a background or complement to this beach location. In the theme of happiness, the majority of public informants indicated that they cared and were interested in the building due to its location on the beach. Some also noted that the guest house building was an old building with historical significance. In the theme of love, the majority of informants stated that they liked the unique sloping shape of the building. The distinctive characteristics of the PERTAMINA housing area include its modern style, which is nonetheless imbued with a sense of history. These characteristics are exemplified by the buildings, window shapes, roofs, building materials and location on the beach.

The primary obstacle in collecting perception data is the temporal constraints imposed by the necessity of conducting interviews within a limited timeframe. Expert informants, including professionals such as architects, homestead administrators, government officials, and lecturers in Balikpapan City and East Kalimantan Province, are often unable to provide the requisite time for interviews, thereby limiting the efficacy of the interview process.

Meanwhile, general informants, who were visitors from the refinery beach, were not focused on the interview activities, which coincided with their holiday at the location. However, results and data were still obtained and collected through direct interviews or online. Data entry via Google Form was only given to informants who did not have time for interviews. It is hoped that if further research is carried out, the research and data collection period should be longer so that more comprehensive results can be obtained.

The results of the analysis indicate that the informants' perception statements are statistically significant. Consequently, this research can be used as a recommendation to designate this building as a suspected cultural heritage object and to designate the research object as part of a tourist destination area through conservation and preservation. This would increase the regional income of the city.

REFERENCES

Affandy, F. B. (2003). *the jengki style in bandung indonesia*. *September*.

ANRI. (2016). *CITRA KOTA BALIKPAPAN DALAM ARSIP*.

Creswell. (2013). *John W. Creswell-Research Design_ Qualitative, Quantitative, and Mixed Methods Approaches-SAGE Publications, Inc (2013) (1)*.

Dahliani, & Wastuty, P. W. (2011). *Studi Karakteristik Bangunan Bergaya Jengki di Banjarmasin*. https://www.semanticscholar.org/paper/89e366751215e4ce69d5c4c632251231ca699ab9

Dranie Putra, A. P. (2019). Empathy, Architecture & Indonesia at Nation Building in the 1950's. *International Journal of Built Environment and Scientific Research*, *2*(2), 87. https://doi.org/10.24853/ijbesr.2.2.87-96

Dwika Aprilian, R., & Widiastuti, I. (2021). *The Story of Adaptive Reuse in Jakarta's Old Building Under the "Instagrammable" Era*. *602*(Artepolis 2020), 172–179.

Lisa, D., & Mardiyanto, A. (2021). Yankee Architecture in Bandar Lampung City. *IOP Conference Series: Earth and Environmental Science*, *764*(1). https://doi.org/10.1088/1755-1315/764/1/012003

Norbruis, O. H. (2022). *ARSITEKTUR DI NUSANTARA*.

Prijotomo, J. (1996). When East Meets West: One Century of Architecture in Indonesia (1890s-1990s). *Architronic*, *5*(3), 1–10. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.39.1000&rep=rep1&type=pdf

Purnamasari, W. W., & Mildawani, I. (2011). *DWELLING HOUSE FADE TYPOLOGY STUDY JENGKI ARCHITECTURAL STYLE IN KEBAYORAN BARU AREA, SOUTH JAKARTA*. https://www.semanticscholar.org/paper/85dfcad98eafe89865c1887fcbb46ae203aae69c

Puspitasari, P., & Handjajanti, S. (2016). 'Precedent Studies and Visual Architecture: in Search of Theoretical Concept of Chinese Shop Houses Facade Style (Case: Kampung Cina, Pekalongan, Central Java, Indonesia). *Applying Local Knowledge for Livable Space*, 156–162. https://trijurnal.lemlit.trisakti.ac.id/index.php/lslivas/article/view/2340

Puspitasari, P., & Lakawa, A. R. (2020). Revealing the vernacular concept through proportions in architecture. *International Journal of Scientific and Technology Research*, *9*(3), 1415–1420.

Rahmanu Widayat. (2006). Spirit Dari Rumah Gaya Jengki Ulasan Tentang Bentuk Estetika Dan Makna. *Dimensi Interior*, *4*(2), 80–89. http://puslit2.petra.ac.id/ejournal/index.php/int/article/view/16698

Safeyah, M. (2006). Perkembangan Arsitektur Kolonial di Kawasan Potroagung. *Jurnal Rekayasa Perencanaan*, *3*(1), 1–11.

Sell, R. H. (2005). *ScholarlyCommons ScholarlyCommons Theses (Historic Preservation) Graduate Program in Historic Preservation The Lazaretto : The Cultural Significance and Preservation Plan in The Lazaretto : The Cultural Significance and Preservation Plan in the Burra Charter the Burra Charter*. https://repository.upenn.edu/hp_theses

Setyabudi, I., Antariksa, & Murti Nugroho, A. (2012). Transisi Ruang Arsitekturrumah Jengki Di Kota Malang, Singosari Dan Lawang. *Tesa Arsitektur*, *10*(2), 84–96.

Setyabudi, I., & Nugroho, A. M. (2012). *Tipologi-Morfologi Arsitektur Rumah Jengki Kota Malang Dan Lawang*. *5*, 32–46.

Susilo, G. A. (2009). Arsitektur Jengki: Bergeometri yang Kreatif. *Spectra*, *7*(13), 15–23. http://eprints.itn.ac.id/id/eprint/3217

Tarigan, A. K. M., Samsura, D. A. A., Sagala, S., & Wimbardana, R. (2017). Balikpapan: Urban planning and development in anticipation of the post-oil industry era. *Cities*, *60*, 246–259. https://doi.org/https://doi.org/10.1016/j.cities.2016.09.012

van Roosmalen, P. K. M. (2016). *From "Indisch" and "Art Deco" to "Jengki": Re-thinking "colonial" architecture of the Dutch East Indies in a globalising world PKMvR heritage research consultancy*.

Widodo, J. (2010). Current state of modern asian architecture discourse and networking: Op arch i. *Journal of Architectural Education*, *63*(2), 79–81. https://doi.org/10.1111/j.1531-314X.2010.01066.x

Widodo, J., Wong, Y. C., & Ismail, F. (2017). DIGITAL HISTORIC URBAN LANDSCAPE METHODOLOGY for HERITAGE IMPACT ASSESSMENT of SINGAPORE. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *4*(2W2), 327–334. https://doi.org/10.5194/isprs-annals-IV-2-W2-327-2017

Winarso, H., & Dewi, C. (2005). Urban Heritage Conservation in Aceh, Indonesia: Conserving Peunayong for Tourism. *ASEAN Journal on Hospitality and Tourism*, *9*, 15–28.

CHAPTER 2

The Impact of Sharia and Conventional Monetary Policy, the Covid-19 Pandemic on the Tourism Industry Sector in Indonesia

Lavlimatria Esya
Faculty of Economics & Business, Universitas Trisakti, Jakarta, Indonesia
lavlimatria.esya@trisakti.ac.id
Orcid: 0009-0002-3500-9446

Raden Ajeng Entaresmen
Faculty of Economics & Business, Universitas Trisakti, Jakarta, Indonesia
raden.ajeng@trisakti.ac.id
Orcid: 0009-0009-1214-7863

Deden Misbahudin Muayyad
Faculty of Economics & Business, Universitas Trisakti, Jakarta, Indonesia
deden.misbahudin@trisakti.ac.id
Orcid: 0000-0002-7429-3411

Syofriza Syofyan
Faculty of Economics & Business, Universitas Trisakti, Jakarta, Indonesia
syofriza.syofyan@trisakti.ac.id
Orcid: 0000-0003-2984-9190

Nuraini Chaniago
Faculty of Economics & Business, Universitas Trisakti, Jakarta, Indonesia
nuraini.chaniago@trisakti.ac.id
Orcid: 0009-0004-2762-4187

IIiBF, **Abdulmajid Obaid Hasan Saleh**
International Islamic University Malaysia

ABSTRACT

This research aims to determine the impact of Monetary Policy (Sharia and Conventional), and the Covid-19 Pandemic on the Tourism Industry Sector in Indonesia. This research uses the Vector Autoregressive (VAR) / Vector Error Correction Model (VECM) method. Data from 2018:01- 2021:12 was obtained from the Central Bureau of Statistics (BPS), Bank Indonesia, and the Ministry of Tourism. The dependent variable used in this research is the Tourism Industry Sector (SIP), while the independent variables are Bank Indonesia Certificate (SBI) as a conventional monetary policy variable and Bank Indonesia Sharia Certificate (SBIS) as a Sharia monetary policy variable, as well as the Covid-19 pandemic as a dummy variable.

The research results show that the stationarity test is fulfilled on the degree of integration, while for the cointegration test, it is found that the data is not cointegrated, so the model used is the VAR model. The results show that there is no long-term relationship between the variables SBI, SBIS, and the Covid-19 Pandemic on the tourism industry in Indonesia, this is because the variables are not cointegrated. The variables that have a significant impact on the Tourism Industry Sector (SIP) are SBI and SBIS, while the COVID-19 pandemic is not significant in influencing SIP.

Keywords: Monetary Policy, Tourism Industry Sector (SIP), Vector Autoregressive (VAR), Bank Indonesia Certificate (SBI), and Bank Indonesia Sharia Certificate (SBIS), Covid-19 Pandemic.

1. INTRODUCTION

In every state administration, the government determines a decision or policy that aims to maintain economic, political, socio-cultural, and defense stability to realize the welfare of the entire community. Monetary policy is determined in the development plan of the monetary authority, namely the central bank, by changing monetary amounts and interest rates. Its implementation is carried out by the monetary authority and financial institutions (Sudirman and Wayan, 2011). Monetary policy plays a significant role in the economy, its presence is expected to focus on price stability and encourage output growth (Wardhono Adhitya et al., 2019).

Monetary policy is a central bank instrument that is deliberately designed in such a way as to influence financial variables, such as interest rates and the level of money supply. The target to be achieved is to maintain the stability of the value of money, both against internal and external factors. The stability of the value of money reflects price stability which will ultimately influence the realization of achieving a country's development goals, such as meeting basic needs, equal distribution, expanding employment opportunities, optimum real economic growth, and economic stability.

The Islamic monetary system is a subsystem of the Islamic economic system that seeks to provide justice and benefit, although global benefit rather than specific benefit to specific parties. In this situation, Islamic monetary policy adheres to the same principles as conventional monetary policy, namely ensuring currency stability (Zainal and Hidayat, 2021). During the Covid-19 pandemic, the Indonesian monetary authority has implemented an expansionary monetary policy by lowering the BI 7-Day Reverse Repo Rate, the Deposit Lending interest rate, and the Lending interest rate. This is to maintain the stability of the rupiah exchange rate and supply liquidity, thereby encouraging accelerated realization of the APBN and movement of the real sector, which ultimately encourages economic.

The COVID-19 pandemic had an impact on slowing and even decreasing economic growth in several countries in the second quarter of 2020. However, China, which experienced Covid-19 at the beginning of the year, was able to record positive economic growth in the second quarter of 2020. Furthermore, restrictions on economic activity had an impact on decreasing economic growth which more in 2020. Economic growth in 2020 was lower than previously estimated (Sigala, 2020). Indonesia's economic growth in the second quarter of 2020 experienced a contraction of -5.32% (y-o-y) from growth in the first quarter of 2020 which was 2.97%. The tourism sector is a sector affected by this pandemic, namely the number of foreign tourists coming to Indonesia has dropped drastically along with the reduction in international flights. Domestic tourists have also experienced a very drastic decline since the pandemic and this has become worse with the implementation of social and physical distancing (Bank Indonesia, 2020).

The impact of the Covid 19 pandemic on Indonesia's macro conditions can be seen from several events, namely: First, in April 2020, around 1.5 million employees were laid off or fired, of which 1.2 million workers came from the formal sector, and 265,000 from the informal sector. Second, the air service sector lost revenue of around IDR 207 billion, of which around IDR. 48 billion in lost revenue came from Chinese airlines. Third, the number of tourists decreased by 6,800 per day, especially tourists from China. Fourth, according to the Indonesian Hotel and Restaurant Association (PHRI), there has been a 50% decline in hotel

occupancy rates in Indonesia, resulting in a decline in tourism foreign exchange by more than half compared to last year. Sixth, hotels, restaurants, and retail entrepreneurs who also support the tourism sector are also affected. The lack of tourists also has an impact on restaurants or eateries where most of their consumers are tourists. Seventh, the spread of Covid 19 also has an impact on the investment, trade, micro, small, and medium enterprises (MSMEs) sectors, because when tourists visit, these tourists will buy souvenirs. Eighth, inflation occurred in March 2020 at 2.96% year on year (yoy), with the price of gold jewelry and several food prices rising quite drastically.

Based on the Central Statistics Agency (2021), the number of foreign tourist visits to Indonesia as of December 2021 reached 163.62 thousand visits. The number increased 8.66% compared to the previous month. Meanwhile, foreign tourist visits to the country compared to December 2020 experienced a slight decrease of 0.28%. Meanwhile, accumulatively from January to December 2021, foreign tourist visits to Indonesia reached 1.56 million visits. This number fell 61.57% compared to the same period in 2020. The number of foreign tourist visits throughout 2021 was also the lowest in the last six years. The number of foreign tourist visits reached 11.5 million in 2016 and continued to increase to 16.1 million in 2019, but fell in 2020 and 2021 due to the Covid-19 pandemic. Figure 1 shows the number of foreign tourists in S2020-2021.

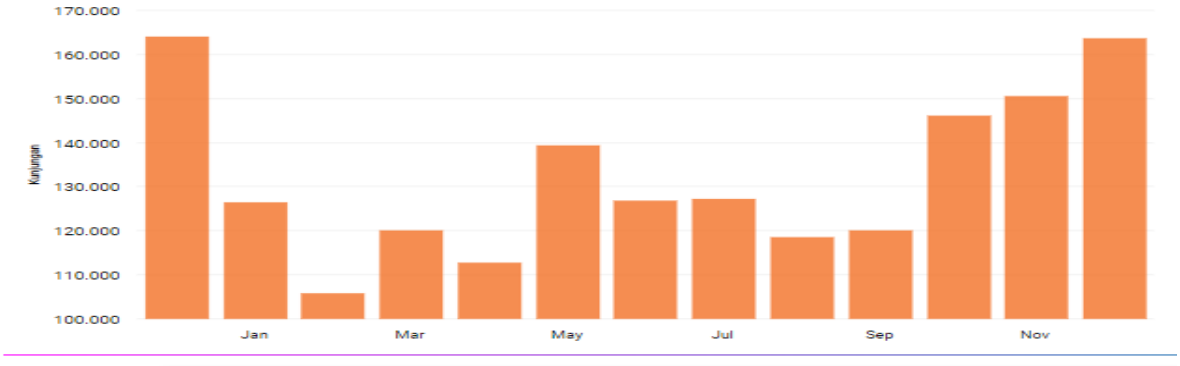


Figure 1. Number of foreign tourist visits (2020-2021)

Salman (2022) analyzed tourism statistical data sourced from the Central Statistics Agency, it was found that the number of foreign tourist arrivals through air entrances had decreased sharply, where Ngurah Rai Airport was the most affected, the occupancy rate of star hotels in Indonesia had decreased sharply, where hotels in Bali have the biggest impact, tens of millions of workers in the tourism sector are threatened with losing their jobs and national income from the tourism sector will decline. According to Fakhrika and Roy (2020), the government policies adopted to overcome macroeconomic problems during the Covid-19 Pandemic are divided into 2, namely the Social Safety Net through additional and supported funding from the State Revenue and Expenditure Budget (APBN) and Economic Safety Net by providing fiscal and non-fiscal incentives. Other stimuli that were also carried out to improve the economy were First, the issuance of PERPPU 1 of 2020. Second, the issuance of tax policies. Third, the issuance of Policies in the Financial Sector.

Research by Irianto et al., (2020), stated that government policy is aimed at social and cultural, and the development of the tourism industry. Sengel U et al., (2023) shows that the tourism industry is strongly driven by monetary policy. Norvadewi (2023), that Islamic

economic principles in tourism advertising are strongly supported to increase tourism in Bandung Regency.

Based on previous background and research, researchers are interested in examining the impact of conventional monetary policy, Sharia, and the COVID-19 pandemic on the Tourism Industry Sector in Indonesia.

2. LITERATURE REVIEW

A Monetary Policy is a policy issued by the central bank or monetary authority that includes controlling monetary amounts and/or interest rates to achieve the desired economic goals. Monetary policy is a government policy to improve the economic situation by regulating the money supply. Monetary quantities consist of base money (M0), money in circulation in a narrow sense (M1), and money in circulation in a broad sense (M2) (Adhitya, 2019). Monetary policy carried out by the Central Bank carries out economic adjustments or a series of regulations that focus on asset markets and goods markets. The monetary policy implemented affects spending, resource absorption, and output in the short term, which leads to price levels in the medium and long term. The monetary policy carried out by Bank Indonesia in influencing asset prices has the ultimate goal of determining the inflation rate.

In practice, the effectiveness of monetary policy depends on the relationship between the money supply and main economic variables such as output and inflation. From several literatures, the main interesting finding regarding the relationship between the money supply, inflation, and output is that in the long term, the relationship between money supply growth and inflation is very high or has a close relationship. Meanwhile, the relationship between money growth and inflation and real output growth may be close to zero or can be said to have almost no relationship. This finding shows that there is a consensus that in the long-term monetary policy only has an impact on inflation, and has little effect on real economic activity. Regardless of the differences in viewpoint above, practitioners and academics generally believe that in the short term expansionary monetary policy can encourage economic activity which is experiencing a prolonged recession. On the other hand, contractionary monetary policy can slow down the rate of inflation which generally occurs when economic activity is increasing (Warjiyo and Solikin, 2011).

Islamic monetary policy (in Indonesia usually called sharia monetary policy) is carried out by Bank Indonesia in the format of a dual monetary system to achieve the single goal of maintaining the stability of the value of the rupiah. Islamic history explains that monetary policy is implied in the lives of the Prophet Muhammad and his companions. Like Caliph Umar, who regulated the monetary sector with various regulations, including prohibiting all forms of action that would affect fluctuations in purchasing power and instability in the value of money, counterfeiting money, protecting against inflation by encouraging his people to invest in the real sector, live simply and not be fashionable. excessively, printing dirhams under Islamic regulations, namely six daniq (Dahniar, 2016).

Islamic monetary policy instruments according to Chapra (in Esya, 2013, 2021):

1. Growth targets in M and M0, these targets will determine the economic growth of a country, so the growth in the money supply needs to be kept under control

2. Public shares in demand deposits (demand deposits), some of the commercial bank demand deposits that are idle funds, should be transferred to the government to be used for public interests, which in the end can increase the social welfare of society.
3. Official mandatory reserves, commercial banks are required to hold a certain proportion of bearer deposits and deposit them with the central bank, this is done to help ensure deposit security and liquidity.
4. Credit limit, this is necessary to ensure that total credit creation is consistent with monetary targets.
5. Value-oriented credit allocation, the aim of which is to help realize the targets of Islamic society and then maximize private profits.
6. Another technique, can be done using persuasion (moral suasion) which will occupy an important position in Islamic banking.

Based on data from the World Health Organization (2020), the Coronavirus is a virus that can attack both animals and humans. This Coronavirus can cause respiratory infections such as flu and Middle East Respiratory (SARS). The new type of virus that spreads from the Coronavirus is Covid-19. Covid-19 was first discovered in China in 2019 in December. The impact of COVID-19 causes respiratory illnesses such as flu with symptoms of coughing, fever, and in more severe cases, difficulty breathing, which can cost lives.

3. METHODOLOGY

The equations used are as follows:

$$SIP = a + b1\ SBI + b2\ SBIS + b3\ COV + e$$

Where:
SIP = Tourism Industry Sector
SBI = Bank Indonesia Certificate
SBIS = Bank Indonesia Islamic Certificate
COV = Covid-19 (Dummy Variable) b1, b2, b3 = Coefficient

The data used is secondary data from 2018.1 - 2021.12, using Autoregression (VAR) analysis, this method is often considered an approach that is not based on a particular economic theory (e-toritis) (Gujarati, 2009, Widarjono, 2007 and Tanjung & Devi, 2013 in Esya, 2013). In VAR testing, the important thing is the prerequisite test used to test the data, because VAR data must be stationary and not cointegrated. However, if the data is stationary and cointegrated, the Vector Error Correction Model (VECM) approach is used. The VAR/VECM approach first carries out data stationary testing or prerequisite testing. Prerequisite tests include the data stationarity test (unit root test, degree of integration test, and cointegration test), as well as the optimal lag determination test. The model above is derived into the VAR equation as follows:

$$SIP_{1,t} = \beta_{01} + \sum_{i=1}^{p} SIP_{,t-i} + \sum_{i=1}^{p} SBI_{,t-i} + \sum_{i=1}^{p} SBIS_{,t-i} + \sum_{i=1}^{p} COV_{,t-i} + \varepsilon_{1t} \ldots..$$

Where:
β01 = Intercept
βi1, αi1, ηin = short-term dynamic coefficients of model adjustment
long-term balance
ε1t = residual error

Finding & Discussion

In this section, the results of data processing on the variables used in this research will be explained and their discussion. The method used in this research is Vector Auto Regression (VAR) which is then followed by the Vector Error Correction Model (VECM) method when there is data cointegration in the model equation. The software used is Eviews 9.0. Explanations will be published sequentially starting with tests of the VAR and VECM models, as well as VECM analysis using IRF and FEVD.

Prerequisite Test

The following explains the prerequisite tests before carrying out the VECM/VAR test, namely the stationarity test (unit root test, integration test).

Stationarity Test

Testing stationarity using the Unit Root Test, namely the Augmented Dickey-Fuller (ADF) Test. If the ADF t-statistic value is smaller than the critical value of 5%, then it can be said that the data has 95% confidence and is stationary because does not contain a unit root. The test results can be seen in Table 1 below:

Table 1. Stationarity test results

Variabel	ADF Test		Critical Value	Kesimpulan
SBI	-2.330931	0.0206	-2.615093	Level – None
SBIS	-3.774795	0.0003	-2.616203	1ST Diference – None
SIP	-4.862302	0.0002	-3.577723	Level – Intercept
COV	-6.708204	0.0000	-2.616203	1ST Diference – None

Source: Processed Data (Eviews 9.0)

Based on table 1, shows that the data is not stationary at the level level, but is only stationary at the integration degree (at degree one), it can be seen that the ADF test value is smaller than the critical value. For the VAR/VECM model, the data must be stationary to the same degree, so that if there is data that is not stationary at a level, then the overall data used is the first difference data.

Cointegration Test

The cointegration test is carried out if the data is stationary at the first difference level to see the possibility of cointegration between variables. The purpose of cointegration testing is to determine whether the model used is VAR or VECM or to see whether there is a theoretical relationship. The results of the cointegration test can be seen in Table 2 below:

Table 2. Cointegration Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace			Max – Eigen		
		Statistic	5%	1%	Statistic	5%	1%
None	0.058893	1.031874	3.841466	0.3097	1.031874	3.841466	0.3097
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace**			**Max - Eigen**		
		Statistic	**5%**		**Statistic**	**5%**	
None	0.358554	39.03672	47.85613		20.42539	27.58434	

Source: Processed Data (Eviews 9.0)

The test results show that the error variable has an ADF statistical value of 20.42539, this value is smaller than the critical value of 27.58434 (alpha 5%), this shows that there is no degree of cointegration between the variables in this study and it is concluded that the error correction term is not stationary. For further testing use the VAR analysis tool.

Optimum Lag Determination Test

This optimum lag length test is very useful for researchers to eliminate autocorrelation problems in VAR systems. This means that if the optimum lag is used, it is hoped that it can eliminate the autocorrelation problem. The first step is to determine the maximum lag length of a stable VAR system. According to Ascarya, (2009), a VAR system is said to be stable (stationary) if all its roots have a modulus smaller than 1 and all of them are located within the circle unit.

Table 3. Results of determining optimum lag

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-364.3271	NA	105.9259	16.01422	16.17323	16.07379
1	-212.2312	271.1275	0.286204	10.09701	10.89207*	10.39484*
2	-192.2048	32.21632*	0.244359*	9.921948*	11.35306	10.45805

*indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Source: Processed Data (Eviews 9.0)

Based on the test results to determine the optimum lag length in this research, it is known that the lag used is Lag 2 based on the LR (Likelihood Ratio) criteria of 32.21632*, FPE (Final Prediction Error) of 0.244359*, AIC (Aikaike Information Criterion) of 9.921948*, SC (Schwarz Information Criterion) of 11.35306, and HQ (Hannan Quinn Information Criterion) of 10.45805.

Model Stability Test

The next test is testing the stability of the VECM model. If a model has stabel then the estimation results will not change with large deviations even though the period is extended so that the estimation results can be accounted for (Gujarati, 2004). In this research, the inverse roots of the AR testing method will be used. If the modulus is in a circle (Unit Circle) then it is likely that the model is stable. From the test results, it was found that the modulus was all within the unit circle, so it could be concluded that the model to be used had stability.

Table 4. Model stability test results roots of characteristic polynomial endogenous variables: sbi sbis cov sip exogenous variables: c lag specification: 1 2 date: 07/15/23 time: 17:14

Root	Modulus
0.939791	0.939791
0.833128 - 0.154544i	0.847340
0.833128 + 0.154544i	0.847340
0.547686 - 0.225082i	0.592133
0.547686 + 0.225082i	0.592133
0.176520 - 0.369792i	0.409763
0.176520 + 0.369792i	0.409763

-0.075305	0.075305
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

Based on the results, to test whether the VAR estimates that have been determined are stable or not, a VAR condition stability check is carried out, namely in the form of roots of characteristic polynomials. A VAR model is said to be stable if all its roots have a modulus smaller than 1 (Gujarati, 2003). From the table above, it can be seen that there are no characteristic root and modulus values that are more than 1. Meanwhile, from Figure 2 below, it can be seen that the inverse root points of the AR polynomial are all inside the circle.

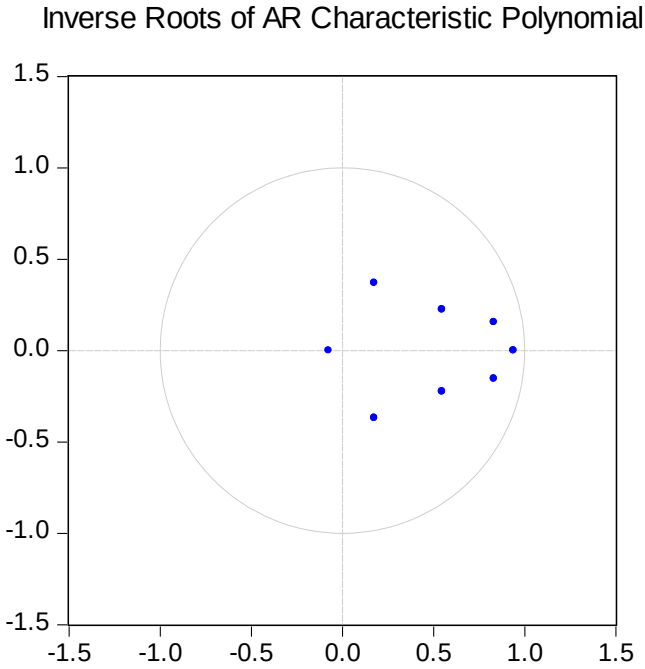


Figure 2. VAR stability test results

Granger Causality Test

The Granger causality test is used to see the causal relationship between variables, whether they have a one-way or two-way relationship. From the tests that have been carried out and obtained the results in Table 5 below:

Table 5. Granger causality test results

Null Hypothesis	F-Statistic	Prob.	Keterangan
SBIS does not Granger Cause SBI	0.73125	0.4875	H0 Di terima
SBI does not Granger Cause SBIS	0.69291	0.5059	H0 Di terima
COV does not Granger Cause SBI	4.29186	0.0203	H0 Di tolak
SBI does not Granger Cause COV	0.40326	0.6708	H0 Di terima
SIP does not Granger Cause SBI	0.22860	0.7967	H0 Di terima
SBI does not Granger Cause SIP	0.30216	0.7409	H0 Di terima
COV does not Granger Cause SBIS	0.11179	0.8945	H0 Di terima
SBIS does not Granger Cause COV	0.93542	0.4006	H0 Di terima
SIP does not Granger Cause SBIS	0.56192	0.5744	H0 Di terima

SBIS does not Granger Cause SIP	1.49842	0.2355	H0 Di terima
SIP does not Granger Cause COV	3.88136	0.0286	H0 Di tolak
COV does not Granger Cause SIP	0.57762	0.5657	H0 Di terima

Source: Processed Data (Eviews 9.0)

From the results of the Granger causality test, it show that there are 2 one-way relationships. The prob value is <0.05 which means H0 is rejected, namely the one-way relationship between Covid-19 affects SBI with a prob value of 0.0203 and SIP affects Covid-19 with a prob value of 0.0286.

VAR Model Estimation

The purpose of estimating the VAR model is to see the effect that the value of a variable in the past can explain its condition in the present and is influenced by the past values of all other endogenous variables in the observed model. In addition, in VAR analysis there are usually no exogenous variables in the model.

Based on the VAR test results, it can be explained through the following equation:

$$SIP = 4.040 – 0.009SBI\ t\text{-}1 + 0.004SBIS\ t\text{-}1 – 0.318COV\ t\text{-}1 + 0.958SIP\ t\text{-}1$$

In the tourism industry sector (SIP) equation, there are significant variables, namely the Bank Indonesia Certificate (SBI) and the Bank Indonesia Sharia Certificate (SBIS). The equation above shows that the variable that significantly influences the tourism sector is conventional monetary policy (SBI) but has a negative relationship, while the variable Sharia monetary policy (SBIS) has a positive and significant relationship. Meanwhile, the Covid variable has a negative and insignificant effect on the tourism industry sector. These results follow the hypothesis and support the research results of Salma (2022). During the pandemic the tourism sector declined sharply, this can be seen from the decline in the number of tourists coming to Indonesia, as well as the sharp decline in labor absorption in the tourism sector, but these results are not significant, this is due to the short amount of data used for the Covid pandemic.

Impulse Response Function (IRF) Test

The Impulse Response Function (IRF) test is used to see shocks in the economy. The results of this test are carried out to describe the level of shock of a variable to other variables in a certain period. So, that way we can see how long it takes for the influence of one variable on other variables to return to the balance point. In the following image are the results of the Impulse Response Function (IRF) test that has been tested.

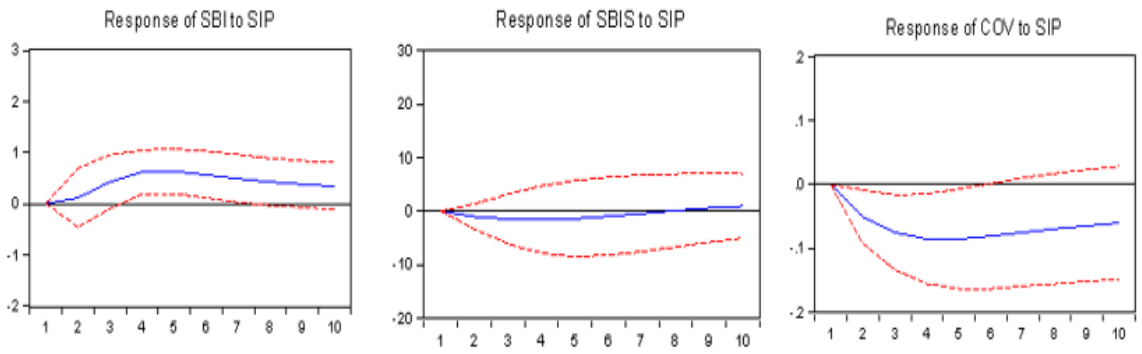


Figure 3. Impulse Response Function (IRF) test results

Based on the results of the image above, the response of the conventional monetary policy variable (SBI) to the Indonesian tourism industry variable (SIP) from the beginning of the period to the tenth period experienced an upward shock and continues to respond positively. It can be seen that in the initial stage of the conventional monetary policy shock the response was positive and increased at the beginning of the period, but after the seventh period it was stable. Then the response to the sharia monetary policy variable (SBIS) in the first to fifth periods decreased and was negative, but in the sixth to tenth period the response of the SBIS variable to the SIP variable was positive. Meanwhile, the Covid response to SIP in the first to tenth periods experienced a negative decline.

Forecast Error Variance Decomposition (FEVD) Test

Apart from carrying out and analyzing behavior through the IRF test on VAR estimation, a forecast error variance decomposition (FEVD) test was also carried out to see the contribution of a variable in explaining the variability of endogenous variables. The FEVD test results can be seen in Table 6 below:

Table 6. Forecast error variance decomposition test results

Variabel	Periode	SE	Shock			
			SBI	SBIS	COV	SIP
SIP	2	2.172706	0.000991	1.517312	1.538343	96.94335
	6	2.623799	0.635980	4.751737	2.221059	92.39122
	10	2.890656	0.483346	23.33407	1.785036	74.39755
SBI	2	15.11451	95.37231	0.700000	0.928198	2.999489
	6	29.18793	65.80236	5.636802	22.63996	5.920878
	10	31.07903	54.51922	9.289604	30.33783	5.853346
SBIS	2	0.196741	1.091339	94.82591	0.028405	4.054343
	6	0.341098	0.525210	92.93375	0.069856	6.471180
	10	0.410152	0.614534	92.48280	0.553441	6.349228
COV	2	0.268010	4.833608	4.708992	66.13597	24.32143
	6	0.347446	2.548102	5.753033	83.50282	8.196042
	10	0.410239	2.403352	5.603839	86.31455	5.678260

Based on Table 6 above, the contribution of conventional monetary policy (SBI) to the tourism industry sector (SPI) is around 0.0-0.63 percent, while each variable of Sharia monetary policy (SBIS) and the COV covid pandemic is 1.5-23 percent and 1.5-2.2 percent. The biggest contribution to variability in the tourism industry sector is the tourism industry

sector itself. The SBI variable can be explained by the SBIS, Covid, and SPI variables, respectively 0.7-9.2 percent, 0.92 -30.3 percent, and 2.9-5.9 percent. The biggest contribution to SBI variability is SBI itself. The SBIS variable can be explained by SBI, Cov, and SIP which respectively have a contribution of 0.52 -1.09 percent, 0.002 -0.55 percent, and 4.03 - 6.4 percent, with the largest contribution being itself. Meanwhile, the Covid variable can be explained by the respective SBI, SBIS, and SIP variables by 2.4-4.8 percent, 4.7-5.7 percent, and 5.6-24.3 percent.

These results show that SIP's largest contribution is exceeded by SBIS's contribution of 23 percent. This means that SBIS sharia monetary policy is able to influence the Indonesian tourism sector industry. This shows that Sharia monetary policy is able to influence the Indonesian tourism industry sector quite significantly.

5. CONCLUSIONS AND SUGGESTIONS

Conclusion

1. The impact of conventional monetary policy (SBI) on the tourism industry sector in Indonesia based on the results of VAR estimates has a positive effect on the Indonesian tourism industry sector. This is also supported by the IRS results that the response of the SBI variable to the SIP variable from the beginning of the period to the tenth period experiences an upward shock and continues to respond positively.
2. The impact of Sharia monetary policy (SBIS) on the tourism industry sector in Indonesia also has a positive influence on the Indonesian tourism industry sector. Although the IRF results show that the response to the SBIS variable in the first to fifth periods decreased, in the sixth to tenth period the response of the SBIS variable to the SIP variable was positive.
3. The impact of the Covid pandemic on the tourism industry sector in Indonesia has had a negative but not significant effect, this can be seen from the VAR test results, this is due to the short amount of data. Based on the IRF results, the Covid response to SIP in the first to tenth periods experienced a negative decline.

Recommendation

Based on the conclusion above that the Covid-19 pandemic has no significant impact on the tourism industry, this is because the VAR test results show a short term. In the long term, the VAR model is unable to explain. Even though the Covid pandemic has had a major impact on all aspects of life including the tourism sector due to increased travel restrictions, cancellation of large events, and reluctance to travel internationally and domestically. To overcome this, various countries are struggling hard to overcome the impact of the Covid-19 outbreak. It requires coordination or cooperation of all parties to overcome this outbreak. Amid efforts to control the spread of Covid-19, it is time to think about the future and plan for recovery. Paying attention to the various impacts resulting from the Covid-19 outbreak, there is still a need for policy intervention and studying policies from various countries specifically to mitigate the impact of Covid-19 in the tourism sector. This is very important because tourism involves a large workforce, and its role economically is being encouraged by the Indonesian government. The aim of the proposed policy response is that the crisis can be handled well, and tourists will return to Indonesia soon.

REFERENCES

Aam Slamet *et al.,* (2021). *The Impact of Covid-19 on Islamic Economics and Finance Industry*: Text Analytics using R. Global Review of Islamic Economics and Business, Vol. 9 No. 2. pp. 055-066.

Aleshina A.V (2018) Tourism and real estate investment. Edition: 1st Edition. Book : Financial and Economic Tools Used in the World Hospitality Industry.

Atiko, G., Sudrajat, R. H., & Nasionalita, K. (2016). Analisis Strategi Promosi Pariwisata Melalui Media Sosial Oleh Kementrian Pariwisata RI (Studi Deskriptif Pada Akun Instagram @Indtravel). Jurnal Sosioteknologi, 15(3), 378–389.

Ascarya, A., & Yumanita, D. (2009). Comparing the Efficiency of Islamic Banks in Malaysia and Indonesia. Buletin Ekonomi Moneter Dan Perbankan, 11(2).

Badan Pusat Statistik. (2021). Jumlah kunjunagan wisatawan mancanegara ke Indonesia 2020 - 2021. www.bps.com

Bank Indonesia, I. (2020). What Can Bali's Tourism Do With Digital Payment in The New Normal Era.

Dahniar (2016), Transmisi Kebijakan Moneter Syariah, Falah Jurnal, Vol.1. No. 1 Maret hal. 91-101.

Donthu, N., & Gustafsson, A. (2020). Effects of COVID-19 on business and research. Journal of Business Research, Vol. 117, pp. 284–289. Elsevier.

Elistia, (2020). Perkembangan dan Dampak Pariwisata di Indonesia Masa Pandemi Covid19. Prosiding Konferensi Nasional Ekonomi Manajemen dan Akuntansi (KNEMA) Journal Homepage: https://jurnal.umj.ac.id/index.php/KNEMA/.

Esya, Lavlimatria. (2013). Analisis Pada Sistem Perbankan Ganda di Indonesia. *Disertasi*, Unpublis, Pasca Sarjana, Universitas Trisakti, Jakarta.

Esya, Lavlimatria. (2001). Pengaruh Krisis Moneter Terhadap Tigkat Bunga Nominal (Aplikasi Model Edward & Khan di Indonesia, Tahun 1988.IV- 1999.III). *Tesis*, di Pubils, Pasca Sarjana UGM, Yogyakarta.

Fahrika dan Roy, (2020). Dampak pandemi covid 19 terhadap perkembangan makro ekonomi di indonesia dan respon kebijakan yang ditempuh. I N O V ASI - 16 (2), 2020; 206-213 http://journal.feb.unmul.ac.id/index.php/INOVASI.

Fatimah, I. R. (2020). Dampak Meningkatnya Harga Masker Di Tengah Mewabahnya Covid-19 Di Kalangan Masyarakat Ditinjau Dari Sudut Pandang Tindakan Manusia. https://doi.org/10.31219/osf.io/j5pn9.

Gujarati. (2003). Ekonometrika Dasar: Edisi Keenam. Jakarta: Erlangga.

Gujarati, A. Damodar. (2012). *Basic Econometrics.* Fifth Edition, Mc Graw Hill.

Gujarati, Damodar N, (2004). Basic Econometrics, Fourth edition, Singapore. McGraw-Hill Inc

Hanoatubun, S. (2020). Dampak Covid–19 terhadap Prekonomian Indonesia. EduPsyCouns: Journal of Education, Psychology and Counseling, 2(1), 146–153.

Hutabarat, M. (2017). Pemodelan Hubungan Antara IHSG, Nilai Tukar Dolar Amerika Serikat Terhadap Rupiah (Kurs) dan Inflasi dengan Vector Error Correction Model (VECM). Skripsi Universitas Pendidikan Indonesia.

Irianto, I. D. K., Purwanto, P., & Mardan, M. T. 2020. Aktivitas Antibakteri dan Uji Sifat Fisik Sediaan Gel Dekokta Sirih Hijau (Piper betle L.) Sebagai Alternatif Pengobatan Mastitis Sapi. Majalah Farmaseutik, 16(2), 202.

Latifah, Nur Aini. 2015. Kebijakan moneter dalam perspektif ekonomi syariah. Moderasi, vol. 11, No. 2, 124-133.

Muljadi. 2010. Kepariwisataan Dan Perjalanan, Jakarta: Raja Grafindo, 2010.

Mulyanti and Fachrurrozi.2017. Sosiologi Ekonomi. Malang : Yayasan Kita Menulis.

Noerkhalishah *et al.,* (2020). The Utilization of Tourism Education Packages in Amanah Borneo Park as a Learning Resources on Social Studies. The Innovation of Social Studies Journal Vol. 1, (2), https://ppjp.ulm.ac.id/journals/index.php/iis.

Norvadewi (2023). Review Of The Sharia Economic Approach To Tourism Promotions. Inisiatif: Jurnal Ekonomi, Akuntansi dan Manajemen. Vol. 2, No. 3. 16-26.

Pakpahan, A. K. (2020). Covid-19 *And Implications for Micro, Small, and Medium Enterprises*. Scientific Journal of International Relations, 59–64.

Paludi Salma. 2020. Analisis Pengaruh Tingkat Kematian Akibat Covid-19 Terhadap Kesehatan Mental Masyarakat di Indonesia.. Vol 3. No 1. Focus: Jurnal Pekerjaan Sosial.

Paludi, Salma (2022). Setahun Pandemi Covid-19 dan Dampaknya Terhadap Industri Pariwisata Indonesia. Vol. 19 No. 1. Equilibrium: Jurnal Penelitian Pendidikan dan Ekonomi.

Prasetyo, Aji. 2017. Peran Uang Dalam Sistem Moneter Islam. Majalah Ekonomi Vol. XXII, No. 1.

Rasbin dan Hermawan Iwan, (2013). Analisis Shock Kebijakan Moneter Dalam Perekonomian Terbuka Kasus Dua Sektor Ekonomi di Indonesia, Jurnal Ekonomi Kebijakan Publik, Vol. 4 No. 1

Sarmigi, E. (2020). Analisis Pengaruh Covid-19 Terhadap Perkembangan UMKM Di Kabupaten Kerinci. Jurnal Al - Dzahab, Vol. 1, 3.

Sengel, U *et al.*, (2023). *Fiscal and monetary policies supporting the tourism industry* during COVID-19. Journal of Hospitality and Tourism Insights *(17).*

Siagian, S. P. (2003). *Teori dan Praktek Kepemimpinan (cetakan kelima*). Jakarta: Rineka Cipta.

Sigala, M. (2020). Tourism and COVID-19: Impacts and implications for advancing and resetting industry and research. Journal of Business Research, 117, 312–321.

Soemitra, Andri. (2018). Bank dan Lembaga Keuangan Syariah. Jakarta: Kencana.

Sudirman, Wayan. (2011). Kebijakan Moneter Dalam Perspektif Ekonomi Syariah. Jakarta: Kencana.

Sukirno, Sadono. Makroekonomi Teori Pengantar Edisi ke-3. Jakarta: RajaGrafindo Persada, 2012.

Sun, Yunpeng and Li, Ying. (2022). COVID-19 Outbreak and Financial Performance of Chinese Listed Firms: Evidence From Corporate Culture and Corporate Social Responsibility. Frontiers in Public Health, Vol. 9, 710-743.

Suryadana, M Liga & Octavia, Vanny. (2015). Pengantar Pemasaran Pariwisata. Bandung: Alfabeta.

Syaharuddin, S. (2020). Menimbang Peran Teknologi dan Guru dalam Pembelajaran di Era COVID-19.

Tanjung, Hendri dan Devi, Abrista. (2013). *Metodologi Penelitian Ekonomi Islam*. Gramata Publishing.

Toding, Rante, Yunus. (2021). Jumlah kunjungan Wisatawan merosot. diakses pada tanggal 06 januari 2021 pukul 21.00 Wita (https://sapos.co.id/2021/01/29/ jumlah-kunjungan-merosot-tajam/).

Wardhono, Adhitya, dan dkk (2019). Perilaku Kebijakan Bank Sentral. Jawa Timur: Pustaka Abadi.

Warjiyo, Perry dan Solikin (2011). Kebijakan Moneter di Indonesia. Jakarta: PSK BI, 2003 dalam Umi Khalsum.

WHO. Coronavirus Disease (COVID-19) Pandemic. World Health Organization. 2020.

Widarjono, Agus. (2009). *Ekonometrika Teori dan Aplikasi Untuk Ekonomi Dan Bisnis* Edisi Kedua. Yogyakarta: FE. UII.

Wulandari, L. W. (2014). Pengembangan Pariwisata Ekonomi Kreatif Desa Wisata Berbasis Budaya Sebagai Niche Market Destination (Studi Kasus Pengembangan Desa Wisata di Kabupaten. Aplikasi Bisnis, 16(9), 2140–2167.

Zainal, Rivai Veitzal, *et al* (2007), Bank and Financial Institution Management, (Jakarta: Raja Grafindo Persada,).

Zainal, Rivai Veitzal, dan Hidayat Rahmat (2021), Ekonomi Makro Islam, (Yogyakarta: UPP STIM YKPN).

CHAPTER 3

The Relationship Between Land Surface Temperature and Water Availability: A Preliminary study

Endah Kurniyaningrum
Departement of Civil Engineering, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
kurnianingrum@trisakti.ac.id
Orcid: 0009-0006-0094-1208

Astri Rinanti
Departement of Environmental Engineering, Faculty of Landscape Architecture and Environmental Engineering,
Universitas Trisakti, Jakarta, Indonesia
astririnanti@trisakti.ac.id
Orcid: 0000-0001-8649-6307

Liana Herlina
Departement of Civil Engineering, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
liana@trisakti.ac.id
Orcid: 0009-0006-1976-6921

Divo Trinugraha Putra
Departement of Civil Engineering, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
divo051002000077@std.trisakti.ac.id
Orcid: 0009-0001-3003-0337

Hira Sattar
Tokyo Institute of Technology, Tokyo, Jepang

ABSTRACT

Land Surface Temperature (LST) is an indicator of climate change, which can influence urban climatological conditions, global environmental changes, and human-environment interactions. In the field of water resources, it is closely related to the hydrological cycle, which has an impact on water security. This research is an initial study of the relationship between surface temperature and water security as climate change mitigation in the Java Island region. The methods used include Supervised Machine Learning with the Random Forest algorithm, Cook's method, and remote sensing using Land Surface Temperature (LST) parameters and Temperature Vegetation Dryness Index (TVDI). The research results show that an increase in built-up land and a decrease in vegetation result in an increase in surface temperature. The surface temperature classification in Jakarta from 1990 to 2021 includes two classes: medium (25–30°C) and high (30–35°C). The increase in built-up land cover reached 25.48%, while the decrease in vegetation 1 and vegetation 2 was 9.26% and 14.73% respectively, so it is predicted that it has the potential to influence the hydrological cycle.
Keywords: Land Surface Covering, Land Surface Temperature, Vegetation, Water security, Climate Change.

1. INTRODUCTION

Satellite remote sensing is a method of observing environmental changes due to human activities physical activities and phenomena. This method can address extraordinary changes in land use/cover, sea level rise, especially in monitoring environmental protection, river deltas, biodiversity and the sustainability of coastal development. Remote sensing systems provide extensive coverage the range of acquisition of spatial data to assess an area using Geographic Information Systems (GIS). In recent years, satellite remote sensing data has been used in research, especially regarding climate change.

Climate change has 5 indicators, including atmospheric composition, temperature and energy, rainfall, ocean conditions and the cryosphere. Understanding changes in these indicators such as CO_2 concentrations, land and sea surface temperatures, rainfall patterns, sea level rise, ocean acidification, and glacier changes is critical to understanding the impacts of climate change and responding effectively.

Based on IPCC data in 2023, global climate change is caused by human activities where air temperatures have increased up to 1.45 and there have been several heat waves in certain countries including the United States, Bolivia, Nepal, Thailand, Japan, Italy, Greece, Morocco, Africa and Indonesia. So 2023 is certain to be the hottest year ever recorded. Heat waves occurred simultaneously in many regions on an unprecedented scale.

The development of climate change is the fundamental reason why problems occur. One of the causes of climate change in Indonesia is that increasing temperatures cause water to evaporate more quickly from land, so that heat waves, droughts and severe forest fires due to climate change become more frequent and intense. This research will discuss the relationship between surface temperature and the condition of water resources in a watershed (Ciliwung Watershed, Jakarta-Indonesia). This research will continue because Indonesia is an archipelagic country which has different characteristics on each island and watershed.

2. LITERATURE REVIEW

Global Climate Change

Climate change (CC) has an influence on the ecological, environmental, socio-political and socio-economic components of the discipline (Adger et al. 2005; Leal Filho et al. 2021; Feliciano et al. 2022). Climatic conditions uncertainty involves increasing temperatures across the world (Battisti and Naylor, 2009; Schuurmans, 2021; Weisheimer and Palmer, 2005; Yadav et al. 2015). Some signs of climate change include the presence of comprehensive long-term trends in temperature and precipitation and other components such as pressure and humidity levels in the surrounding environment. Besides irregular weather patterns and intensity, shrinking global ice sheets and rising sea levels are among the most well-known international and domestic effects of climate change (Lipczynska-Kochany, 2018; Michel et al. 2021; Murshed and Dao, 2020).

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levels in the surrounding environment. Besides irregular weather patterns and intensity, shrinking global ice sheets and rising sea levels are among the most well-known international and domestic effects of climate change (Lipczynska-Kochany 2018; Michel et al. 2021; Murshed and Dao 2020).

Sources of green house gases (GHG) include natural resources, including volcanoes, forest fires, and seismic activity which contain compounds such as CO2, CH4, N2O, and H2O into the atmosphere (Murshed et al. 2020; Hussain et al. 2020; Sovacool et al. 2021; Usman and Balsalobre-Lorente 2022; Murshed 2022). At the PBB level regarding climate Change (UNFCCC) reached a major agreement that must be addressed climate change and accelerate and intensify action and the investments needed to achieve a sustainable low carbon future at the Conference of the Parties (COP-21) in Paris on 12 December 2015 at which the Paris Agreement was expanded. Aims and objectives of the Paris Agreement is to increase the global response to the threat of climate change by controlling the rise in global temperatures century well below 2 °C compared to pre-industrial levels and up to make efforts to limit the temperature rise to 1.5° C (Sharma et al. 2020; Sharif et al. 2020; Chien et al. 2021).

Along with the acceleration of infrastructure development in Indonesia, the need for concrete is increasing. Minimizing environmental, energy and CO2 impacts is very important in anticipating the effects of greenhouse gases that cause climate change. In the world of construction, the intensity of concrete used for construction plays an important role because it is directly proportional to the decline in natural resources and the increase in the greenhouse effect. Cement is the main ingredient in conventional concrete which is important for society and the construction industry, but in the process it emits greenhouse gases, including carbon dioxide (CO2), which contributes to global warming (Nelfia, LO., et.al., 2024).

Land Surface Temperature

Land surface temperature (LST) is an indicator of climate change (Dash et al., 2002; Li et al., 2014). This is an indicator of energy and water exchange between the land surface and the atmosphere which influences the rate and timing of growth and plant density (Myneni et al., 1997; Peng et al., 2014; Zhang et al., 2007) , LST is widely used in analyzing balance surface energy (Friedl, 2002; Tajfar et al., 2020; Vancutsem et al., 2010; Xu, Guo, et al., 2019; Xu, He, et al., 2019), the urban heat island effect (Alexander, 2020; Fu & Weng, 2016; Estimated surface soil moisture (SM) and evapotranspiration (ET) (Colliander et al., 2017; Gallego-Elvira et al., 2019; Kalma et al., 2008; Karnieli et al., 2010). The development of LST knowledge can improve the understanding of surface-atmosphere exchange processes at global and regional scales and provide valuable surface state metrics for various applications so that LST has been recognized as a key parameter in studying climate change.

LST image coverage of large areas and periodic revisits, satellite observations provide the only way to perform worldwide LST measurements at a spatially averaged pixel scale (Li et al., 2013). Since the 1960s, evolving thermal modeling of infrared instruments (TIR, atmospheric window wavelength region 8–14 μm) has been carried out on different satellites, such as the National Oceanic and Atmospheric Administration (NOAA) satellite series, the Landsat satellite series, the Earth Observing System Terra and Aqua satellites, the Second Generation Meteosat (MSG) satellite series, and the Chinese Fengyun (FY) satellite series. Currently there are various methods for extracting LST from TIR remote sensing data in the

literature (Rozenstein et al., 2014) including LST Moderate Resolution Imaging Spectroradiometer (MODIS) (Wan & Dozier, 1996), Landsat Collection 2 surface temperature product (Malakar et al., 2018), Advanced Thermal Emission and Reflection Radiometer (ASTER) Surface Kinetic Temperature (AST_08) product (Gillespie et al., 1998), Spinning Enhanced Visible and InfraRed Imager (SEVIRI) LST product (Trigo et al., 2011), and Copernicus Global Land LST product Operations (Koetz et al., 2018).

Various methods for obtaining LST data, these methods focus on discussing atmospheric effects, geometric effects, and emissivity effects (Prata et.al., 1995) complemented by Li et al. (2013) provide a more systematic and comprehensive review than stated by clarifying the assumptions, advantages, limitations, and requirements of ESG retrieval and validation methods and presents topics for further research.

3. RESEARCH METHOD

Study Area

The research was carried out in the Ciliwung watershed, especially the DKI Jakarta area, with a watershed area of 13,995 ha. The watershed covers parts of North Jakarta, Central Jakarta, West Jakarta, South Jakarta, and East Jakarta. The Ciliwung watershed in this study borders several sub-district administrative areas, including Penjaringan and Tanjung Priok sub-districts in North Jakarta, Taman Sari and Tambora sub-districts in West Jakarta, Gambir and Tanah Abang sub-districts in Central Jakarta, Setia Budi sub-districts, Mampang Prapatan, Pancoran, Pasar Minggu, and Jagakarsa in South Jakarta, as well as the sub-districts of Matraman, Jatinegara, Kramatjati, and Ciracas in East Jakarta.

Figure 1. Location map of the study area

Data acquisition

This research uses secondary data which includes satellite image data, administrative data and land cover classification data. The digital satellite image data used includes Landsat 5 for 1990, 2000, 2010 and Landsat 8 for 2021, where this data was obtained from the Earth explorer USGS and Earth Angine Data Catalog. The second data about shapefile map Ciliwung Watershed with the classification land cover, was obtained from River Basin Organization / Balai Besar Wilayah Sungai (BBWS) Ciliwung-Cisadane and The Ministry of Environment and Forestry.

Data Processing

d. Image processing

Image processing in this research went through three stages, including geometric and radiometric correction, image cropping, and image processing. For geometric and radiometric correction, Landsat 8 imagery with OLI type is used, where the data has been corrected both radiometrically and geometrically. In the image cutting section, it is carried out using digital data on the administrative boundaries of the Jakarta area and the Landsat image of Jakarta, so that the image that previously covered the area of Jakarta becomes an image with the area coverage of only the Jakarta area, which is within the Ciliwung watershed. At the image processing stage, it is divided into several stages, which include image classification and land surface temperature extraction.

Image classification is used to obtain land cover in the Jakarta area. Classification was carried out using digital image classification using ENVI 5.0 digital image processing software using the maximum likelihood method. Land cover classification uses ROI (Regions of Interest). ROI is needed as a representative for each different land cover so that the computer can recognize it based on its pixel value.

The land cover that will be used in image classification can be seen in Table 4, which is the land cover classification class, but in this table, the land cover is modified to suit the research area, namely the Jakarta area in the Ciliwung watershed. The basic classification used refers to the provisions of the Indonesian National Standard (SNI) 7645:2010, the River Basin Organization Ciliwung-Cisadane, and the Ministry of Environment and Forestry. Each land cover class is detailed with its original form in the field, which can be seen in Table 1 below.

Tabel 1. Land cover classification in the ciliwung watershed

Classification	Landcover
Build up land	Settlements, road networks, railway networks, airports, ports
Field land	Badlands
Waters body	Lakes or reservoirs, swamps, rivers, shipping lines, coral reefs.
Vegetation 1	wetland forest, grass marsh. rice fields, swamp bushes
Vegetation 2	Residential gardens, grasslands, savannas, reeds, dry land farming

e. Land surface temperature extraction

Convert DN (Digital Number) values to TOA values

TOA correction is carried out using ENVI 5.0 software using bands 10 and 11 on Landsat images, the aim is to eliminate the influence of atmospheric disturbances on the absolute temperature between objects on the ground and the satellite.

$$L_\gamma = M_L Q_{Cal} + A9_L$$

where:

$L\gamma$: TOA spectral radiance (watts / (m2 * srad * μm))

ML : Band-specific (RADIANCE_MULT_BAND_x, x = band number)

$A9L$: Band-specific (RADIANCE_MULT_BAND_x, x = band number)

$QCal$: Image pixel value DN (Digital Number)

Convert the Radiance value into a brightness temperature value

$$BT = \frac{K2}{ln\,(\frac{K1}{L\lambda} + 1)} - 273{,}15$$

where:
BT : Top Of Atmosfer (TOA) brightness temperature (°C)
Lλ : Top Of Atmosfer (TOA) Radiance
K1 : thermal constant band 10 or 11 (found in metadata)
K2 : thermal constant band 10 or 11 (found in metadata)

Normalized Different Vegetation Index (NDVI)

NDVI functions to determine the level of vegetation density that makes up an area by looking for the fraction value of the area covered by vegetation which will later become a value to obtain information on land surface temperature. In the process, two bands from Landsat imagery are used, namely band 4 (red) and band 5 (near infrared).

$$\text{NDVI} = \frac{(NIR-RED)}{(NIR+RED)}$$

Where:
NDVI : Normalized Differential Vegetation Index
RED : Digital Number value (DN) dari RED band
NIR : Digital Number value (DN) dari Near-Infrared band

Fractional Vegetation Cover, The FVC value is estimated using the previously obtained NDVI value as well as the NDVI (soil) and NDVI (vegetation) values. Functions to estimate the fraction of an area covered by vegetation.

$$FVC = \frac{NDVI - NDVI_{soil}}{NDVI_{veg} - NDVI_{soil}}$$

$where$:
FVC : Fractional Vegetation Cover
NDVI : Normalized Differential Vegetation Index
$NDVI_{veg}$: NDVI for soil = 0.2 (Latif, 2014)
$NDVI_{soil}$: NDVI value for vegetation = maximum value NDVI

Land Surface Emissity (LSE)

To measure the inherent characteristics of the earth's surface and measure its ability to convert thermal energy or heat into radiation energy. The LSE value calculation can be estimated using the FVC value from previous calculations. LSE estimation requires soil emissivity values and vegetation emissivity values from both TIRS bands (band 10 and band 11).

$$LSE = \varepsilon_s * (1 - FVC) + \varepsilon_v * FVC$$

Where:
LSE : Land Surface Emissity
FVC : FVC value
εs : Band 10 and band 11 soil emissivity
εv : Band 10 and band 11 soil emissivity

Land Surface Temperature (LST)

Calculated by applying a structured mathematical algorithm, namely the Split Window Algorithm (SWA). This algorithm uses brightness temperature values from two bands on the Landsat 8 image TIRS sensor, the average value and the LSE (land surface emissivity) difference value to estimate LST.

$$LST = TB10 + C1(TB10 - TB11) + C2(TB10 - TB11)2 + C0 + (C3 + C4W)(1 - M) + (C5 + C6W)\Delta m$$

Where:
LST : Land Surface Temperature (K)
C0 – C6 : Split Window Coefficient
TB10, TB11 : Brightness Temperature (K) band 10 abd band 11
m : average LSE value band 10 and band 11
W : Atmospheric Water Vapour Content = 0,013
Δ m : difference between LSE band 10 and band 11 values

Analysis Data

The data analysis method contains stages in analyzing research results, which consist of spatial descriptive analysis. Spatial descriptive analysis is used to explain and describe the spatial distribution of land cover and the results of extracting surface temperatures (Normalized Different Vegetation Index (NDVI), Top of Atmosphere (TOA), Temperature Brightness, and Land Surface Temperature). To find out the relationship between the two, an overlay is carried out to combine the land cover data and surface temperature data so that the two data become one and overlap each other, so that later the surface temperature can be known for each land cover. Then the assumption is made that the more vegetation, the lower the land surface temperature will be, and if there is little vegetation, the land surface temperature will be high.

4. RESULT AND DISCUSSION

Land cover changes using supervised classification of 1990, 2000, 2010 and 2021

Land cover in the Ciliwung watershed, DKI Jakarta province, is divided into five categories: built-up land, open land, water, vegetation 1, and vegetation 2. Land cover in the Ciliwung watershed (DKI Jakarta) is experiencing changes. Built-up land has increased without decreasing from 1990 (7932.26 ha) to 2021 (11498.92 ha), open land has decreased without increasing from 1990 (358.35 ha) to 2021 (58.31 ha), waters or water bodies decreased from 1990 (393.51 ha) to 2000 (236.93 ha) then increased until 2021 (485.62 ha), vegetation 1 experienced a decrease from 1990 (2581.91 ha) to 2000 (637.31 ha) then increased until 2021 (1284.06 ha), vegetation 2 experienced an increase from 1990 (2728.97 ha) to 2000 (2803.68 ha) then decreased until 2021 (668.09 ha).

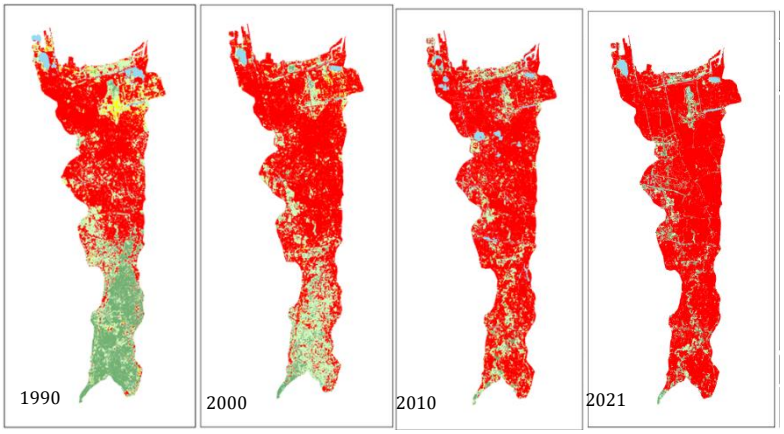


Figure 2. Land cover changes 1990-2021

Based on the image above Figure 3, in the period 1990-2000 there was a change in land cover of 14.85% for built-up land. This can be assumed that every year development progress is 1.4%. Based on Figure 4 above, in the period 2010-2021, there was a change in land cover in vegetation classification 2 of 15.26%. It can be assumed that each year there will be a reduction in vegetation due to development of 1.5%. Of the five existing land classes, it can be seen that from 1990 to 2021, built-up land has experienced a significant increase, filling from 56.68% (1990) to 82.16% (2021), while water has experienced a less significant increase, from 2.81% (1990) to 3.47% (2021). Open land along with vegetation 1 and 2 experienced a decline, where open land decreased from 2.56% (1990) to 0.42% (2021), vegetation 1 decreased from 18.45% (1990) to 9.18% (2021), and vegetation 2 decreased from 19.5% (1990) to 4.77% (2021). From these data, it can be seen that the composition of built-up land is increasing or expanding, and vegetation land is decreasing.

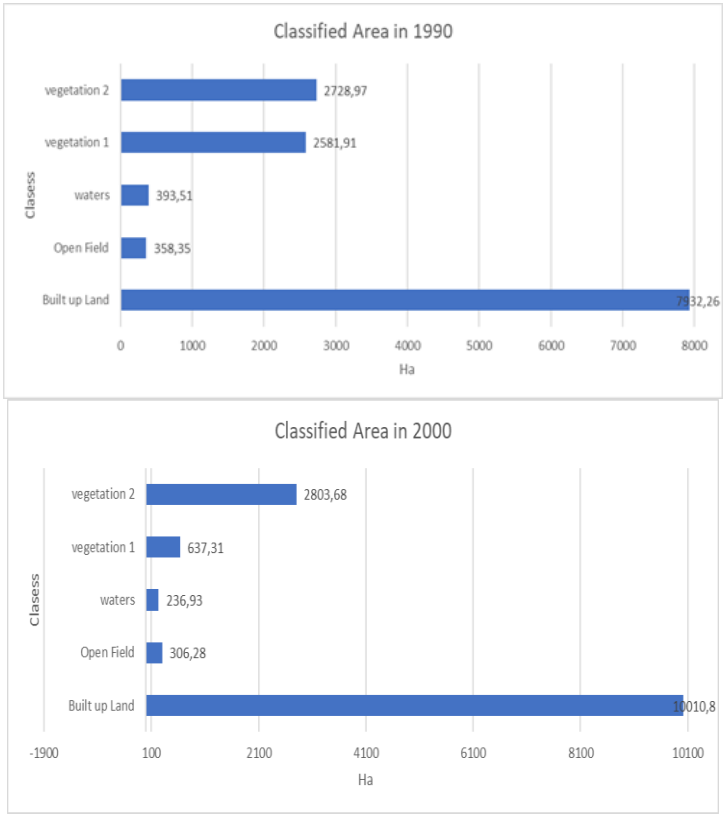


Figure 3. Change in area size 1990-2000

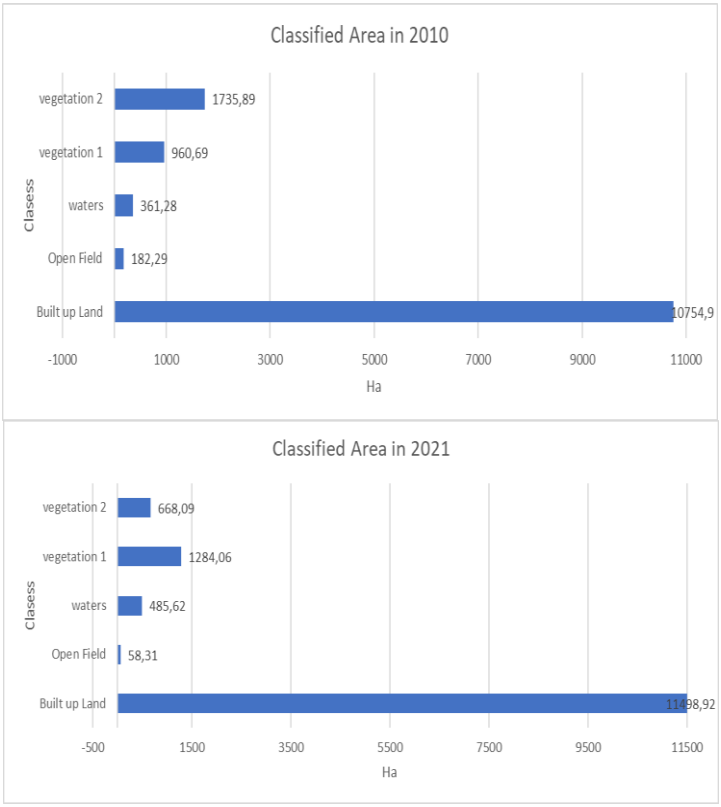


Figure 4. Change in area size 2010-2021

The composition of built-up land increased while vegetated land decreased, reflecting significant changes in the land use of the region. Overall, the vegetation cover in the study area is under the serious threats of floods, drought and seawater intrusion.

Land surface temperature of 1990, 2000, 2010 and 2021

The classification of land surface temperature analysis is divided into 5 classes, namely very low (15^0C-20^0C)-Light blue, low (20^0C-25^0C)-blue, moderate (25^0C-30^0C)-yellow, high (30^0C-35^0C)-brown and very high (35^0C-40^0C)- red.

LST of 1990: Figure 6 and Table 2 are showing the LST ranged from 21°C to 35,2°C with a mean of 27°C. Based on the results of analysis in 1990, land surface temperature conditions in the low category had an area of 9.27% (20^0C-25^0C), the medium category was 90.56% (25^0C-30^0C) and the high category was 0.18% (30^0C-35^0C). This is because in 1990 it had an area with a vegetation distribution of 37.95%.

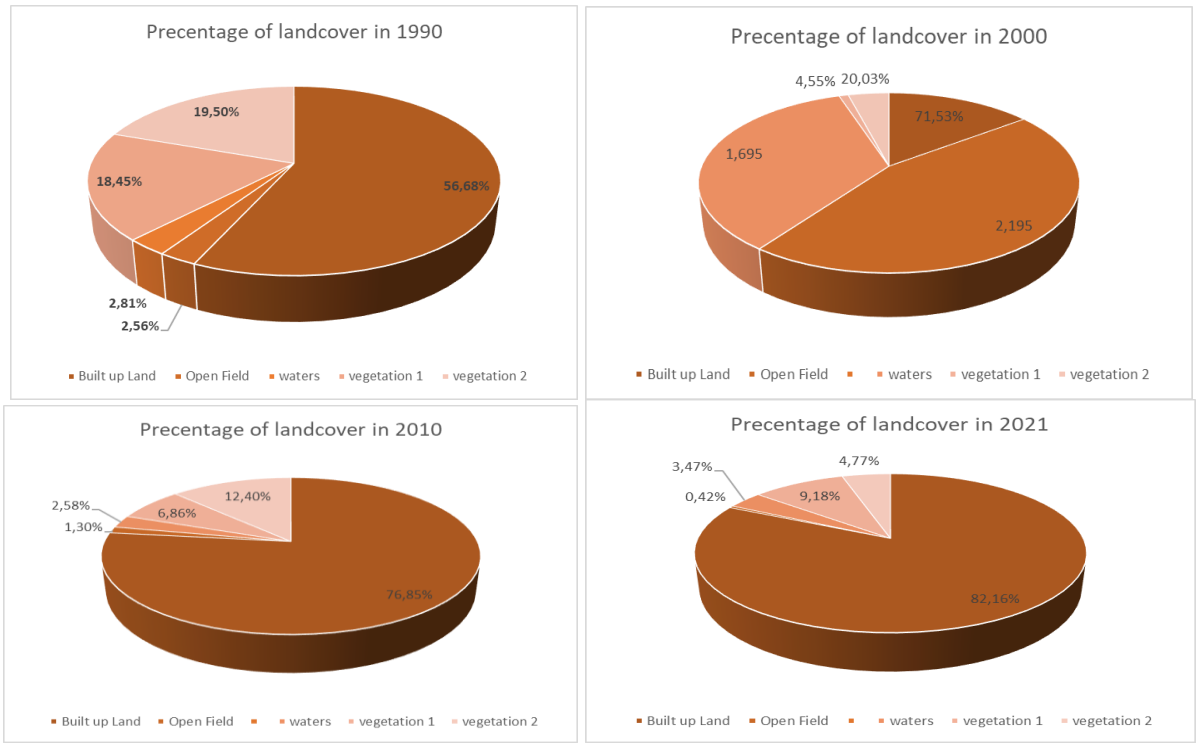


Figure 5. Precentage of landcover in 1990-2021

LST of 2000: Figure 6 and Table 2 are showing the LST ranged from 22°C to 35,5°C with a mean of 27°C. Based on the results of analysis in 2000, land surface temperature conditions in the low category had an area of 0.84% (20^0C-25^0C), the medium category was 45.39% (25^0C-30^0C) and the high category was 53.77% (30^0C-35^0C). This is because in 2000 it had an area with a vegetation distribution of 24.58% and built up land of 1.4% per year.

LST of 2010: Figure 6 and Table 2 are showing the LST ranged from 21,6°C to 35,6°C with a mean of 27,4°C. Based on the results of analysis in 2010, land surface temperature conditions in very low category had an area of 0.20% (15^0C-20^0C) ,the low category had an area of 10.96% (20^0C-25^0C), the medium category was 88.82% (25^0C-30^0C) and the high category was 0.01% (30^0C-35^0C). This is because in 2000 it had an area with a vegetation distribution of 19.26% and built up land of 0.53% per year. However, this year's LST data has a low level of accuracy. This is because the map used is mostly still covered by clouds so that the resulting analysis has a low category for land surface temperature.

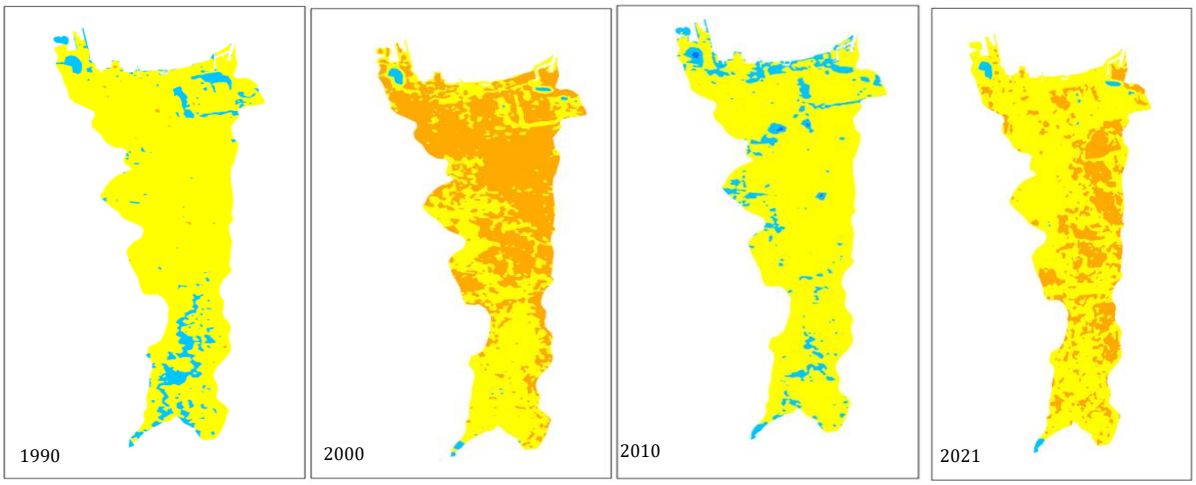


Figure 6. Land surface temperature in 1990-2021

Table 2. LST values of 1990, 2000, 2010 and 2021

No	Year	Minimum Temperature (^{0}C)	Maximum Temperature (^{0}C)	Mean Temperature (^{0}C)
1	1990	21,0	35,2	27,0
2	2000	22,0	35,5	27,0
3	2010	21,6	35,6	27,4
4	2021	19,2	38,0	27,6

LST of 2021: Figure 6 and Table 2 are showing the LST ranged from 19,0°C to 38,0°C with a mean of 27,6°C. Based on the results of analysis in 2021, land surface temperature conditions in very low category had an area of 0.20% (15^0C-20^0C), the low category had an area of 0.77% (20^0C-25^0C), the medium category was 73.64% (25^0C-30^0C) and the high category was 25.39% (30^0C-35^0C). This is because in 2021 it had an area with a vegetation distribution of 13.95% and built up land of 0.53% per year.

Climatic factors affecting land cover changes

Cyclone: Satellite imageries provide extensive information about extreme weather patterns like Tropical cyclones. These are part of climate of tropical region of Asia, which affect various countries in the region including Indonesia. The intensity and frequency of these cyclones are increased in the end of 19th century. It goes more destructive with the sea level rise, high tides and motions of waves. It even raised the loss of infrastructure and erotion the land area. This usually occurs due to negative coastal development, tectonic plate movements, climate patterns, as well as increased tidal and wave movements due to rising sea levels, affect land.

Flood/ Rain: The devastating floods that occurred in Jakarta occurred in 1872, 1918, 1979, 1996, 2002, 2007, 2013, 2015 and 2021. Floods are an overflow of water that extends to submerge the land. Jakarta occasionally experiences slow and fast types of river flooding in the rainy season.

Figure 7. Sinking area at Muara Baru (source: google, 2022)

Figure 8. Sinking area at Muara Baru (source: Kompas 2007; 2021)

5. CONCLUSION AND RECOMMENDATIONS

The surface temperature classification in Jakarta from 1990 to 2021 includes two classes: medium (25–30°C) and high (30–35°C). The increase in built-up land cover reached 25.48%, while the decrease in vegetation 1 and vegetation 2 was 9.26% and 14.73% respectively, so it is predicted that it has the potential to influence the hydrological cycle. Higher vegetation density generally leads to lower land surface temperatures, while lower vegetation density is associated with higher surface temperatures. Jakarta is prone to significant flooding, with historical events highlighting risks. Satellite data, especially Landsat imagery, reveals key threats and land degradation, particularly on the north coast due to both human and natural factors. Temporal datasets show changing land cover in the Ciliwung watershed, including shifts in vegetation and coastal erosion. Continuous monitoring and mitigation can address these issues. This research is a foundation for future studies on climate change and water resource resilience. In planning for mitigation and adaptation due to climate change, it is necessary to add parameters, such as rainfall based on satellite imagery, climatological data, and condition of vegetation types. This aims to strengthen the resulting influence, thereby allowing a deeper understanding of the relationship between variables.

REFERENCES

Adger WN, Arnell NW, Tompkins EL (2005) Successful adaptation to climate change across scales. Glob Environ Chang 15(2):77–86

Alexander, C. (2020). Normalised difference spectral indices and urban land cover as indicators of land surface temperature (LST). International Journal of Applied Earth Observation and Geoinformation, 86, 102013. https://doi.org/10.1016/j.jag.2019.102013

Battisti DS, Naylor RL (2009) Historical warnings of future food insecurity with unprecedented seasonal heat. Science 323(5911):240–244

Chien F, Anwar A, Hsu CC, Sharif A, Razzaq A, Sinha A (2021) The role of information and communication technology in encountering environmental degradation: proposing an SDG framework for the BRICS countries. Technol Soc 65:101587

Colliander, A., Fisher, J. B., Halverson, G., Merlin, O., Misra, S., Bindlish, R., et al. (2017). Spatial downscaling of SMAP soil moisture using MODIS land surface temperature and NDVI during SMAPVEX15. IEEE Geoscience and Remote Sensing Letters, 14(11), 2107–2111. https:// doi.org/10.1109/lgrs.2017.2753203

Dash, P., Gottsche, F. M., Olesen, F. S., & Fischer, H. (2002). Land surface temperature and emissivity estimation from passive sensor data: Theoryand practice-current trends. International Journal of Remote Sensing, 23(13), 2563–2594. https://doi.org/10.1080/01431160110115041

Feliciano D, Recha J, Ambaw G, MacSween K, Solomon D, Wollenberg E (2022) Assessment of agricultural emissions, climate change mitigation and adaptation practices in Ethiopia. Clim Policy 1–18

Fu, P., & Weng, Q. H. (2016). A time series analysis of urbanization induced land use and land cover change and its impact on land surface temperature with Landsat imagery. Remote Sensing of Environment, 175, 205–214. https://doi.org/10.1016/j.rse.2015.12.040

Friedl, M. A. (2002). Forward and inverse modeling of land surface energy balance using surface temperature measurements. Remote Sensing ofEnvironment, 79(2), 344–354. https://doi.org/10.1016/s0034-4257(01)00284-x

Gallego-Elvira, B., Taylor, H. M., Harris, P. P., & Ghent, D. (2019). Evaluation of regional-scale soil moisture-surface flux dynamics in Earth system models based on satellite observations of land surface temperature. Geophysical Research Letters, 46(10), 5480–5488. https://doi.org/10.1029/2019gl082962

Gillespie, A., Rokugawa, S., Matsunaga, T., Cothern, J. S., Hook, S., & Kahle, A. B. (1998). A temperature and emissivity separation algorithm for advanced spaceborne thermal emission and reflection radiometer (ASTER) images. IEEE Transactions on Geoscience and Remote Sensing, 36(4), 1113–1126. https://doi.org/10.1109/36.700995

Hussain M, Butt AR, Uzma F, Ahmed R, Irshad S, Rehman A, Yousaf B (2020) A comprehensive review of climate change impacts, adaptation, and mitigation on environmental and natural calamities in Pakistan. Environ Monit Assess 192(1):48

Kalma, J. D., McVicar, T. R., & McCabe, M. F. (2008). Estimating land surface evaporation: A review of methods using remotely sensed surface temperature data. Surveys in Geophysics, 29(4–5), 421–469. https://doi.org/10.1007/s10712-008-9037-z

Karnieli, A., Agam, N., Pinker, R. T., Anderson, M., Imhoff, M. L., Gutman, G. G., et al. (2010). Use of NDVI and land surface temperature for drought assessment: Merits and limitations. Journal of Climate, 23(3), 618–633. https://doi.org/10.1175/2009jcli2900.1

Kurniyaningrum, E., Limantara, L.M., Suhartanto, E., Sisinggih, D. Sensitivity of Flow Depth Inundation Based on the Micro-Scale Topography in Krukut River, Jakarta, Indonesia. International Journal of Civil Engineering and Technology (IJECT), 2019, 10(1), pp. 697-706.

Kurniyaningrum, E., Kurniawan, M.A. Climate Change Effect on Water Balance For Water Critically in Upper Bogowonto Watershed, Indonesia. IOP Conf. Series: Earth and Environtmental Science, 2022, pp. 1-10.

Kurniyaningrum, E., Kadri, T., Daniel, H.M., Condition Of Riparian Buffer Zone In Krukut River, Indonesia. In Proceedings of The 2nd Complexity In Applied Science and Engineering International Conference, 2018, Phuket, Thailand, 12-14 October 2018.

Kadri, T., Kurniyaningrum, E., Limantara, L.M. Hydrology Characteristics in Krukut River Riparian Buffer Zone. Journal of Southwest Jiaotong University, 2021, 56(6), pp. 277-284.

Koetz, B., Bastiaanssen, W., Berger, M., Defourney, P., Del Bello, U., Drusch, M., et al. (2018). High spatio-temporal resolution land surface temperature mission-A Copernicus Candidate Mission in support of agricultural monitoring. In IGARSS 2018-2018 IEEE International Geoscience and Remote Sensing Symposium (pp. 8160–8162). IEEE.

Leal Filho W, Azeiteiro UM, Balogun AL, Setti AFF, Mucova SA, Ayal D, . . . Oguge NO (2021) The infuence of ecosystems services depletion to climate

Li, H., Sun, D., Yu, Y., Wang, H., Liu, Y., Liu, Q., et al. (2014). Evaluation of the VIIRS and MODIS LST products in an arid area of NorthwestChina. Remote Sensing of Environment, 142, 111–121. https://doi.org/10.1016/j.rse.2013.11.014

Lipczynska-Kochany E (2018) Efect of climate change on humic substances and associated impacts on the quality of surface water and groundwater: a review. Sci Total Environ 640:1548–1565

Michel D, Eriksson M, Klimes M (2021) Climate change and (in) security in transboundary river basins Handbook of Security and the Environment: Edward Elgar Publishing

Murshed M, Dao NTT (2020) Revisiting the CO2 emissioninduced EKC hypothesis in South Asia: the role of Export Quality Improvement. GeoJournal. https://doi.org/10.1007/ s10708-020-10270-9

Murshed M (2020) An empirical analysis of the non-linear impacts of ICT-trade openness on renewable energy transition, energy efciency, clean cooking fuel access and environmental sustainability in South Asia. Environ Sci Pollut Res 27(29):36254– 36281. https://doi.org/10.1007/s11356-020-09497-3

Murshed M (2022) Pathways to clean cooking fuel transition in low and middle income Sub-Saharan African countries: the relevance of improving energy use efciency. Sustainable Production and Consumption 30:396–412. https://doi.org/10.1016/j. spc.2021.12.016

Myneni, R. B., Keeling, C. D., Tucker, C. J., Asrar, G., & Nemani, R. R. (1997). Increased plant growth in the northern high latitudes from 1981to 1991. Nature, 386(6626), 698–702. https://doi.org/10.1038/386698a0

Nelfia, L.O., et.al. (2024). Investigation of Cement Substitution with Industrial Solid Waste as an Alternative Material in Construction: A Review. Social Green Behaviour, Artificial Intelligence and Business Strategies & Perspectives in Global Digital Society.

Peng, S.-S., Piao, S. L., Zeng, Z. Z., Ciais, P., Zhou, L. M., Li, L. Z. X., et al. (2014). Afforestation in China cools local land surface temperature.Proceedings of the National Academy of Sciences, 111(8), 2915–2919. https://doi.org/10.1073/pnas.1315126111

Prata, A. J., Caselles, V., Coll, C., Sobrino, J. A., & Ottle, C. (1995). Thermal remote sensing of land surface temperature from satellites: Current status and future prospects. Remote Sensing Reviews, 12(3–4), 175–224. https://doi.org/10.1080/02757259509532285

Rozenstein, O., Qin, Z., Derimian, Y., & Karnieli, A. (2014). Derivation of land surface temperature for Landsat-8 TIRS using a split window algorithm. Sensors, 14(4), 5768–5780. https://doi.org/10.3390/s140405768

Schuurmans C (2021) The world heat budget: expected changes Climate Change (pp. 1–15): CRC Press

Sharma R, Sinha A, Kautish P (2020) Examining the impacts of economic and demographic aspects on the ecological footprint in South and Southeast Asian countries. Environ Sci Pollut Res 27(29):36970–36982

Sharif A, Mishra S, Sinha A, Jiao Z, Shahbaz M, Afshan S (2020) The renewable energy consumption-environmental degradation nexus in Top-10 polluted countries: Fresh insights from quantile-onquantile regression approach. Renew Energy 150:670–690

Sovacool BK, Grifths S, Kim J, Bazilian M (2021) Climate change and industrial F-gases: a critical and systematic review of developments, sociotechnical systems and policy options for reducing synthetic greenhouse gas emissions. Renew Sustain Energy Rev 141:110759

Tajfar, E., Bateni, S. M., Lakshmi, V., & Ek, M. (2020). Estimation of surface heat fluxes via variational assimilation of land surface temperature,air temperature and specific humidity into a coupled land surface-atmospheric boundary layer model. Journal of Hydrology, 583, 124577.https://doi.org/10.1016/j.jhydrol.2020.124577

Trigo, I. F., Dacamara, C. C., Viterbo, P., Roujean, J. L., Olesen, F., Barroso, C., et al. (2011). The satellite application facility for land surface analysis. International Journal of Remote Sensing, 32(10), 2725–2744. https://doi.org/10.1080/01431161003743199

Usman M, Balsalobre-Lorente D, Jahanger A, Ahmad P (2022b) Pollution concern during globalization mode in fnancially resourcerich countries: Do fnancial development, natural resources, and renewable energy consumption matter? Rene. Energy 183:90–102

Vancutsem, C., Ceccato, P., Dinku, T., & Connor, S. J. (2010). Evaluation of MODIS land surface temperature data to estimate air temperature in different ecosystems over Africa. Remote Sensing of Environment, 114(2), 449–465. https://doi.org/10.1016/j.rse.2009.10.002

Wan, Z., & Dozier, J. (1996). A generalized split-window algorithm for retrieving land-surface temperature from space. IEEE Transactions on Geoscience and Remote Sensing, 34(4), 892–905. https://doi.org/10.1109/36.508406

Weisheimer A, Palmer T (2005) Changing frequency of occurrence of extreme seasonal temperatures under global warming. Geophys Res Lett 32(20)

Xu, T., Guo, Z., Xia, Y., Ferreira, V. G., Liu, S., Wang, K., et al. (2019). Evaluation of twelve evapotranspiration products from machine learning, remote sensing and land surface models over conterminous United States. Journal of Hydrology, 578, 124105. https://doi.org/10.1016/j.jhydrol.2019.124105

Xu, T., He, X., Bateni, S. M., Auligne, T., Liu, S., Xu, Z., et al. (2019). Mapping regional turbulent heat fluxes via variational assimilation of land surface temperature data from polar orbiting satellites. Remote Sensing of Environment, 221, 444–461. https://doi.org/10.1016/j. rse.2018.11.023

Yadav MK, Singh R, Singh K, Mall R, Patel C, Yadav S, Singh M (2015) Assessment of climate change impact on productivity of diferent cereal crops in Varanasi. India J Agrometeorol 17(2):179–184

Zhang, X., Tarpley, D., & Sullivan, J. T. (2007). Diverse responses of vegetation phenology to a warming climate. Geophysical Research Letters,34(19), L19405. https://doi.org/10.1029/2007gl031447

CHAPTER 4

The Influence of Social Media Usage, Organizational Attributes, and Employer Branding Attributes on Intention to Apply Job Vacancies

Ida Rosyidah
Faculty of Economics and Business, Universitas Trisakti, Jakarta, Indonesia
122012101026@std.trisakti.ac.id

B. Medina Nilasari
Departement of Master of Management, Faculty of Economics and Business,
Universitas Trisakti, Jakarta, Indonesia
medina@trisakti.ac.id

Renny Risqiani
Departement of Master of Management, Faculty of Economics and Business,
Universitas Trisakti, Jakarta, Indonesia
rennyrisqi@trisakti.ac.id

Justine Tanuwijaya
Departement of Doctoral Program in Economics, Faculty of Economics & Business,
Universitas Trisakti, Jakarta, Indonesia
justine@trisakti.ac.id

Norzanah Mat Nor
Arshad Ayub Graduate Business School (AAGBS) Universiti Teknologi Mara, Selangor, Malaysia

ABSTRACT

The scarcity of qualified workers is becoming a global issue of concern, especially in this online era, where the business environment is changing rapidly. As such, organizations to survive in today's job market face several challenges to grow and sustain. If a company is able to find and retain employees who have better competencies than other companies, it will have its own advantages. Therefore, it is important for companies to attract job seekers to have Intention to Apply to available job vacancies. Intention to Apply a job is a process of interest in having a job that starts from a series of job vacancy information searches, determining job choices, and decision making from prospective employees to determine the desired company. The emergence of Social Media provides companies with a new communication channel to convey job-related information, strengthen Employer Branding, and be able to have a dialog with potential candidates early in the job selection process. The main attraction factors for workers in Indonesia are salary & compensation, career development opportunities, and job security. Hence the importance of Organizational Attributes in job advertisements. This study was conducted to analyze the effect of Social Media Usage, Organizational Attributes, Employer Branding Attributes on Intention to Apply Job Vacancies. The sample in this study was 185 fresh graduates from the Faculty of Economics and Business at three Islamic Universities in the South Tangerang area, Banten province, Indonesia. The choice of this research object is to see how far the company can attract job applicants with an Islamic campus background. Data analysis using Structural Equation Modeling (SEM) techniques with AMOS 24 software
Keywords: Social Media Usage, Organizational Attributes, Employer Branding Attributes, Intention to Apply Job Vacancies.

INTRODUCTION

The quality of the company's human resources will determine the progress of the business in the short and long term, and bring the organization to a better direction (Imbron & Pamungkas, 2021). Currently, companies in Indonesia are also experiencing a shortage of qualified workers (Chhabra & Sharma, 2014). The scarcity of qualified workers is becoming a global issue that attracts enough attention, especially in this online era, where the business environment is changing rapidly. Thus, organizations to survive in today's job market face several challenges to grow and sustain themselves (Mosley, 2007) and gain a competitive advantage (Sivertzen et al., 2013). Every company is required to be creative in generating ideas or innovations for the company (Rayadi et al., 2023), including in the activity of recruiting potential employees. If a company is able to find and retain employees who have better competencies than other companies, then they have a distinct advantage (Sivertzen et al., 2013). Therefore, it is important for companies to attract job seekers so that they have Intention to apply to available job vacancies.

As a fresh-graduate with a major in economics and business, it is easy to enter almost any job field. According to data from Jobstreet Indonesia in August 2022, the total available vacancies were 39,842. (JobStreet Job Outlook Report 2023). Several predictors of intention to apply can be seen from various aspects, both direct and indirect. Thus, the main predictor of intention to apply is the applicant's interest in the organization (Xie et al., 2015). According to JobStreet Job Outlook Report 2023, the main attraction factors for workers in Indonesia are salary & compensation, career development opportunities, and job security. This is in line with the research findings which show that organizational attributes are strong predictors of Intention to Apply. This requires an emphasis on the importance of Organizational Attributes in job advertisements (Elbendary et al., 2023). This finding is also consistent with the research of Gomes & Neves (2010); Uggerslev et al. (2012). Job seekers state that they prefer companies they know, and companies that guarantee personal development and job security, which are considered key characteristics of Employer Branding (Franca & Pahor, 2012). For potential employees, Employer Branding refers to what the organization will offer and what working life will be like (McLaren, 2011; Vercic & Coric, 2018). Therefore, it increases the likelihood and intention to apply for a job. This means that Employer Branding is very important in attracting job seekers to Intention to apply job vacancies.

Employer branding highlights the mechanisms through which Organizational Attributes can influence job seekers' intentions to apply for a job. From a prospective employee's perspective, Organizational Attributes reflect perceptions of organizational features relating to policies and working conditions (e.g., Robertson et al., 2005; Gomes & Neves, 2011). These features lead job seekers to know the benefits contained in an organization that can ultimately form the intention to apply for a job. Employer brand mediates the relationship between various organizational variables and job application intentions. This is supported by the results of recent research, according to Elbendary et al. (2023), if there is a relationship between organizational attributes and intention to apply which is mediated by employeer branding, there is a relationship between organizational attributes and intention to apply.

Based on the description above, this study was conducted to examine "The Effect of Social Media Usage, Organizational Attributes, Employer Branding Attributes on Intention to Apply Job Vacancies" on fresh-graduated Faculty of Economics and Business at the Islamic

University of South Tangerang area. The object of this research was chosen to see the extent to which the company can attract job applicants with the background of the largest Islamic campus in the South Tangerang area.

LITERATURE REVIEW

Social media usage can act as an effective recruitment tool to communicate desired information in the labor market and gain the attention of potential candidates (Bharadwaj, 2023). A manager also needs to analyze the desired consequences of Social Media usage using search engine tools, to ensure the content reaches the right audience at the right time (Pham & Vo, 2022). Therefore, this study also proposes the use of social media usage analysis to measure audience growth and their engagement with employers (Bharadwaj, 2023). Social Media has become a strategic tool for marketing and recruitment for many companies (Alfajri, Adhiazni, & Aini, 2019). Based on the results of previous research, the following hypotheses can be formulated:

H1: Social Media Usage influence Intention to Apply

In addition, respondents are also interested in applying for jobs in companies that describe the company's work environment on the company's social media or Instagram, and provide content about the work environment in the company, the benefits received by employees, and also the career development that employees who work in the company get (Putri & Abdurrahman, 2023). This is in accordance with the findings of Soeling, et al. (2022), companies that successfully promote their Employer Branding through various programs have a significant and direct impact on intention to apply. Companies that offer perceived benefits related to application, development, and social values are considered more reputable by potential applicants and will have a positive impact on intention to apply (Junça Silva & Dias, 2022). This result is consistent with previous findings from many published articles which show that employer branding has a positive effect on job Intention to Apply. Based on the results of previous research, the following hypotheses can be formulated:

H2: Employer Branding Attributes influence Intention to Apply job vacancies

Organizational attributes influence organizational actions by serving as a limiting and supporting factor for organizational behavior (Geetha & Devi, 2022). Organizational attributes which include work location, company conditions, organizational image, job security, employment conditions, and familiarity affect job application intentions (Rizky, Dwi, & Yuni, 2023). Research proves that wages, promotion opportunities, layoff policies, and environmental policies of an organization have a significant influence on potential employees in having an interest in the organization and also the intention to get a job at that organization (Sari, 2018). There is research conducted by Goar & Silitonga (2022) which aims to determine the effect of work meaningfulness, institutional image, organizational attributes, and company attractiveness on interest in applying for internships. The results show that institutional image has a positive and significant effect on company attractiveness and interest in applying for internships. Organizational attributes have an effect on company attractiveness and interest in applying for internships. In addition, company attractiveness also has a positive and significant effect on interest in applying for internships. While other factors produce the opposite (Goar & Silitonga, 2022). Based on the results of previous research, the following hypothesis can be formulated:

H3: Organizational Attributes influence Intention to Apply job vacancies

In this digital era, the use of social media is increasingly used in Employer Branding campaigns and in the recruitment process (Sivertzen et. al., 2013). Social media can help to build an image in the eyes of the public, therefore many companies use more than one social media so that the dissemination of information can be done thoroughly without exception (Haryani, 2020). This is also in line with the findings of Tripathi et, al (2018) that social media is an easy and affordable platform for sending information to many audiences. Organizations are now using social media in their corporate branding strategy. It builds applicants' intention to join the organization. It is an interactive platform that provides two-way communication. Job seekers can easily compare different organizations based on the information available on their websites and other social networking sites. In addition, social media and websites in the recruitment process are considered increasingly important and provide opportunities for potential applicants to obtain a lot of information about an organization such as job offers and organizational culture (Kurniawan & Prameka, 2022). For Millennials looking for a place to work, they not only want to find out about open job positions but they also want to access information about the employer organization whether it matches their expectations. Based on the results of previous research, the following hypotheses can be formulated:

H4: Social Media Usage influence Employer Branding Attributes

Chhabra and Sharma (2014) point out that a strong employer brand starts with communicating elements of the organization's attributes to shape the perception that the organization is the best place to work. Muruganantham et al. (2021) state that employers use various strategies to send signals to differentiate their organizations from competitors in the job market. These signals may include aspects such as job security and job stability (Zhu et al., 2014), comfortable working environment and employee-centered working conditions (Lee et al., 2018) as well as professional training activities and opportunities for career advancement (Kucherov & Zavyalova, 2012). The extent to which job seekers perceive these signals favorably plays a decisive role in formulating the employer brand in the job market (Carpentier et al., 2019). Based on the results of previous research, the following hypothesis can be formulated:

H5: Organizational Attributes influence Employer Branding Attributes

According to Kissel & Buttgen (2015), the emergence of Social Media provides companies with a new communication channel to convey job-related information, strengthen Employer Branding, and be able to conduct dialog with potential candidates early in the job selection process. In line with the results of his research, all elements do have a positive effect on each other. Where, social media does have an indirect influence on interest in applying for a job. Because, good utilization of social media is an informative medium or means of information. There are many things that can be formed with good social media utilization. According to Santiago (2019), that employer branding attributes have a strategic role in providing an overview of the advantages offered by the company. In this digital era, many candidates use social media pages in finding their applications or the intention to apply aspect where there is a relationship between how positive and the benefits offered by the company to candidates and can be promoted through social media pages (Collin and Steven, 2002). Based on the results of previous research, the following hypothesis can be formulated:

H6: Employer Branding Attributes mediate the effect between Social Media Usage and Intention to Apply job vacancies

Lievens and Highhouse (2006) revealed a given instrumental-symbolic framework, in which new graduates and job seekers can use instrumental and symbolic inference to build initial perceptions of the employer brand (Muruganantham et al., 2021). According to signal theory, job seekers determine their preferred employer based on the signals received from the employer, including good career perspectives and career advancement opportunities. Therefore, when companies want to be an attractive employer for the most talented employees, they should highlight their organizational attributes that reflect positively on the job market. Employer Branding highlights the mechanisms through which organizational attributes influence job seekers' intentions to apply for a job. From a prospective employee's perspective, organizational attributes reflect perceptions about organizational features relating to policies and working conditions (Robertson et al., 2005; Gomes & Neves, 2011). Recent research results from Elbendary et al. (2023) are also aligned showing that organizational attributes have the strongest impact on intention to apply, followed by organizational reputation and employer brand. The results of this study provide evidence of the partial mediating impact of employer brand in the relationship. These results suggest that positive organizational attributes will influence intention to apply if the employer ensures economic and psychological benefits. As a result, organizational attributes can enhance the employer brand, which is a precursor to intention to apply. Organizations should pay more attention to promoting the corporate brand by disseminating information to job seekers about organizational attributes to expand the candidate pool. Based on the results of previous research, the following hypothesis can be developed:

H7: Employer Branding Attributes mediate the effect of Organizational Attributes on Intention to Apply job vacancies

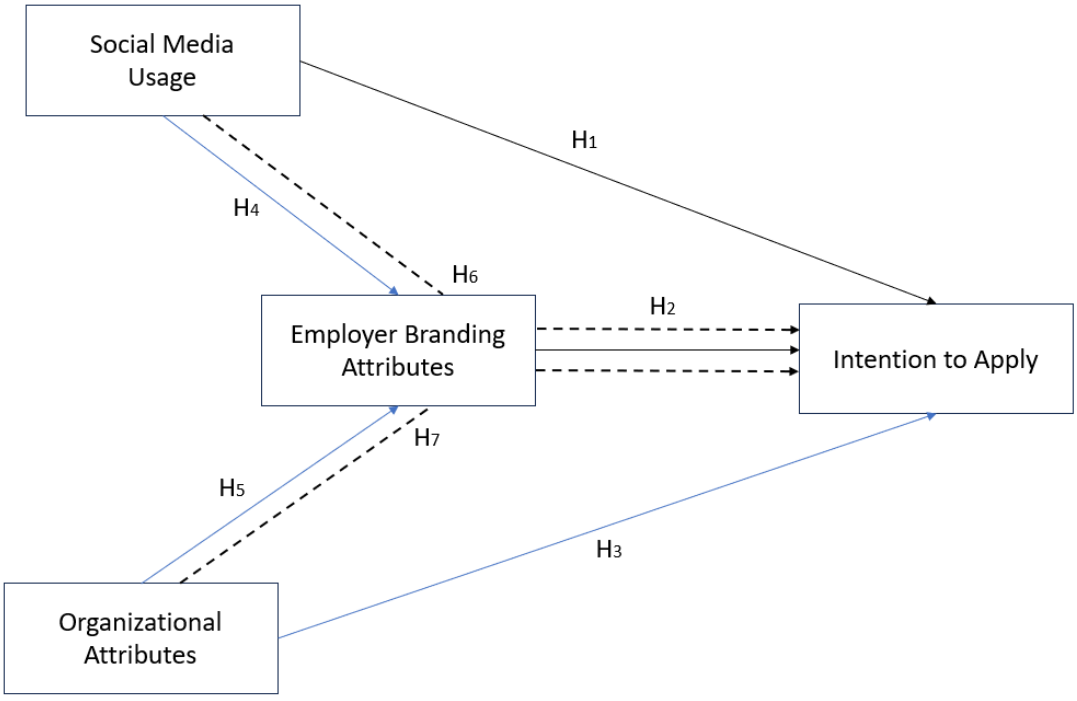


Figure. 1. Conceptual framework

RESEARCH METHOD

The unit of analysis of this research is fresh-graduated from the Faculty of Economics and Business at the Islamic University in the South Tangerang area. The variables in the study are Social Media Usage, Organizational Attributes, Employer Branding Attributes, and Intention to Apply Item questions to measure research variables can be seen in table 1 below:

Table 1. Research variable statement items

No	Item	Source
1	**Social Media Usage**	Bharadwaj (2023)
1.1	My dream company uses social media to advertise their jobs	
1.2	My dream company keeps posting detailed information about their job opportunities	
1.3	My dream company's profile caught my attention	
2	**Organizational Attributes**	Robertson et al., (2005)
2.1	The organization will provide an appropriate salary	
2.2	The organization will provide good benefits	
2.3	The organization will provide access to training and development programs	
2.4	The organization will provide good career perspectives to its employees	
2.5	The organization has good prospects for career advancement	
2.6	The organization will provide me with a good working environment.	
3	**Employer Branding Attributes**	Bharadwaj (2023)
3.1	*Corporate Social Responsibility*	
3.1.1	My dream company has a fair attitude towards its employees	
3.1.2	In my dream company, employees are expected to follow all rules and regulations.	
3.1.3	My dream company is a humanitarian company	
3.1.4	My dream company follows a confidential procedure for reporting workplace violations.	
3.2	*Healthy work culture*	
3.2.1	My dream company gives its employees autonomy to make decisions	
3.2.2	My dream company offers opportunities to enjoy the group atmosphere	
3.2.3	People in my dream company are ready to share my responsibilities at work during my absence	
3.2.4	My dream company offers the opportunity to work in a team	
3.2.5	My dream company recognizes me when I do a good job	
3.2.5	My dream company offers a relatively stress-free work environment	
3.3	*Compensation and Benefits*	
3.3.1	In my dream company, the salary offered is high	
3.3.2	My dream company provides overtime pay	
3.3.3	My dream company provides good health benefits	
3.3.4	My dream company provides insurance coverage for employees and their dependents	

No	Item	Source
3.4	*Work-life balance*	
3.4.1	My dream company offers flexible working hours	
3.4.2.	My dream company offers the opportunity to work from home	
3.4.3	My dream company provides on-site sports facilities	
3.5	*Training and development*	
3.5.1	My dream company provides online training courses	
3.5.2	My dream company organizes conferences, workshops and training programs on a regular basis	
3.5.3	My dream company offers opportunities to work on overseas projects	
3.5.4	My dream company invests heavily in training and development of its employees	
3.5.6	My dream company emphasizes skill development	
3.6.7	My dream company communicates a clear progression path for its employees	
4	**Intention to Apply**	Pham & Vo (2005)
4.1	I want to work in this company immediately	
4.2	I will apply even if the position is different from my major.	
4.3	I will apply for this job even if I have to work overtime.	
4.4	I will be responsible and work seriously for this company	
4.5	I will introduce this company to my acquaintances	

For the purposes of quantitative analysis, the answers were measured on a 5 Likert scale, as follows: 1 for STS (Strongly Disagree), 2 for TS (Disagree), 3 for CS (Moderately Agree), 4 for S (Agree), and 5 for SS (Strongly Agree). Data collection using questionnaires, interviews and documentation. To determine the sample size based on the number of indicator items times 5-10 (Hair, et al., 2018). The indicators of this study amounted to 37 statement items so that the minimum sample was 185 respondents and the maximum sample was 370. After distributing the questionnaire, data was collected from 185 respondents. The research data analysis used the Structural Equation Modeling (SEM) technique with the help of AMOS software.

RESULT AND DISCUSSION

Testing of the questionnaire was carried out to measure the goodness of the questionnaire with validity and reliability tests. According to the respondent data obtained in this study, totaling 185 respondents, that all statements in the questionnaire have a factor loading value ≥ 0.45. So it can be concluded that all statement items used are valid and suitable for research. From the results of the reliability test in table 2, the Cronbach's alpha value on all variables is> 0.70, which can be concluded that all indicators in measuring the four variables meet the standard criteria for reliability or consistency.

Table 2. Reliability test results

Variable	Indicator	Cronbach's Alpha	Decision

Social Media Usage	3	0,869	Reliable
Organizational Attributes	6	0,850	Reliable
Employer Branding Attributes	23	0,955	Reliable
Intention to Apply	5	0,914	Reliable

Source: Data processed using AMOS 24 (2024)

In this study, researchers used the Structural Equation Modeling (SEM) technique using AMOS software. Structural Equation Modeling (SEM) is described as an analysis that combines factor analysis, structural model and path analysis approaches. From the processing results for the goodness of fit test, there are 7 measurements that contain goodness of fit, namely RMSEA of 0.062 ≤ 0.08, NFI of 0.913 ≥ 0.90, TLI of 0.953 ≥ 0.90, CFI of 0.961 ≥ 0.90, IFI of 0.962 ≥ 0.90, AGFI of 0.840 ≤ GFI value and CMIN / DF value of 1.715 which is between the lower limit and upper limit values. While other measurements, namely GFI and RFI, contain marginal fit, which means that the resulting value is close to the cut off value of 0.881 and 0.895. So it can be concluded that this research can be continued to the next test, namely hypothesis testing.

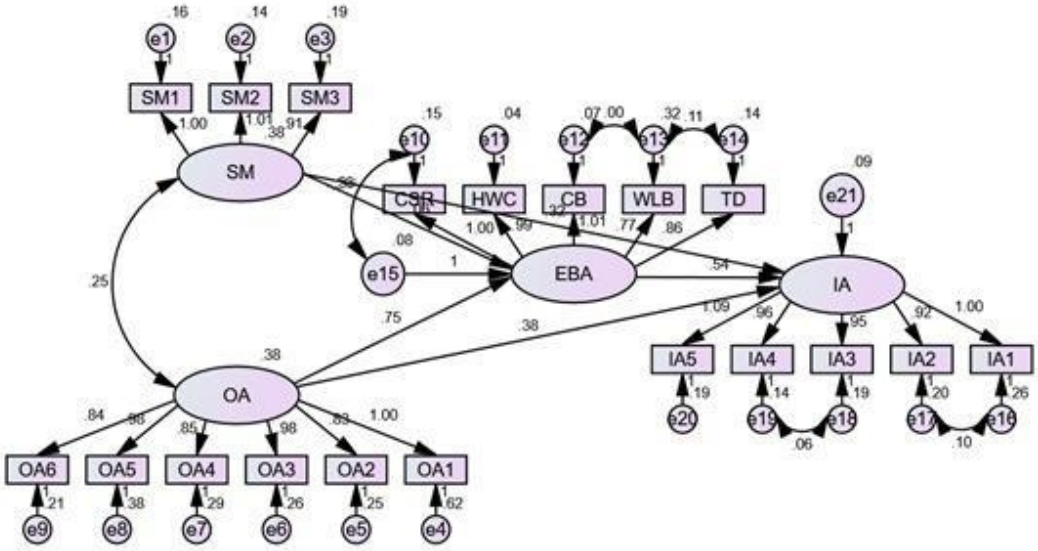


Figure 2. Full structural model
(Data processed using AMOS 24, 2024))

Table 3. Hypothesis testing results

Hypothesis	Estimate	p-value	Decision
Social Media Usage → Intention to Apply	0,319	0,000	H1 Supported
Employer Branding Attributes → Intention to Apply	0,543	0,000	H2 Supported
Organizational Attributes → Intention to Apply	0,377	0,000	H3 Supported
Social Media Usage → Employer Branding Attributes	0,333	0,000	H4 Supported
Organizational Attributes → Employer Branding Attributes	0,748	0,000	H5 Supported
Social Media Usage → Employer Branding Attributes	0,181	0,004	H6 Supported

→ Intention to Apply				
Organizational Attributes → Employer Branding Attributes → Intention to Apply		0,406	0,000	H7 Supported

Source: Data processed using AMOS 24 (2024)

The results of testing the first hypothesis show that the higher the Social Media Usage of the company, the higher the fresh-graduate Intention to Apply to the company. This result is in line with research conducted by Aprilia, et al., (2020) which believes that Social Media is very influential, especially for fresh graduates who are looking for job vacancies where social media usage is a convergence between personal communication which means sharing among individuals (to be shared one-to-one) and as a public medium for sharing among individuals (Nasrullah, 2020). The indicators that best describe Social Media Usage are: "My dream company keeps posting detailed information about their job opportunities" which means that companies quite often inform potential applicants about detailed job vacancy information. The indicator that best describes Intention to Apply is: "I will be responsible and work seriously for this company" which means that fresh graduates feel responsible and serious about getting into the company they want. Companies that use social media for job advertisements, posting information about job opportunities, and posting company profiles can increase fresh-graduate interest in applying for jobs.

From testing the second hypothesis, it shows that the higher the Employer Branding Attributes owned by the company, the higher the fresh-graduate Intention to Apply to the company. This is in accordance with the findings of Soeling, et al (2022), companies that successfully promote their Employer Branding through various programs have a significant and direct impact on the intention to apply. Companies that offer perceived benefits related to application, development, and social values are considered more reputable by potential applicants and will have a positive impact on intention to apply (Junça Silva & Dias, 2022). This result is consistent with previous findings from many published articles which show that employer branding has a positive effect on job Intention to Apply. The indicators that best describe Employer Branding Attributes are: "My dream company is a humanitarian company" which means that the dream company where fresh graduates work is a company that prioritizes employees as assets of the company. The indicator that best describes Intention to Apply is: "I will be responsible and work seriously for this company" which means that fresh graduates feel responsible and serious about getting into the company they want. Companies that prioritize employees as assets of the company with various efforts to prosper employees to get the best results given by their employees can increase the interest of fresh graduates applying for jobs.

From the results of testing the third hypothesis, namely if the higher the Organizational Attributes of a company, it will increase the fresh-graduate Intention to Apply to the company. The results are in accordance with the findings of Geetha & Devi (2022) which states that organizational attributes affect organizational actions by functioning as a limiting and supporting factor for organizational behavior. Organizational attributes include work location, company conditions, organizational image, job security, employment conditions, and familiarity affect the intention to apply for a job (Rizky, Dwi, & Yuni, 2023). Research proves that wages, promotion opportunities, layoff policies, and environmental policies of an

organization have a significant influence on potential employees in having an interest in the organization and also the intention to get a job at that organization (Sari, 2018). Research proves that wages, promotion opportunities, layoff policies, and environmental policies of an organization have a significant influence on potential employees in having an interest in the organization and also the intention to get a job at the organization (Sari, 2018). The indicators that best describe Organizational Attributes are: "The company has good prospects for career advancement" which means that the company provides opportunities for prospective applicants to have a career in the company because of a good career path. The indicator that best describes Intention to Apply is: "I will be responsible and work seriously for this company" which means that fresh graduates feel responsible and serious about getting into the company they want. Companies that provide career opportunities with good career paths within the company can increase fresh-graduate interest in applying for jobs.

Testing the fourth hypothesis shows that if the higher the Social Media Usage of a company, it will increase good Employer Branding Attributes in the minds of employees. This is in line with the findings of Tripathi et, al (2018) that social media is an easy and affordable platform for sending information to a large audience. Organizations are now using social media in their corporate branding strategy and this builds applicants' intention to join the organization. The indicator that best describes Social Media Usage is: "My dream company keeps posting detailed information about their job opportunities" which means that the company quite often informs potential applicants about detailed job vacancy information. The indicator that best describes Employer Branding is: "My dream company is a humanitarian company" which means that the dream company where fresh graduates work is a company that prioritizes employees as assets of the company. Companies that use social media to post information about job opportunities, and post company profiles on how the company welfare its employees can increase fresh-graduate interest in applying for jobs.

In testing the fifth hypothesis testing the effect of Organizational Attributes on Employer Branding Attributes which means that the higher the Organizational Attributes of a company, the better the Employer Branding Attributes in the minds of employees. This is in line with the findings of Chhabra and Sharma (2014) which show that a strong corporate brand starts with communicating elements of organizational attributes to form the perception that the organization is the best place to work. The indicators that best describe Organizational Attributes are: "The company has good prospects for career advancement" which means that the company provides opportunities for prospective applicants to have a career in the company because of a good career path. The indicator that best describes Employer Branding is: "My dream company is a humanitarian company" which means that the dream company where fresh graduates work is a company that prioritizes employees as assets of the company. Companies that have good career prospects can provide a sense of security felt by employees where they will feel part of the assets of the company and can increase the company's Employer Branding.

Testing the sixth hypothesis means that the influence of a company's Social Media Usage on Intention to Apply will be stronger if there is a role of good Employer Branding Attributes in the minds of employees. The results of this study are also in line with the findings of Kissel & Buttgen (2015), where the emergence of Social Media provides companies with a new communication channel to convey job-related information, strengthen Employer Branding,

and can conduct dialog with potential candidates early in the job selection process. In line with the results of his research, all elements do have a positive effect on each other. Where, social media does have an indirect influence on interest in applying for a job. Because, good utilization of social media is an informative medium or means of information. The indicator that best describes Social Media Usage is: "My dream company keeps posting detailed information about their job opportunities" which means that companies quite often inform prospective applicants about detailed job vacancy information. The indicator that best describes Intention to Apply is: "I will be responsible and work seriously for this company" which means that fresh graduates feel responsible and serious about getting into the company they want. Companies that use social media for job advertisements, posting information about job opportunities, and posting company profiles can increase fresh-graduate interest in applying for jobs. Based on the test results, the p-value is 0.004 <0.05 with an estimate value of 0.181. So it can be concluded, the influence of a company's Social Media Usage on Intention to Apply will be stronger if there is a role of good Employer Branding Attributes in the minds of employees.

The seventh hypothesis testing examines the effect of Organizational Attributes on Employer Branding Attributes, showing the influence of a company's Organizational Attributes on Intention to Apply will be stronger if there is a role of good Employer Branding Attributes in the minds of employees. The results of recent research from Elbendary et al., (2023) are also in line showing that organizational attributes have the strongest impact on intention to apply, followed by organizational reputation and employer brand. The indicators that best describe Organizational Attributes are: "The company has good prospects for career advancement" which means that the company provides opportunities for prospective applicants to have a career in the company because of a good career path. The indicator that best describes Intention to Apply is: "I will be responsible and work seriously for this company" which means that fresh graduates feel responsible and serious about getting into the company they want. Companies that provide career opportunities with good career paths within the company can increase fresh-graduate interest in applying for jobs.

2. CONCLUSION AND RECOMMENDATIONS

The finding is the use of social media and Organizational attributes affect the interest in applying for a job fresh graduated from Islamic University in South Tangerang. Branding attributes can mediate and strengthen this influence. Managerial implications that can be suggested and can provide benefits to the company are:

1. To increase the intention to apply to prospective job applicants, which in this study are fresh graduates, companies should increase social media usage activities by continuing to post detailed information about job opportunities.
2. Companies also need to improve and strengthen their employer branding by disseminating through social media that the company prioritizes employees as assets of the company. This needs to be disseminated, not only making it easier for job seekers but also making it easier for companies to get superior and competitive job candidates. This needs to be disseminated through social media, which not only makes it easier for job seekers but also makes it easier for companies to get superior and competitive job candidates.

3. Organizational attributes owned by the company also need to be maintained. When the company has good prospects for the career advancement of its workers as one of the company's attributes, it will not only increase the intention to apply at the company, but will also increase employer branding where prospective job applicants will know if the company has opportunities for career advancement.

This research still has limitations so it is recommended that further researchers can be carried out in the future, namely:

6. Mapping the social media used by the research sample, so that it can be found what social media diversity is used by job applicants in applying for jobs. Thus, companies can increase promotion on social media appropriately in the fresh-graduated population at the Islamic University in the South Tangerang area.

It is recommended to conduct research with a wider population so that the research results can be used by companies appropriately in increasing the use of social media, employer branding, and organizational attributes, as an effort to convey company messages and values appropriately among prospective job applicants.

REFERENCES

Aprilia, R., Sriati, A., & Hendrawati, S. (2020). "Tingkat Kecanduan Media Sosial pada Remaja", **Journal of Nursing Care**, *3*(1). https://doi.org/https://doi.org/10.24198/jnc.v3i1.26928

Alfajri, M. F., Adhiazni, V., & Aini, Q. (2019). "Pemanfaatan Social Media Analytics Pada Instagram Dalam Peningkatan". **Interaksi: Jurnal Ilmu Komunikasi**, 8(1), 34. https://Doi.Org/10.14710/Interaksi.8.1.34-42

Bharadwaj, S. (2023). "How The Interplay Of Social Media Usage And Online Reviews Generate Intention To Apply For A Job Vacancy: An Employer Branding-Based Agenda". **Management Research Review**, 47(3), 441–463. https://Doi.Org/10.1108/MRR-05-2022-0365

Chhabra, N. L., & Sharma, S. (2014). "Employer branding: Strategy for improving employer attractiveness". **International Journal of Organizational Analysis**, (22) 1, 48-60. https://doi.org/10.1108/IJOA-09-2011-0513

Carpentier, M., Van Hoye, G., & Weijters, B. (2019). "Attracting applicants through the organization's social media page: Signaling employer brand personality", **Journal of Vocational Behavior**, Vol. 115. https://doi.org/10.1016/j.jvb.2019.103326

Collins, C. J., & Stevens, C. K. (2002). "The relationship between early recruitment-related activities and the application decisions of new labor-market entrants: A brand equity approach to recruitment", **Journal of Applied Psychology**, *87*(6), 1121–1133. https://doi.org/10.1037/0021-9010.87.6.1121

Elbendary, I., Elsetouhi, A. M., Marie, M., & Aljafari, A. M. (2023). "A Mixed-Methods Approach For The Relationship Between Organizational Attributes, Reputation, Employer Brand And Intention To Apply For A Job Vacancy", **Personnel Review**, https://Doi.Org/10.1108/PR-03-2021-0188

Franca, V., & Pahor, M. (2012). "Influence of management attitudes on the implementation of employee participation". **Economic and Industrial Democracy**, 35(1). https://doi.org/10.1177/0143831X12464070

Geetha, S., & Devi, P. (2022). "The Impact Of Organizational Goals On Organization Behavior, **International Journal For Innovative Engineering And Management**, 11(1), 125–129. https://Doi.Org/10.48047/IJIEMR/V11/I01/25

Goar, G., & Silitonga, M. (2022). "Examining The Intention Of Joining Internship Programs Among Undergraduate Students In Bandung", **Asian Journal Of Research In Education And Social Sciences**, 4(3), 1–10. https://Doi.Org/10.55057/Ajress.2022.4.3.1

Gomes, D., & Neves., J. (2011). "Organizational attractiveness and prospective applicants' intentions to apply", **Personnel Review**, *40*(6), 684–699. https://doi.org/10.1108/00483481111169634

Haryani, D. S. (2019). "Pengaruh Persepsi Risiko Terhadap Keputusan Pembelian Online Di Tanjungpinang", **Jurnal Dimensi**, *8*(2), 198–209. https://doi.org/10.33373/dms.v8i2.2155

Hair, Joseph F., G., Hult., T. M., Ringle., C. M., & Sarstedt., M. (2017). **A Primer on Partial Least Squares Structural Equation Modelling (PLS-SEM)** (2nd ed.), Thousand Oaks, CA: Sage Publications Inc.

Imbron, I., & Pamungkas, I. B. (2021). **Manajemen Sumber Daya Manusia**, Widina Media Utama.

Junça Silva, A., & Dias, H. (2022). "The relationship between employer branding, corporate reputation and intention to apply to a job offer", **International Journal of Organizational Analysis**, *31*(8), 1–16.

https://doi.org/10.1108/IJOA-01-2022-3129

Kurniawan, D. T., & Prameka, A. S. (2022). "Apakah Career Website Employer, Social Media And Employer Branding Mempengaruhi Daya Tarik Dan Keinginan Melamar Pada Industri Perbankan?", **E-Journal Ekonomi Bisnis Dan Akuntansi**, 9(1), 1. https://Doi.Org/10.19184/Ejeba.V9i1.30463

Kissel, P., & Buttgen, M. (2015). "Using social media to communicate employer brand identity: The impact on corporate image and employer attractiveness", **Journal of Brand Management,** *22*(9), 755–777. https://doi.org/10.1057/bm.2015.42

Kucherov, D. and Zavyalova, E. (2012), "HRD practices and talent management in the companies with the employer brand", **European Journal of Training and Development**, 36(1), 86-104. https://doi.org/10.1108/03090591211192647

Lee, C.-C., Lin, C.-J., & Kao, R.-H. (2018). "A study on the factors to measure employer brand: the case of undergraduate senior students", **Chinese Management Studies**, *12*(1). https://doi.org/10.1108/CMS-04-2017-0092

Lievens, F., & Highhouse, S. (2006). "The Relation of Instrumental and Symbolic Attributes to A Company's Attractiveness as An Employer", **Personnel Psychology**, 56(1), 75-102. https://doi.org/10.1111/j.1744-6570.2003.tb00144.x

McLaren, J. P. (2011). "Mind the gap: Exploring congruence between the espoused and experienced employer brand". https://www.researchgate.net/publication/304016614_Mind_the_gap_Exploring_congruence_between_the_espoused_and_experienced_employer_brand

Murugananthan, G., Antony, S. P., & George, E. (2020). "Understanding job and organizational attributes as signals from recruitment advertisement", **Journal of Indian Business Research.** https://doi.org/10.1108/JIBR-04-2018-0112

Mosley, R. (2007). "Customer experience, organisational culture and the employer brand", **Journal of Brand Management**, 15, 123–134. https://doi.org/10.1057/palgrave.bm.2550124

Nasrullah, R. (2020). **Media Sosial.** Bandung: Simbiosa Rekatama Media

Pham, Q. T., & Vo, D. A. (2022). "Impact Of Employer Value Proposition And Social Media Use On The Intention To Apply For A Job In The IT Industry Of Vietnam", **The South East Asian Journal Of Management**, 16(2), 1–25. https://Doi.Org/10.21002/Seam.V16i2.1092

Putri, R. L., & Abdurrahman, A. (2023). "Pengaruh Employer Branding, Reputasi Perusahaan Dan Informasi Sosial Media Terhadap Niat Melamar Pekerjaan Generasi Milenial Dan Generasi Z". **Innovative: Journal Of Social Science Research,** 3(3), 10844–10861.

Rayadi, A., Nilasari, B. M., Kurniawati, Muhidin, S. (2023). The Effect of Organizational Commitment on Individual Creativity Mediated by Organizational Citizenship Behavior and Knowledge Sharing in Indonesia Banking Industry, **Contemporary Exploration of Social Sciences Inquiries with New Approaches in the Post-Pandemic Era 1**, Editors: Ruhul Amin Sardar, Bahrullah Safi, Sarit J. Levy, Bursa-Turley: NCM Publishing House, 4-22, ISBN 978-625-99157-3-9. http://www.ceocongress.org/files/E-Book/Book%206.pdf?_t=1690812238.

Rizky, G., Dwi, P. U., & Yuni, Y. P. (2023). "Daya Tarik Perusahaan Dan Kompetensi Karir Yang Memengaruhi Niat Melamar Pekerjaan Pada Mahasiswa Tingkat Akhir", **Jurnal Ekombis Review**, 11(2), 1317–1328. https://Jurnal.Unived.Ac.Id/Index.Php/Er/Indexdoi:Https://Doi.Org/10.37676/Ekombis.V11i12

Roberson, Q. M., & Collins, C. J. (2005). "The Effects Of Recruitment Message Specificity On Applicant Attraction To Organizations", **Journal of Business and Psychology**, 3(1). https://Digitalcommons.Ilr.Cornell.Edu/Articles/47

Santiago, J. (2019). "The relationship between brand attractiveness and the intent to apply for a job: A millennials' perspective", ***E*uropean Journal of Management and Business Economics**, *28*(2), 142–157. https://doi.org/10.1108/EJMBE-12-2018-0136

Sari, N. A. (2018). "Faktor-Faktor Yang Mempengaruhi Ketertarikan Pada Organisasi Dan Moderasi", ***J*urnal Manajemen Bisnis Dan Inovasi,** 5(1), 64–74. https://ejournal.unsrat.ac.id/v2/index.php/jmbi/article/view/19150/18708

Sivertzen, A., Nilsen, E. And Olafsen, A. (2013). "Employer Branding: Employer Attractiveness And The Use Of Social Media". **Journal Of Product & Brand Management**, 22(7), 473–483. https://Doi.Org/Https://Doi.Org/10.1108/JPBM-09- 2013-0393.

Soeling, P. D., Ajeng Arsanti, S. D., & Indriati, F. (2022). "Organizational Reputation: Does It Mediate The Effect Of Employer Brand Attractiveness On Intention To Apply In Indonesia?", **Heliyon**, 8(4), E09208. https://Doi.Org/10.1016/J.Heliyon.2022.E09208

Tripathi, M. A., & Ramswaroop, S. (2018). "Impact of Social Media in Employer Branding and Talent Acquisition : Study of IT Industry in India", **International Journal for Research in Engineering Application & Management (IJREAM)**, *04*(03), 566–569. https://doi.org/10.18231/2454-

9150.2018.0382

Uggerslev, K. L., Fassina, N. E., & Kraichy, D. (2012). "Recruiting Through the Stages: A Meta-Analytic Test of Predictors of Applicant Attraction at Different Stages of the Recruiting Process", **Personnel Psychology,** *65*(3). https://doi.org/10.1111/j.1744-6570.2012.01254.x

Vercic, A. T., & Sinčić, D. (2018). "The relationship between reputation, employer branding and corporate social responsibility", **Public Relations Review**, *44*(4). https://doi.org/10.1016/j.pubrev.2018.06.005

Xie, C., R. P., Bagozzi, A., & Meland., K. V. (2015). "The impact of reputation and identity congruence on employer brand attractiveness", **Marketing Intelligence & Planning**, *33*(2), 124–146. https://doi.org/10.1108/MIP-03-2014-0051

Zhu, F., Wang, Z., Yu, Q., Hu, T., Wen, Y., & Liu, Y. (2014). "Reconsidering the Dimensionality and Measurement of Employer Brand in the Chinese Context", **Social Behavior and Personality: an international journal**, *42*(6), 933–948. https://doi.org/10.2224/sbp.2014.42.6.933.

CHAPTER 5

Utilization of Facebook Social Media: In Designing the Pharmaceutical Industrial for Branding Company Profile

Kireyna Dini Nurcahyani
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
091301900033@std.trisakti.ac.id
Orcid: 0009-0000-5509-1155

Menul Teguh Riyanti
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
menul.teguh@trisakti.ac.id
Orcid: 0009-0005-6631-2140

Virginia Suryani Setiadi
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
virginia@trisakti.ac.id
Orcid: 0009-0005-5555-1218

Wegig Murwonugroho
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
wegig@trisakti.ac.id
Orcid: 0000-0002-3231-1300

Ekananda Haryadi
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
ekananda@trisakti.ac.id
Orcid: 0009-0007-2463-0153

Muhamad Hafiz bin Hassan
College of Creative Arts, Universiti Teknologi MARA, Malaysia
hafizhassan@uitm.edu.my
Orcid: 0009-0008-0475-5036

Bambang Tri Wardoyo*
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
bambangtri@trisakti.ac.id
Orcid: 0000-0002-6336-6574

ABSTRACT

Utilization of Facebook Social Media: In the Design of Pharmaceutical Industrial Design for Company Profile Branding. The research object is pharmaceutical companies operating in a highly competitive digital environment. Identified issues include challenges in building a strong brand image and effective use of Facebook as a branding tool. The research methodology involves in-depth analysis of user interactions, types of content presented, and evaluation of the effectiveness of branding campaigns. The discussion results reveal effective strategies employed by pharmaceutical companies, positive impact of user interactions on consumer perception, and strategic measures to enhance user engagement through creative content and interactive promotions. The

conclusion of this study provides profound insights into the utilization of Facebook social media in the pharmaceutical industry context, emphasizing the importance of digital literacy and creativity in achieving branding success on this platform. This study also offers valuable contributions to pharmaceutical companies in facing modern marketing challenges, guiding branding strategies based on active consumer interactions through social media.

Keywords: Facebook, Promotion, Pharmaceutical industry.

1. INTRODUCTION

In this digital era, social media has become a part of our day-to-day life, influencing various aspects of people's lives, including education, information, social interaction and health. Among the various social media platforms that exist, Facebook remains one of the most dominant and most widely used throughout the world. In the educational context, Facebook and other social media platforms offer great potential as quite effective tools for promotion within companies. The pharmaceutical industry is a business sector that relies heavily on brand image and consumer trust. In a highly competitive environment, building and maintaining a positive brand image is the main key to gaining consumer trust and increasing product sales. In the current digital era, where access to information is effortless via the internet, social media, especially Facebook, has become one of the most influential platforms in shaping the perception and brand image of a company.

Branding is not only limited to logo design or product packaging, but also involves active interaction with consumers. Facebook social media provides a unique opportunity to create direct connections between pharmaceutical companies and their consumers. By engaging consumers through engaging content, sharing relevant information, and responding to consumer feedback quickly and efficiently, pharmaceutical companies can build close, trusting relationships with their customers.

Figures 1. Kalbe logo and company
(https://images.bisnis.com/posts/2023/01/04/1615106/kalbe-office-1.jpg)

In the digital era that continues to develop rapidly, social media, especially Facebook, has become a dominating strength in various aspects of business. In the pharmaceutical industry, where competition is tough and customer trust in brands is critical, leveraging Facebook social media has become increasingly vital. Social media doesn't just provide a platform to interact with customers, but is also a very effective tool for building brand image (branding) and developing company profile.

In the midst of intense competition in the pharmaceutical industry, designing the right industrial design, especially in the context of company profile branding via Facebook social media, can be a significant added value. A strong and creative design can create a positive impression, increase brand awareness, and build strong relationships with customers. Therefore, research on the use of Facebook social media in pharmaceutical industry design is not only relevant, but also important to help companies face modern marketing challenges.

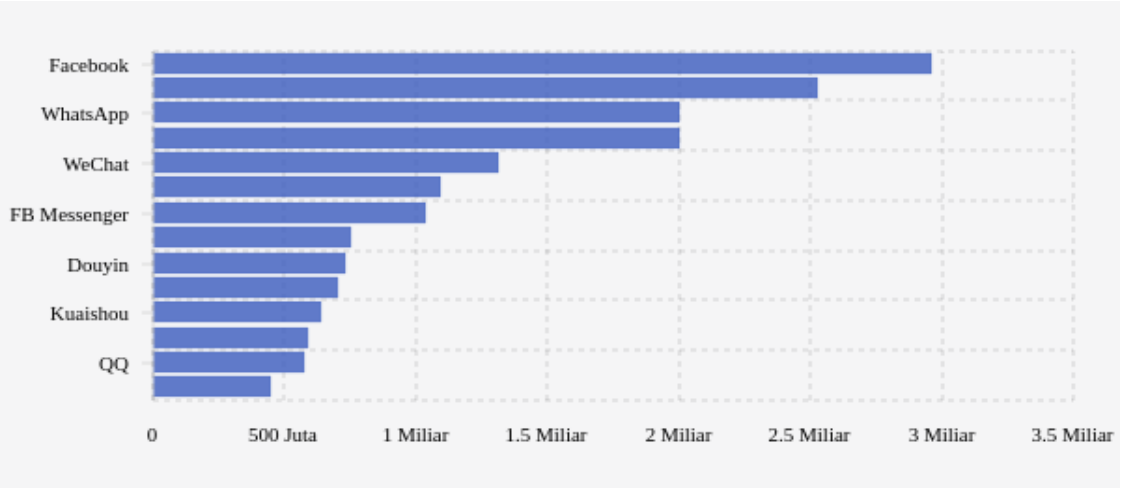


Figure 2. Graph of the most popular social media users in the world april 2023 (https://databoks.katadata.co.id/datapublish/2023/09/26/daftar-media-sosial-terpopuler-di-dunia-april-2023-facebook-masih-juara)

Facebook can also be used as an effective means of supporting lecture activities at the Information Systems Study Program of the Kalbe Institute of Technology and Business. However, to make the most of it, a deep understanding of how students and educators can interact with this platform in a productive and efficient way is required (Ziveria, 2017). Spread of fake news on social media, especially Facebook. In the Indonesian context, where Facebook is very widely used, the spread of fake news has become a serious problem that affects people's perception of the information they receive. Therefore, information literacy is very important to help social media users identity the correct information and hoaxes (Eka Syafrina & Rifai Alfarisi, 2021). Addiction and social impact of Facebook use. Excessive use of social media, as illustrated in this article, can disrupt life balance and daily responsibilities. This phenomenon raises questions about how users can manage their time and attention wisely in the face of social media temptations (Khairul et al., 2023)

Utilization of Facebook as a reference source for Islamic knowledge and a tool to support business activities. In the midst of the rapid growth of information on the internet, how people can use this social media as a valid knowledge tool and expand their business is a question that needs to be answered. Challenges in breastfeeding in Indonesia and how social media, including Facebook, can be a tool that facilitates social support for mothers. In the midst of changing lifestyles and social pressure, social media platforms have become a potential platform for strengthening social support and providing accurate information about breastfeeding practices (Yasya et al., 2019).

This in-depth research involves a detailed analysis of the use of Facebook social media in the context of pharmaceutical industry design. The main focus of the research is to identify effective strategies implemented by pharmaceutical companies in utilizing Facebook as a powerful branding tool. One aspect that is highlighted is how pharmaceutical companies build a long-lasting brand image through user interaction, the type of content presented, and evaluating the effectiveness of branding campaigns.

This research also details the challenges pharmaceutical companies face, from industry regulations to competition with competitors on the same platform. In addition, this research explores the impact of Facebook user interactions on consumer perceptions of pharmaceutical

products, both positive and negative. Effective strategic steps to increase user engagement are also analyzed in depth, including the use of creative content, gamification elements and the implementation of interactive promotions. This research is expected to provide an in-depth understanding of the potential for utilizing Facebook social media in improving pharmaceutical company branding, as well as providing practical direction for this industry to strengthen their brand profiles through this social media platform.

Considering the problems above, research was conducted to answer two problem formulations. First, How Can Pharmaceutical Companies Effectively Leverage Facebook Social Media to Build a Strong Brand Image? Second, what are the main challenges faced by pharmaceutical companies in utilizing Facebook as a company profile branding tool? By providing answers to these questions, it is hoped that this research can provide an in-depth understanding of the use of Facebook social media in the context of the pharmaceutical industry and at the same time provide practical guidance for pharmaceutical companies in an effort to strengthen their branding profile through this platform.

The research object is a pharmaceutical company operating in a highly competitive digital environment. The selection of pharmaceutical companies was carried out using purposive sampling based on their presence and activities on Facebook social media.

2. LITERATURE REVIEW

The use of social media, including Facebook, as a tool to support lecture activities has attracted the attention of researchers and academics. Facebook has great potential as an effective means of supporting lecture activities in the Information Systems Study Program. The use of Facebook in higher education has become a relevant research topic, demonstrating its positive contribution in improving the quality of academic interaction and collaboration between students and educators (Ziveria, 2017).

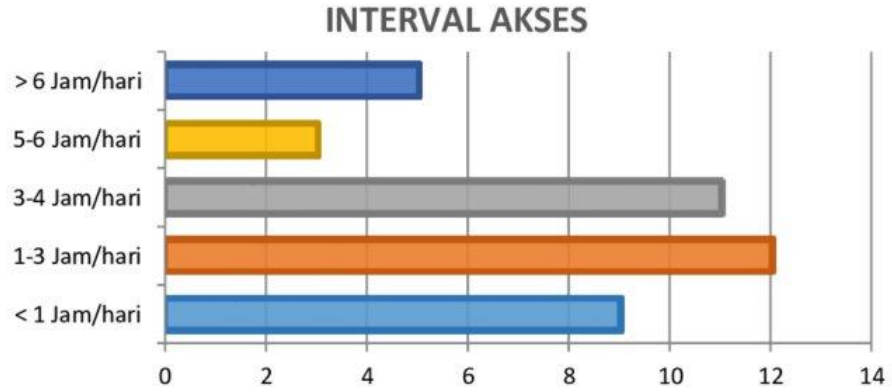


Figure 3. Use of social media on religion among adolescents (https://www.researchgate.net/publication/339044871_Preference_of_Social_Media_Usage_in_Teenagers_Religion)

Social media is an interactive platform that allows users to share content, information and communicate online. In a business context, social media is an effective channel for interacting with consumers. The Importance of Social Media in Business can be said that the use of social media is not only as a marketing tool, but also as a means to build relationships and consumer engagement. In the pharmaceutical industry, where trust and brand image are very

important, social media can shape positive perceptions (Arifin, 2015). Domination of Facebook itself as one of the largest social media platforms in the world, Facebook offers global coverage and a variety of features that support multimedia interaction. Analysis of these characteristics is important for designing appropriate marketing strategies. Understanding how Facebook algorithms structure and display content provides insight into how to maximize the visibility of branding campaigns (Triyono, 2011).

The marketing strategy for using Facebook social media itself is not only about including content, but also actively interacting with users. However, interactions with speedy and positive responses increase consumer engagement. Creative and relevant content design increases appeal. Understanding consumer preferences helps in creating content that suits the target audience (Purbohastuti, 2017). Digital literacy, as the ability to use information and communication technology effectively plays a key role in college students' use of Facebook. Digital literacy influences the way students use social media, especially in educational contexts. Good digital literacy not only influences the quality of academic interactions but also manages the use of student study time on the Facebook platform (Eka Syafrina & Rifai Alfarisi, 2021).

In a comparative context, the study by Davis et al. (2015) compared the use of Facebook and other social media platforms in higher education. The results show that Facebook is more often used as a collaboration and group learning tool, while other platforms are more likely to be used for one-to-one communication. On the other hand, research by Wang et al. (2017) compared the use of Facebook by students with high and low digital literacy. The results show that students with high digital literacy tend to utilize Facebook in a more productive and effective way in the learning process. However, there has been no research that specifically compares the use of Facebook in the Information Systems Study Program of the Kalbe Institute of Technology and Business by considering students' digital literacy and managing their study time. Therefore, it is hoped that this research can fill this gap by providing a deeper understanding of how digital literacy influences students' academic interactions and study time management in the Facebook environment, as well as a comparison with the use of other social media platforms.

The use of social media, including Facebook, also presents its own challenges and complexities. Pharmaceutical companies need to understand the dynamics of user interactions, the most effective types of content, and evaluate the impact of their branding campaigns. In addition, digital literacy and the ability to manage interactions wisely on social media are the keys to success in building a positive brand image. The novelty of advertising's visual structure is closely related to media implementation (Murwonugroho, W & Yudarwati, G. A. 2020). This research aims to investigate in depth the use of Facebook social media in designing pharmaceutical industry designs. This research will not only identify effective strategies, but will also deepen understanding of user interactions, positive impacts on consumer perceptions, and strategic steps to increase user engagement through creative content and interactive promotions. Thus, it is hoped that this research can make a significant contribution in guiding pharmaceutical companies to face modern marketing challenges and build strong branding through Facebook social media.

3. METHODOLOGY

Research design

This research uses a qualitative approach to gain a holistic understanding of the use of Facebook social media in designing pharmaceutical industry designs. In-depth analysis methods are used to examine user interactions and content types.

Data Collection Technique

In collecting data the author did the following things:

1. Deep Analysis of User Interactions
   Data collection was carried out by monitoring user interactions on the Facebook pages of selected pharmaceutical companies. In-depth analysis involves monitoring comments, likes, and shares, as well as the company's response to those interactions.
2. Analyze Content Types
   Data collection involves recording the types of content presented by pharmaceutical companies, such as health articles, product promotions, testimonials, and visual content. Content type analysis is carried out to assess the diversity and relevance of content in supporting branding.

Data Analysis

1. Deep Analysis of User Interactions
   User interaction data is analyzed qualitatively to identify patterns and trends in consumer response. Evaluation is carried out on the company's response to assess i the level of involvement and concern for consumers.
2. Analyze Content Types
   Content type data is processed to understand consumer preferences and the effectiveness of various types of content in building brand image. Comparisons between content types are carried out to identify those that are most successful in achieving branding goals.

Visual analysis generally uses Roland Barthes' semiotic methods and several of his approaches. In Barthes' concept, the connotative sign includes two parts of the denotative sign which are the basis of its existence. Connotative signs do not only have meaning, so the semiotic method in research on symbols and signs not only examines the signifier and its meaning, but also the general relationship that exists between the two. Therefore, Barthes sees the text in a very broad sense, going beyond the linguistic aspect, because semiotics has the ability to observe the text where the signs are encoded into the linguistic system. Thus, semiotics can basically examine various forms of text manifestation, such as news, films, advertising, fashion, fiction, poetry and drama. All manifestations of this text have two orders of meaning, namely denotation in the first order and connotation in the second order (Murwonugroho et al., 2022).

This research method is designed to provide a holistic understanding of the use of Facebook social media in designing pharmaceutical industry designs for company profile branding. The combination of in-depth analysis, quantitative measurements, and evaluation of campaign effectiveness allows for a comprehensive investigation of the impact of social media on brand image in the pharmaceutical industry.

4. RESULTS AND DISCUSSION

Strategy for Utilizing Facebook Social Media

Pharmaceutical companies are adopting the strategy of effectively utilizing Facebook social media. Active interaction with users through quick responses to comments and questions creates high engagement. This strategy contributes to improvement company brand image. Creative and diverse content is also seen in various types of posts, including health articles, product information, and customer testimonials. The use of visual content and interactive promotions such as quizzes or contests supports the creation of engaging experiences for consumers.

1. Active Interaction and Quick Response
   Pharmaceutical companies have succeeded in implementing active interaction strategies with users via Facebook social media. Fast response to consumer comments, questions and feedback creates high engagement. It was found that companies responded to most comments within a short time, increasing the company's positive image in the eyes of consumers (Juwita et al., 2020).
2. Creative and Diverse Content
   The strategy of utilizing creative and diverse content has also proven effective. Posts that include different types of content, such as health articles, product information, and testimonials, provide interesting variety for consumers. Visual content, such as images and videos, received a higher positive response, indicating consumers' preference for attractive visual presentations.
3. Use of Interactive Promotions
   Interactive promotions, such as quizzes or contests, have been shown to increase user participation and engagement. These campaigns create a two-way interaction between companies and consumers, creating a stronger bond. Using this strategy also gives rise to the potential for virality, with consumers more likely to share content that actively engages them.
4. Continuity in Posting
   Continuity in posts is also a strategy that has been observed successfully. Pharmaceutical companies regularly update the content on their Facebook pages, ensuring a consistent presence in the eyes of users. Regular posts about the latest news, health tips, and product information provide added value to consumers and help build ongoing relationships (Hutter et al., 2013).
5. Collaborate with Influencers
   In some cases, it has been seen that pharmaceutical companies collaborate with health or beauty influencers. This strategy aims to leverage the influencer's audience to expand reach and increase brand credibility. However, the success of this strategy can vary depending on the alignment of values and vision between the company and the influencer.

An effective strategy for utilizing Facebook social media has positive implications for the brand image of pharmaceutical companies. Active engagement, creative content, interactive promotions and continuity in posts drive consumer engagement. Collaboration with influencers can also be an important aspect in expanding marketing impact. This implication

shows that sustainable adoption of this strategy can strengthen the company's branding profile in a competitive environment (Arief & Milayani, 2015).

The Positive Impact of User Interaction on Consumer Perception

Positive interactions with consumers on Facebook social media have been proven to have a positive impact on consumer perceptions of pharmaceutical companies. Quick and informative responses increase consumers' level of trust in the brand, creating deeper relationships. Consumer sentiment analysis shows that the majority of responses to the company's interactions on social media are positive. Consumers feel valued and heard, which creates loyalty and support for the brand (Bryan et al., 2017).

Figure 4. Display of the kalbe farma facebook page (https://www.facebook.com/KalbeFarma.Tbk)

1. Increasing Consumer Confidence Levels
   Positive interactions between pharmaceutical companies and users on Facebook social media significantly increase the level of consumer trust in the brand. Quick responses to questions and feedback create the perception that the company cares about consumer needs and concerns. It was found that consumers who received a positive response tended to have a higher level of trust in the brand.
2. Build Deeper Relationships
   Active interaction via social media creates deeper relationships between companies and consumers. Consumers feel heard and appreciated, which is fundamental for closer relationships. The discussions that occur in comments and private messages help form personal bonds, adding value to the consumer experience.
3. Positive Consumer Sentiment
   Consumer sentiment analysis shows that the majority of responses to the company's interactions on social media are positive. Consumers expressed their satisfaction with the response given, citing it as a positive factor influencing their perception of pharmaceutical companies.

4. Contribute to Positive Word-of-Mouth
   The positive impact of user interactions contributes to the creation of positive word-of-mouth. Consumers who feel positively connected to a company are more likely to share their experiences with others on social networks, supporting the spread of positive information about the brand.
5. Increased Consumer Satisfaction
   Positive interactions on social media also have an effect on increasing consumer satisfaction levels. Consumers who feel involved with companies through social platforms tend to be more satisfied with the services and products they receive. This can have a positive impact on customer retention and repeat purchases.

The positive impact of user interaction on consumer perceptions shows that responsive strategies and interacting with consumers on social media have significant implications for pharmaceutical company brand relationships and image.

Strategic Steps to Increase User Engagement

Based on the research results, several strategic steps were identified to increase user engagement on Facebook social media. Increasing creative content, using gamification elements and interactive promotions can be a solution to maintain consumer interest. Additionally, collaborations with health influencers or providing incentives for consumers who participate in certain campaigns can be additional steps to increase user engagement.

1. Creative Content Improvement:
   Increase user engagement with engaging creative content, including the development of visual content such as images and videos. Explore innovative content formats, such as dynamic infographics and short animations, to enrich the user experience.
2. Interactive Promotion:
   Strengthen user engagement through interactive promotions, such as quizzes or contests, by scheduling campaigns at regular intervals. The combination of interactive promotions with incentives for participants can increase participation and create a positive experience.
3. Integration of Consumer Feedback
   Build engagement by responding quickly to consumer feedback, creating an atmosphere where consumers feel valued. Use consumer feedback as a guide to refine content and marketing strategies, strengthening relationships with audiences.
4. Collaboration with Influencers:
   Explore potential collaborations with health or beauty influencers to expand reach and create more targeted content. Select influencers who align with company values and vision to ensure authentic and effective collaboration.
5. Collaboration with Consumers:

Increase engagement by involving consumers in campaign or content planning. Establishment of focus groups or consumer panels to gain valuable feedback throughout the planning journey.

These strategic steps are aimed at increasing user engagement on Facebook social media, closer relationships with consumers, and strengthening the brand image of pharmaceutical companies. Implementing this strategy can be the key to success in responding to modern marketing dynamics, maintaining consumer interest and building customer loyalty. Implications for the Pharmaceutical Industry and Future Recommendations. The research findings have major implications for the pharmaceutical industry in facing modern marketing challenges. Recommendations for pharmaceutical companies include increased investment in creative content, further engagement with consumers, and increased understanding of applicable regulations. In facing an ever-changing environment, pharmaceutical companies need to continue to monitor trends and innovations in digital marketing, as well as maintain consumer engagement through social media (Mulitawati & Retnasary, 2020).

The case study that the author took in this research, the author took PT Sido Muncul Tbk as material for the author to research. PT Sido Muncul was founded in 1940 by Mrs. Rahkmat Sulistio and started by producing traditional herbal medicine. Jamu is a traditional Indonesian concoction made from natural ingredients and has a role in traditional medicine. Over several decades, PT Sido Muncul has experienced significant growth. The company continues to innovate in traditional herbal medicine formulations and is gradually diversifying its products into various health segments, including food supplements and other health products. PT Sido Muncul became a public company in 2013 after holding an initial share offering on the Indonesia Stock Exchange (BEI). This share offering strengthens the company's position in the pharmaceutical industry in Indonesia.

The company continues to innovate in product development, combining herbal medicine traditions with modern technology to create products that suit contemporary consumer needs PT Sido Muncul Tbk continues to be one of the main players in the Indonesian pharmaceutical industry and continues to strive to strengthen its position through product expansion, innovation and effective marketing strategies. Its history reflects the company's long journey in preserving the heritage of traditional Indonesian herbal medicine while continuing to adapt to the demands of an ever-growing market.

Facebook is one of the largest social media platforms in the world with millions of active users every day. By utilizing Facebook, PT Sido Muncul can access a wide reach to promote its brand to various consumer groups. Facebook allows PT Sido Muncul to interact directly with consumers. Through comments, direct messages, and reactions, companies can get direct feedback from customers, forge closer connections, and understand their needs and preferences. Facebook provides powerful analytical tools to monitor campaign and content performance. PT Sido Muncul can analyze follower growth statistics, interaction levels and user sentiment to measure the effectiveness of branding strategies and adjust their approach based on the data obtained.

By being on a platform that is frequently used by the public, PT Sido Muncul can increase brand recognition and consumer awareness of its products. Interesting content can create a strong visual appeal and help shape a positive image of the company in the eyes of consumers. The social media platform allows PT Sido Muncul to communicate in real-time with consumers, conveying the latest news, product launches or special promotions. This allows the company to stay relevant and connected with its audience.

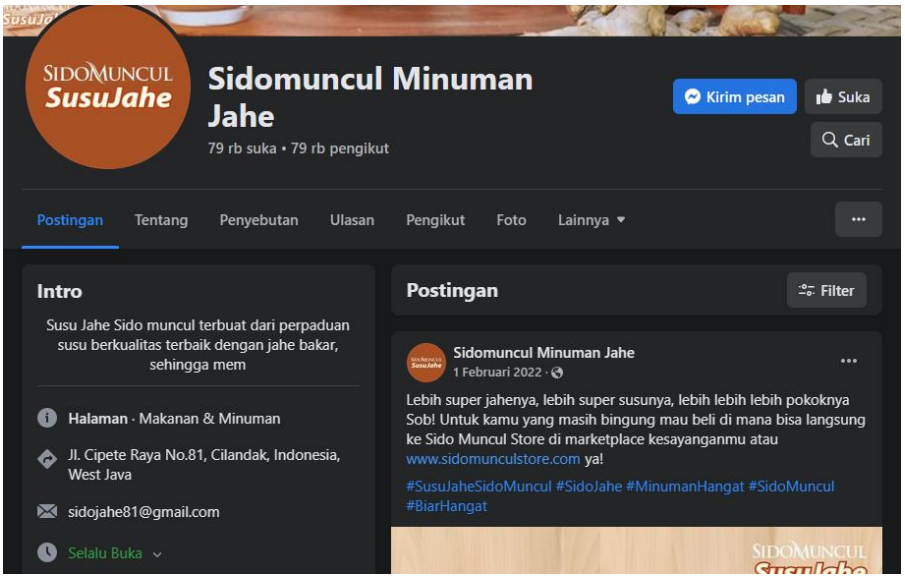


Figure 5. PT Sido Muncul Tbk facebook social media (https://id-id.facebook.com/sidomunculcorp)

Data on the growth of PT Sido Muncul Tbk's followers on Facebook during the research period shows a significant increase. Growth analysis can differentiate between the reception of new content, promotional campaigns, and the effects of active interactions with users. Involves analyzing follower demographic data such as age, gender, geographic location, and interests. This information can help companies adjust content and promotional strategies to reach more specific target groups. Connect growth, engagement, and sentiment data with business performance indicators, such as increased sales or profits. Demonstrate the direct contribution of a social media strategy to a company's business results.

The use of Facebook social media by PT Sido Muncul Tbk as part of the company's profile branding strategy is a strategic step that takes advantage of the communication, reach and analytical power of the platform. With this approach, companies can build strong relationships with consumers and strengthen their brand image in the market.

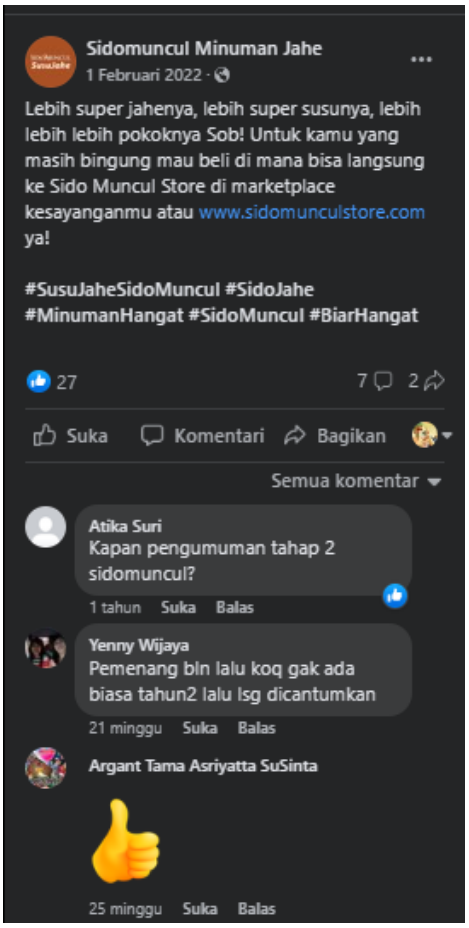


Figure 6. Facebook social media PT Sido Muncul Tbk (https://id-id.facebook.com/sidomunculcorp)

5. CONCLUSION

This research explores the use of Facebook social media in designing pharmaceutical industry designs with the aim of strengthening company profile branding. Based on the analysis and findings, several key conclusions can be drawn:

1. Effective Strategy for Using Social Media:
   It is proven that pharmaceutical companies adopt the strategy of utilizing Facebook social media effectively. Active interaction, creative content and interactive promotions are the main pillars in building a positive presence on the platform.
2. Positive Impact of User Interaction:
   Positive interactions with users on social media have a significant positive impact on consumer perceptions. Quick response, personal, and positive consumer sentiment contribute to increased consumer trust and satisfaction.
6. Challenges and Complexities of Modern Marketing:
   Challenges in the form of industry regulations and the dissemination of inaccurate medical information are complexities in pharmaceutical marketing via social media. The strategy must carefully consider legal and ethical aspects.
7. Strategic Steps to Increase User Engagement:

The research findings provide the basis for strategic steps to increase user engagement on social media. Increasing creative content, interactive promotions, and integrating consumer feedback are the keys to maintaining consumer interest.

8. Implications and Recommendations for the Pharmaceutical Industry:
   The implications of the research findings provide practical guidance for pharmaceutical companies in facing modern marketing challenges. Recommendations involve developing responsive programs, intensive training of customer service teams, and integration of consumer feedback in marketing strategies.

This research provides in-depth insight into the role of social media Facebook in pharmaceutical industry design. A successful social media strategy not only creates strong branding, but also forms positive relationships with consumers. By continuously updating strategies according to social media dynamics and paying attention to regulatory aspects, pharmaceutical companies can optimize marketing potential through this platform. These conclusions provide practical direction and contribute to the understanding of social media engagement in the context of the pharmaceutical industry in the digital era.

REFERENCES

Arief, G. M., & Millanyani, H. (2015). Pengaruh social media marketing melalui instagram terhadap minat beli konsumen sugar tribe. eProceedings of Management, 2(3).

Arifin, R. W. (2015). Peran facebook sebagai media promosi dalam mengembangkan industri kreatif. Bina Insani ICT Journal, 2(2), 117-126.

Bryan, C., Sudika, I. N., & Aryanto, H. (2017). Perancangan *Branding* Perusahaan 7coffeeaday. Jurnal DKV Adiwarna, 1(10), 8.

Davis III, C. H., Deil-Amen, R., Rios-Aguilar, C., & González Canché, M. S. (2015). Social media, higher education, and community colleges: A research synthesis and implications for the study of two-year institutions. Community College Journal of Research and Practice, 39(5), 409-422.

Eka Syafrina, A., & Rifai Alfarisi, M. (2021). PENGGUNAAN MEDIA SOSIAL FACEBOOK SEBAGAI SARANA KOMUNIKASI DAN INFORMASI DI KALANGAN REMAJA. 3, 17–28.

Fawahan, L., & Purnasari, I. M. (2022). Membangun *Branding* Produk UMKM Melalui Media Sosial Tiktok. Al-Kharaj: Jurnal Ekonomi, Keuangan & Bisnis Syariah, 4(1), 280-289.

Hutter, K., Hautz, J., Dennhardt, S., & Füller, J. (2013). The impact of user interactions in social media on brand awareness and purchase intention: the case of MINI on Facebook. Journal of product & brand management, 22(5/6), 342-351.

Juwita, F. I., Widayati, A., & Istyastono, E. P. (2020). The Use Of Internet And Social Media For Drug Information Services In Pharmacies In Yogyakarta Province: A Study Of Asthma Care. Jurnal Farmasi Sains Dan Komunitas, 17(1), 59-68.

Khairul, A., Institut, N., Islam, A., Kerinci, N., Kapten Muradi, J., Liuk, K. S., Penuh, K. S., Jambi, P., & Id, A. A. (2023). MEMAHAMI PENGGUNAAN MEDIA SOSIAL FACEBOOK DI KALANGAN IBU RUMAH TANGGA. Communcications, 5(1), 353–370. https://doi.org/Communications5.1.4

Mulitawati, I. M., & Retnasary, M. (2020). Strategi Komunikasi Pemasaran dalam Membangun Brand Image Melalui Sosial Media Instagram (Studi kasus deskriptif komunikasi pemasaran prodak polycrol forte melalui akun instagram@ ahlinyaobatmaag). Komunikologi: Jurnal Pengembangan Ilmu Komunikasi Dan Sosial, 4(1), 23-38.

Murwonugroho, W., & Yudarwati, G. A. (2020). Exposure to Unconventional Outdoor Media Advertising. Pertanika Journal of Social Sciences and Humanities, 28(4). https://doi.org/10.47836/pjssh.28.4.50, 95-124.

Purbohastuti, A. W. (2017). Efektivitas media sosial sebagai media promosi. Tirtayasa Ekonomika, 12(2), 212-231

Tommi, T., Saidi, A. I., Chonmaitree, T., Razak, M. R. A., & Murwonugroho, W. (2022). Humanization of Logo as a Representation of Social Values in Halodoc. JSW (Jurnal Sosiologi Walisongo), 6(1), 43-58.

Triyono, A. (2011). Pengaruh situs jejaring sosial facebook sebagai media alternatif untuk promosi. Jurnal Dian, 11(1).

Wang, R., Yang, F., & Haigh, M. M. (2017). Let me take a selfie: Exploring the psychological effects of posting and viewing selfies and groupies on social media. Telematics and Informatics, 34(4), 274-283.

Yahya, M., Syarif, A., & Penulis, N. (2021). PENGGUNAAN FACEBOOK DALAM PROMOSI PRODUK BARANG JADI. Jurnal Kajian Islam Kontemporer, 12(2).

Yasya, W., Muljono, P., Boro Seminar, K., Pascasarjana, S., Pertanian Bogor, I., Ekologi Manusia, F., Teknologi Pertanian, F., & Pertanian Bogor Jalan Raya Dramaga, I. (2019). EFFECTS OF FACEBOOK SOCIAL MEDIA USE AND ONLINE SOCIAL SUPPORT ON BREASTFEEDING BEHAVIOR.

Ziveria, M. (2017). Pemanfaatan Media Sosial Facebook Sebagai Sarana Efektif Pendukung Kegiatan Perkuliahan di Program Studi Sistem Informasi Institut Teknologi dan Bisnis Kalbe. 4, 169–178.

CHAPTER 6

Environmental Sustainability: The Influence of Economic Growth on the Spatial Pattern of Old Towns in Java

Lucıa Helly Purwanıngsıh
Departement of Master of Architecture, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
lucia@trisakti.ac.id

Popi Puspitasari*
Departement of Doctor of Architecture, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
popi@trisakti.ac.id
Orcid: 0000-0003-4143-6807

Retna Ayu Puspatarini
Departement of Master of Architecture, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
retna.ap@trisakti.ac.id

I Gede Oka Sindhu Pribadi
Departement of Master of Architecture, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
gede.oka@trisakti.ac.id

M. Oliver Ensor Bin Silini
School of Built Environment, University of Technology Sarawak, Malaysia

ABSTRACT

The growth of informal economic activities in the historic city center is organic, sporadic and tends to be uncontrolled. From the perspective of the sustainability of cultural preservation, this has implications for the loss of historical traces and spatial patterns of the old city. Currently, documenting historical traces is used as an economic investment by the government in order to increase regional income through tourism activities, so that documents of the order of spatial elements are needed. This research aims to identify the elements that form the spatial pattern of old towns in Java that still survive and are significantly preserved, as well as elements that are vulnerable to change. The method used is a field survey in the old town of Pekalongan (central Java, Indonesia), review of previous research on old towns, followed by a case dialogue on the spatial patterns of old towns in Java. The results show that elements that survive in the growth of the old town spatial pattern include The strategic estuary became the center of the old city and economic growth, a meeting place for different ethnic groups with ethnic zoning associated with social stratification, the center of inter-island/inter-country trade activities, the development of its spatial pattern in line with economic growth and the development of the infrastructure of transport routes. While those that tend to be vulnerable to change are secondary and tertiary road networks, buildings supporting the city's main economic activities that are organic and sporadic.
Keywords: Sustainability, Economic Growth, Spatial Pattern, Old Town.

1. INTRODUCTION

In recent decades, Indonesia has experienced a notable increase in economic growth, particularly on the island of Java, which serves as the country's primary economic and administrative hub. This economic growth has had a significant impact on various aspects of life, including the structure and layout of historic old towns. The historic cities of Java, including Jakarta, Surabaya and Yogyakarta, are of significant historical and cultural value. As centers of civilization from the colonial period to the modern era, these cities possess a rich heritage of architectural, urban planning and historical significance. Nevertheless, in parallel with the aforementioned economic development, these historic urban areas are undergoing a series of alterations and challenges.

The expansion of the economy is accompanied by urbanization, augmented investment in infrastructure, and alterations to land use. This phenomenon not only brings positive impacts such as increased welfare and modernisation, but also creates problems such as congestion, damage to historical buildings, and loss of local cultural characteristics. The research question based on the problems above is how economic growth influences the spatial patterns of old towns, especially in the city of Pekalongan.

The objective of this article is to analyze the impact of economic growth on the spatial structure of old towns in Java. To this end, the cases of Pekalongan Old Town, Tangerang Old Town, and Batavia Old Town will be discussed. A morphological study approach will be employed to reveal the structure and spatial patterns that develop as a consequence of the phenomenon of economic growth experienced by the inhabitants. This approach will enable us to understand how economic changes affect the distribution of space, building functions, and land use in these historical areas. In the case of Pekalongan's Old Town, for example, economic growth triggered by the batik industry has resulted in the transformation of numerous historic buildings into commercial and tourist centers. In Kota Lama Tangerang, rapid economic development has facilitated the construction of modern infrastructure in conjunction with colonial structures, thereby creating a stark contrast. Meanwhile, Batavia's Old Town, which is one of Indonesia's most significant historical and cultural centers, is confronted with the challenge of preserving its architectural heritage in the context of urbanization and commercialization.

Soil characteristics affect urban development. Topographically, Pekalongan City is a low-lying area with land elevations ranging from 1 to 6 metres above sea level and an average slope of 0-5%. The region is also vulnerable to climate change, particularly tidal flooding, which is expected to increase with sea level rise[1][2][3]. The Old town of Pekalongan, particularly in the North Pekalongan District, is experiencing significant coastal erosion. The coastline in this area has retreated 2405.08 metres with an erosion rate of 353.3 metres per year. [4]. Seawater intrusion has a significant influence on the development of Pekalongan City, including the old town area, causing groundwater quality problems, resulting in an increase in clean water demand along with population growth and land use change [5]. From 1991 to 2009, the coastal zone exhibited an increase in built-up areas and ponds and a decrease in agricultural areas, influenced by distance to main roads and population density. Population growth had a significant impact on land change, with land use classification accuracy reaching 79.50% [6]. Tidal floods have resulted in damage to physical, economic, sociocultural, health, educational, and environmental aspects. In response, communities have

diversified their income sources, utilised kinship networks, and implemented strategies such as saving on non-food expenditures and improving education levels in order to cope with the challenges posed by tidal floods[7]. The impact of tidal flooding in coastal areas requires adaptive efforts to deal with tidal flooding through the arrangement of urban drainage systems accompanied by integrated landscape planning so that it can be utilized to improve the economy, tourism, social, and environment[8][9].

The batik industry and culinary business have become the defining characteristics of Pekalongan's identity and cultural heritage, and a significant contributor to economic growth and job creation. In 2007, the government opened "Kauman Batik Village" as an implementation of the economic cluster policy as well as a tourist destination area, followed by Pesindon Batik Tourism, Jenggot Batik Tourism, and Medono ATBM Centre [10]. Pekalongan is renowned as the centre of batik production, or "City of Batik". This designation has shaped the spatial structure of the city, with the social and economic status of the community influencing the distribution of batik-related businesses. The city centre is home to fine batik and hand-drawn batik entrepreneurs, who operate their factories there. Printed batik factories are located in urban villages that are within the city limits but outside the city centre. Raw materials are transported from the city centre to the periphery at the beginning of the week, and finished products are transported back to the city centre at the end of the week [11]. The domestic batik industry has influenced the spatial structure of the city. The main street functions as a shopping, commercial and tourist centre, with the development of industrial villages that are also tourist attractions. Another effect is the emergence of spatial segregation based on social class, indicated by the emergence of shopkeepers along the main street, while wealthy entrepreneurs run industrial businesses along the linear path connecting the southern and northern areas of the city. This phenomenon has led to Pekalongan's branding as the 'World Batik City'[12].

Pekalongan has potential economic assets derived from halal culinary food, possibly due to the influence of the existence of Arabian villages[13]. In some places in Indonesia, pilgrimages to the graves of Islamic prophets are part of the cultural heritage of Hadramaut immigrants in the archipelago. This has led to the emergence of informal economic activities around the pilgrimage site in the form of bazaars, street markets, stalls and shops selling Muslim accessories and holy water. The location of the kampong in the old town, strategically placed for intercity transport, encourages the development of a business of renting spaces or buildings at relatively low prices compared to the city centre. [14].

The previous research related to the city of Pekalongan is a study that examines the preservation of conservation areas as a cultural foundation in the planning of the city of Pekalongan. This study recommends four areas in Pekalongan City to be preserved, namely the Dutch Village Area (Jetayu), the Chinatown Village, the Arab Village and the Kauman Village. These four areas also reflect the harmonious inter-ethnic relations of the past, which is one of Unesco's Outstanding Universal Values (OUV) criteria for World Heritage cities [15]. A descriptive qualitative method with a comparative study among three study objects, namely Kauman village in Surakarta, Malang and Pekalongan, is used in the research on ethnic settlements in Pekalongan city with a research focus on Kauman villageThe village of Kauman is representative of Muslim settlements in Indonesia, particularly in Java. This research aims to explore the patterns used by the community to realise Islamic values in the

settlement. Kauman villages in Surakarta, Malang and Pekalongan were chosen as part of similar cities with their dynamics and development [16]. Ethnic settlements are interconnected to form an integrated settlement covering Sampangan Village, Sugihwaras Village and Jetayu Area (European/Colonial), Pekalongan City. The culture and customs of different ethnic communities and politics influence the formation of ethnic settlement patterns [17]. The presence of a Chinese village is characterised by an eclectic architectural style of traditional Chinese architecture based on the concept of Feng Shui with an Art Deco style, a legacy of the colonial period [18]. These studies focus more on ethnic segregation, whereas the study in this article is more concerned with how the spatial pattern of the city is related to economic growth, beginning with the early growth of the old town.

2. LITERATURE REVIEW

In this research, theory acts as a guide for researchers when uncovering units of information in the field. Thus, the theory is not intended to be proven, but rather serves as a guide for research implementation. This research draws upon two theories, namely Environmental Sustainability and Urban Morphology theories. Sustainability theory is based upon three fundamental aspects, namely the economic, environmental, and social value of an investment related to the concept of sustainable development [19]. The content of the influence of economic growth on the spatial structure of the old town is related to land use (zoning functions in an urban area) and its changes caused by human activities in the economic sector from the early growth of the city to the present. In theory, the factors that drive rapid change of function in urban areas are: concentration of population with its activities, accessibility to activity centres and city centres, and the distance that connects an area to higher service centres. The location, population, and activities within a given area collectively influence the type of land use and its subsequent evolution over time [20]. In the field of architecture, alterations in urban spatial configurations are classified within the domain of urban morphology studies. These studies encompass three key aspects: temporality, contextual scale, and the specific content under investigation. Temporality pertains to historical chronology, while contextual scale encompasses the physical dimensions utilized as the focal point of research, such as artifacts, buildings, neighborhoods, areas, or entire cities. Content, on the other hand, encompasses changes in spatial form that are associated with shifts in socio-cultural conditions and philosophical foundations. In order to uncover spatial changes, it is necessary to consider both tangible and intangible information units[21]. Revealing the morphology of the city from the perspective of environmental sustainability can be diagrammatically described as follows:

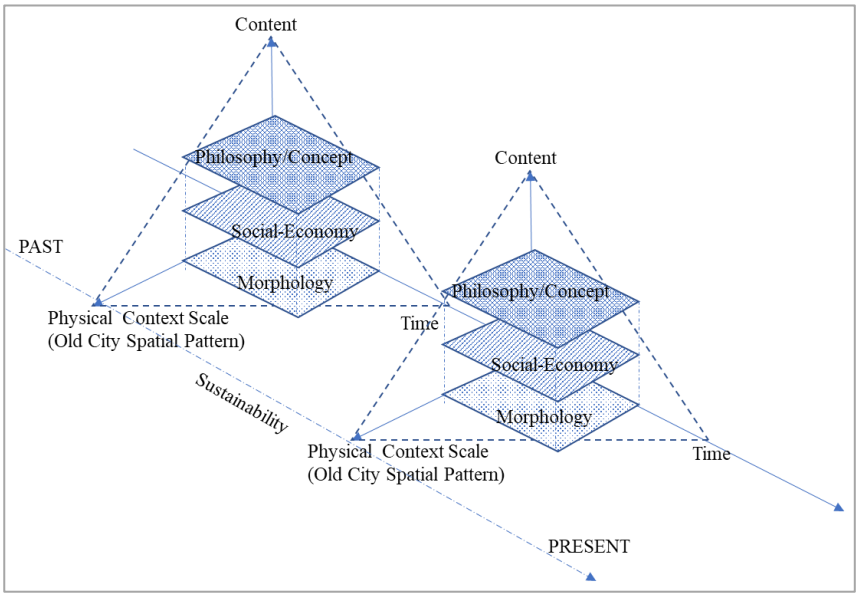


Figure 1. Schematic of the theoretical concepts guiding the research (Puspitasari, 2024)

In the context of the old town morphology, sustainability is contingent upon the continuity of the city's spatial pattern, with a focus on the economic growth phenomena identified through a literature review, map analysis and field survey results. The unit of information is the content of physical changes in the city's spatial patterns associated with the context of economic activities, based on the chronology of time.

3. RESEARCH METHOD

The research method employs quasi-qualitative analysis, utilising a multitude of sources, including books, journal articles, and field visits. In this instance, the researcher employs theoretical frameworks to guide their search for data and information from primary and secondary sources. The selected theoretical lens is morphological theory of spatial patterns, which considers the sustainability of economic activities in relation to their spatial characteristics. The research is conducted in the old town of Pekalongan, and the findings are then transferred to the results of previous research conducted by the author in the old towns of Jakarta and Tangerang. The final result of the research is the formulation of a conceptual model.

The operational definition of the research can be described as follows: 1) Environmental sustainability concerns the continuity of urban spatial patterns, which are characterised by the persistence of spatial patterns in certain areas accompanied by differentiation of changes in spatial patterns in other areas; 2) Economic growth refers to economic activities that accompany changes in spatial patterns in the old town; 3) The old town is the research locus, as it is the location that historically became the forerunner of the current big city. The initial conditions of growth are referred to as the old conditions.

The unit of observation is the old town of Pekalongan and its growth. The data collected includes information regarding the spatial configuration of the city, the types of economic activities conducted within it, with a particular focus on those related to batik production, the

geographical location of these activities, and the temporal aspects of their occurrence. The sources of information include journal articles, books, map documentation, and field facts. The research instrument was the researcher themselves, with supporting tools for field recording. The research stages are as follows: 1) The theoretical framework is employed to guide the researcher (not to prove the theory) in the collection of information during the research process. 2) Information units were obtained from literature studies, studying maps, and field visits; 3) Tabulation of information based on chronological time accompanied by descriptions of phenomena related to the occurrence of spatial patterns due to economic activities or the potential to generate economic activities, 4) Categorisation of information units on certain themes; 3) Interpretation of links between phenomena into conceptual models, 5) In the final stage is the formulation of a conceptual model which is a constellation between themes. The research methodology employed an inductive approach, as illustrated in the subsequent diagram.

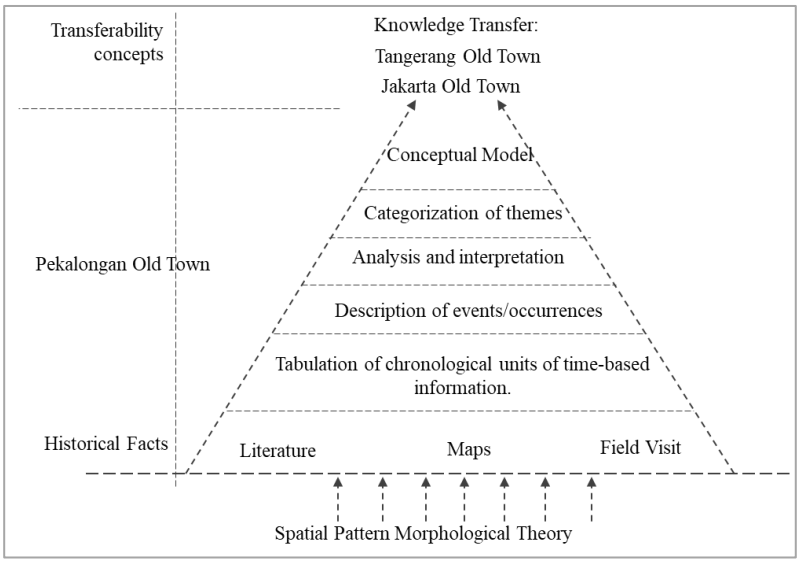


Figure 2. The inductive research way of thinking
(Puspitasari, 2024)

4. RESULT AND DISCUSSION

4.1. Result Themes Categorization

Theme-1. The waterways represent the initial catalyst for the growth and evolution of the Old Town: The Kupang River Estuary as Melting Pot

The name Pekalongan is derived from the word 'Pek-Along-An', which means income, or in the Javanese language Krama, it is called 'Pangangsalan'. The city is also known by several other names, including 'Batik City', 'Creative City', and 'Santri City' [19]. Pekalongan's early history is marked by its identification with the mouth of the Kali Pekalongan, also known as the Kupang River. This riverine connection facilitated the movement of people and goods between the northern coastal area and the inland region. The 1863 and 1918 maps document the river's name as 'K. Pekalongan' or Kali Pekalongan, with 'Kali' denoting a river (Figure 3).

The function of Kali Pekalongan as a means of water transport is evidenced by the following timeline, which indicates that this activity has been in operation since at least the 7th century (see Table 1). The development of the city is closely related to the economic activities of various ethnic groups, including Chinese, Arab, European, and local people. The harbour at the mouth of the river served as a loading and unloading point for a variety of goods, including sugar, batik, crops, and others. Additionally, it functioned as a means of transportation between villages situated along the river.

Table 1. Timeline of the early growth of Pekalongan Old Town on the Kupang River

Year	Events/Occurrences	Information Units Keywords
1960	The Kerimunan road area is a residential area, which is now known as an economic area.	• Chinese residential to economic area (jl. Kerimunan)
1935	Santo Petrus Church was established, close to the harbour	• Church building in Cina village
1934	In Juliana Weeg Street (Jalan Belimbing), you will find a modern house owned by a Chinese businessman.	• Chinese residential on Belimbing Street
Awal abad 18-20	The Kupang River estuary served as a port of call for merchant vessels originating from a multitude of countries, including China, Arabia, India, and Europe, as well as for a diverse array of ethnic groups, such as the Bugis, Madura, Malay, and Kalimantan. It was also a pivotal point for the batik trade, with loading and unloading operations occurring around Kauman/Kampung Arab (Sugihwaras), situated in close proximity to the Surabaya street batik market.	• Interstate stop for commercial vessels and fishing port • Kupang river estuary as Melting Pot • Batik and fish trade goods loading and unloading port
1854	Found a number of graves with sea shell headstones	• Kupang River, a stopover for fishermen and maritime traders and its surroundings a burial place for fishermen and maritime traders.
1882	The temple of Thian Po was established in Kampung Cina.	• The establishment of temples is an indicator of new cultural intrusion into the local area
1830	Pekalongan became a significant producer of sugar, which was shipped to Europe. As a result, the Kupang River Estuary became a key stopover point for Dutch merchant ships bound for Europe. Chinese traders played an important role in facilitating Dutch trade activities.	Function of the Kupang River Estuary:: • Port of loading and unloading of import-export goods between countries • Second-class Chinese merchants in the city economy
1816	British rule came to an end.	The UK's supporting record in the city economy is limited

1808	Marker km '0' Jl. Paal for Java has been set. (1808-1811) Governor-General of the Dutch East Indies, Daendels built the postal highway in Java.	Marking the starting point of mainland road infrastructure (Jl. Paal)
17th century	During the period of the Mataram Sultanate, Pekalongan emerged as a major centre for rice production, significantly contributing to the economic prosperity of the region.	Pekalongan as an economic source of rice for its people
1753	VOC Fortress was built (Rutan in Jatayu now)	The Dutch controlled the north coast of Pekalongan (Jatayu) with the administrative centre at Benteng.
1746	VOC established a new government in the North Beach area	
1743	Pekalongan was under VOC control	
1630	Kerkhoff Christian Cemetery established (Panjang Wetan), kerk (=church) and hof (=garden), cemetery located in the churchyard, graves of Europeans	Europeans live in Pekalongan
1485	Wu Hang, supervisor of legitimate trade activities in the port city of Pekalongan	The Kupang River estuary became a harbour in the 15th century.
1458	A Chinese named Wu Hang (Syahbandar) once controlled the trade traffic of the port of Pekalongan, according to the Cirebon Kertabumi manuscript.	River Estuary activities managed by Syahbandar
Abad 14	Ma Huang, the secretary of Admiral Ceng Ho, discovered Chinese people living in Sampangan village (situated at the mouth of the Kupang river/Ali Loji) during his brief stopover in Pekalongan. In addition to the Chinese, he encountered indigenous people and Arabs. The Kupang river estuary is a harbour where junks, or 'jung boats', carrying merchandise enter and leave the harbour.	The function of the Kupang River Estuary: • Multi-ethnic melting pot • Inter-island trade goods loading and unloading port
960-1279	The Sung Dynasty in China recorded Pekalongan, which Chinese merchants called "Pu-koa-lung". It is known that Chinese merchant ships sailed through the ocean from Canton and took approximately one month to reach Pekalongan.	Ethnic Chinese anchored in Pekalongan in the 10th century, possibly entering the mainland via the Kupang River, which served as a means of transport in the 8th century AD.
Abad 8 M	Sungai Kupang menjadi alat transportasi utama antara pedalaman dan pesisiran di Pekalongan	

Source: M. Dirhamsyah [20] Puspitasari [18] Sarah at all, 2023 [2]; M. Farras at.all.[4]; E.Suharini [5]; R.Rukayah at.all.[12]; Wikipedia Indonesia [19]

Figure 3. Road development and settlement growth in the early city of Pekalongan (Leiden University Libraries Digital Collections, http://hdl.handle.net/1887.1/item:815172, downloaded and redrawn 7 July 2024)

Theme-2.The Pekalongan Old town Spatial Structure

The Pekalongan area in the 10-12 century AD during the Tsung Dynasty in China became the destination for merchant ships from China sailing from Canton. Pekalongan is already known by the name of *Pu-Kau-Lung* whose people wear patterned cloth clothes like the batik we know today. The ancient manuscript Yitoung Techi suggests that the Chinese may have arrived in Java around the 7th century, including Pou-Kia-Lung (Chinese pronunciation), to establish the name Pekalongan. These traders from China then settled in the area around Sampangan on the banks of the Kupang river which was the base of a trading port.

Upon assuming power in Java, the Dutch East Indies Government identified the Pekalongan area as a key location along the island's northern coastline. This was due to the region's rapid economic growth and its strategic position along the Jalan Raya Pos trade route, which connected Anyer to Panarukan. In response, the VOC government constructed a defensive wall along the Kali Kupang. The development of settlements in the Pekalongan region in the 18th century, coupled with the concomitant economic and political growth, necessitated the regulation of settlement grouping based on ethnicity by the Dutch Colonial Government. This regulation was intended to control population growth and crime. In addition to the indigenous ethnic groups (Javanese and ethnic Chinese), the area also accommodates other foreign ethnic groups, namely Hadramauts/Arabs. [15].

The Dutch government designated the Sampangan area as a Chinese settlement (Chinese Wijk), which included Keplekan Lor (Jalan Sultan Agung) and Keplekan Kidul (Jalan

Hasanudin), in addition to the Kerimunan area (Jalan Salak and Jalan Manggis). Each area was administered by a division head (Afdeeling). At the beginning of its development, the Chinatown area was known as a residential area, which later developed as an economic area. The economic area is characterised by the Sentiling (Banjarsari) market, situated behind the Chinatown area, as well as batik shops developed by ethnic Chinese descendants [20].

Chinatown is situated on the eastern bank of the river, where the course of the river is shaped by the natural contours of the landscape, resulting in a basin-like appearance. This is attributed to the fact that the area in question possesses favourable Feng Shui values. The land use is a mixed function. The area is characterised by a mixture of residential, shop houses and markets. The area of Chinatown is characterised by the presence of buildings dedicated to worship, including a temple and a gate. Additionally, there are residential houses and shop-houses that adhere to the Chinese architectural style, characterised by their distinctive curved roof shape. Furthermore, the area exhibits a unique blend of Chinese architectural elements and the Indische Colonial Tropical style, evident in the architectural design of some buildings. The distinctive block/lot pattern observed in several Indonesian Chinatowns, characterised by narrow plots extending to the rear, can also be identified in the Pekalongan Chinatown area. However, this pattern is only found in the Chinatown area on Jalan Belimbing. The Pekalongan Chinatown area's distinctive pattern can also be observed in the combination of linear and organic patterns. This is a rare occurrence in some other Chinatown locations in Indonesia.

Kampong Arab settlements are distinguished by a number of characteristic features, including the presence of mosques, cemetery complexes, public and social facilities, shops specialising in the sale of items associated with the Islamic faith, such as batik fabrics and prayer items. Additionally, houses in these villages adhere to Islamic architectural principles, incorporating elements of tropical architecture and Indische colonial styles. This is evident in the curved shapes used on walls, door and window openings, and ornaments supporting the canopy or roof. The Kampung Arab settlement in Sugihwaras, Pekalongan, is characterised by an area arrangement with a grid pattern, narrow streets with dead ends (cul-de-sac) in some parts. The pattern of Pekalongan Arab ethnic settlements is influenced by street spatial patterns, the layout of residential houses, mosques, and spatial layouts that are in accordance with Islamic principles, namely *hablumminallah*, *hablumminannas*, and *hablumminal'alamin*.

Kauman, a Javanese ethnic settlement, is predominantly populated by Muslims who adhere to the tenets of *hablumminallah* (worship of God), *hablumminannas* (worship of humanity) and *hablumminal'alamin* (worship of all of creation). Hablumminallah values are reflected in mosques as centres of worship and community activities. The hablumminannas values are evident in environmental and residential patterns that prioritize visual privacy (hijab), and reflect friendliness. The value of hablumminalalamien is reflected in the adaptation of residential houses to the local environment and climate. The strategic position of Kauman village, which is situated in the centre of Pekalongan city to the west of the Alun-alun and behind the Great Al-Jami Pekalongan Mosque, makes Kauman village one of the tourist destinations, namely Batik village tourism. The Alun-alun is a square-shaped public open space situated in the city centre. It is surrounded by a mosque to the west, a palace or regent's house to the south, and markets or shops to the east or north. The Alun-alun is a common feature of city centres on the island of Java.

The area known as Jetayu is historically significant due to its concentration of architectural and cultural heritage sites exemplifying the Indische Tropical Colonial style. The colonial settlement exhibits a concentric arrangement, characterised by an open central space. The road pattern displays both a linear and a grid-like structure, with numerous intersections, reaching a maximum of four or six.

Theme-3. Spatial Patterns and Economic Growth

The spatial pattern of Pekalongan city is shaped by the expansion of economic activities. (1) The initial growth of housing activities at the mouth of the Kupang river was followed by the development of informal trade per household, traditional markets and shop houses in the area around the Kupang river mouth. (2) The growth of the The batik home industry, which encouraged the emergence of Pekalongan branding as "Batik City", was a significant factor in the city's economic growth. The existence of the cemetery of religious leaders (Aulia) and Regent officials also encouraged the emergence of economic activities as a result of pilgrimage activities.

Residential growth was followed by the growth of shop houses around Chinatown

The Chinese ethnic settlements were established in the area designated "Pintoe Dalam", which was subsequently named "Chinese Wijk". This area consisted of the following streets: Jalan Sultan Agung, Jalan Hasanudin, Jalan Salak, Jalan Manggis and Jalan Belimbing. The entrance gate to this district was in the form of an old building belonging to Kapitan Tionghoa, which was located at the T-junction leading to Jalan Belimbing. In the Chinatown area around Jalan Belimbing, there are several historic buildings belonging to ethnic Chinese, including the Pho An Tian Temple and Vihara temple. According to Liem Bwan Tjie (a figure of the first generation of modern Indonesian architects), in 1934, Jalan Belimbing (formerly Juliana Weeg) was home to a luxurious residential building with a swimming pool belonging to a Chinese businessman. Meanwhile, Jalan Salak and Jalan Manggis (formerly known as the Kerimunan area) are residential areas, according to Baliem Subarjo, a prominent figure among the Pekalongan Chinese community. However, they have recently undergone a transformation, becoming primarily commercial hubs characterised by a diverse range of businesses, including offices and warehouses.

The existence of the cemeteries of the Aulia and the Regents encourages the emergence of economic activities as a result of pilgrimage

The cemetery is situated in Sapuro, which is administratively defined as encompassing the hamlets of Sapuro Lor, Buragan, Sapuro Kidul, Sawah Tengah, Brontokan, portions of Jagalan and Kandang Arum. The name Sapuro is derived from that of an influential figure, Tumenggung Raden Yosodipuro, who resided in the area. Historically, the burial area and pilgrimage activities have been of significant importance to the local community and migrants from various regions in the archipelago and abroad. Those buried in the area include religious leaders and regents in Java. The presence of the grave of a prominent Islamic scholar, Al Habib Ahmad bin Abdullah bin Tholib Al Athas (from Hadramaut, South Yemen), has led to a surge in pilgrimage activities, accompanied by a sporadic increase in informal economic activities in the vicinity of the cemetery. These include lodging, shops offering pilgrimage-related products and services, and food and drink stalls [20].

Table 2. Timeline of the Existence of Pilgrimage Activities that Impact Economic Activities

Now	Informal economic activities increased due to pilgrimage activities around the cemetery of the great cleric Al Habib Ahmad bin Abdullah bin Tholib Al Athas.
1980	The Galuh Rantai Mosque changed its name to the Jami' Aulia Mosque, in its development it became a religious tourism destination, near the mosque there is a tomb of a number of Aulia, for example: Habib Ahmad bin Abdullah Al-Attas. The mosque is a testament to the history of Islamic civilisation in Pekalongan.
1950 an	After Indonesia's independence, the Sapuro cemetery developed into the largest cemetery in Pekalongan.
1899	Prince Adipati Aryo Notodirdjo, Regent of Pekalongan passed away, buried in Sapuro.
1854	Sayied Husein bought land in the middle of the forest, currently on Surabaya Street. Van Huyzen's notarisation recorded it as a Muslim place of worship.
1374	The existence of a prominent Islamic scholar, Al Habib Ahmad bin Abdullah bin Tholib Al Athas, was established.
1666	Regent of Pasuruan Rd. Tumenggung Amongnegoro passed away and was buried in Sapuro.
Abad 17 M/1600	The Regent of Ponorogo, Raden Tumenggung Amongrogo died, presumably during the attack on Batavia by the Mataram kingdom (during the reign of Sultan Agung Hanyokrokusumo).
1035 H/ 1614 M	Galuh Rantai Mosque, built on waqf land in the cemetery complex of Sapuro village, Pekalongan sub-district, on the banks of Kali Kupang by Hadramaut (South Yemen) merchants for the purpose of spreading Islam.

Source: M. Dirhamsyah [20] Sarah at all, 2023 [2]; M. Farras at.all.[4]; E.Suharini [5]; R.Rukayah at.all.[12]; Wikipedia Indonesia [19]

The growth of the batik home industry affects the spatial structure of the social class agglomeration of the batik trade business community, which has an impact on home industry tourism activities.

In the mid-18th century, there was a transformation in the batik craft, which was originally intended for personal use, typically by the nobility or royal family. It subsequently began to be produced in large quantities or on an industrial scale and traded in the city of Pekalongan and its surrounding areas. The batik industry in Pekalongan became open and mass-produced thanks to European women named Van Zuylen and B. Fisfher. The batik industry subsequently became a home industry, carried out by indigenous batik craftsmen. This is the origin of the establishment of Batik Village in Pekalongan and its surroundings. The batik home industry then spread to batik production houses in several batik villages in Pekalongan, developing rapidly and making Pekalongan a renowned centre for batik production by 1850. The expansion of batik villages is evidenced by the emergence of new settlements in the vicinity of Pekalongan city, including Kauman, Pesindon, and Sugihwaras, as well as in the rural hinterland, where Pekajangan, Buaran, and Wonopringgo villages have also emerged [22].

Pekalongan's spatial development is significantly influenced by its distinctive urban design and the active involvement of the local community in shaping the city's image. The main road that bisects the city into distinct street corridors serves as a prominent shopping destination, transforming the area into a hub for trade and tourism, both local and international. Additionally, the town has home industry centres and industrial villages that

have evolved into tourist attractions, with the spatial arrangement of houses naturally forming based on the aggregation of social classes within the community. The phenomenon of social class segregation is also discernible in the urban design, whereby merchants construct shops along the main street, while affluent merchants operate their industrial enterprises in three locations that collectively constitute a linear axis linking the southern and northern sections of the city [12]. The development of the Kauman and Pesindon Batik Centres in Pekalongan City has had a considerable impact on the expansion of urban space. These Centres play an important role in fostering creative environments and have a significant impact on the development of creative economies and communities. Furthermore, they have a positive influence on the growth of urban space and the advancement of creative sectors [23].

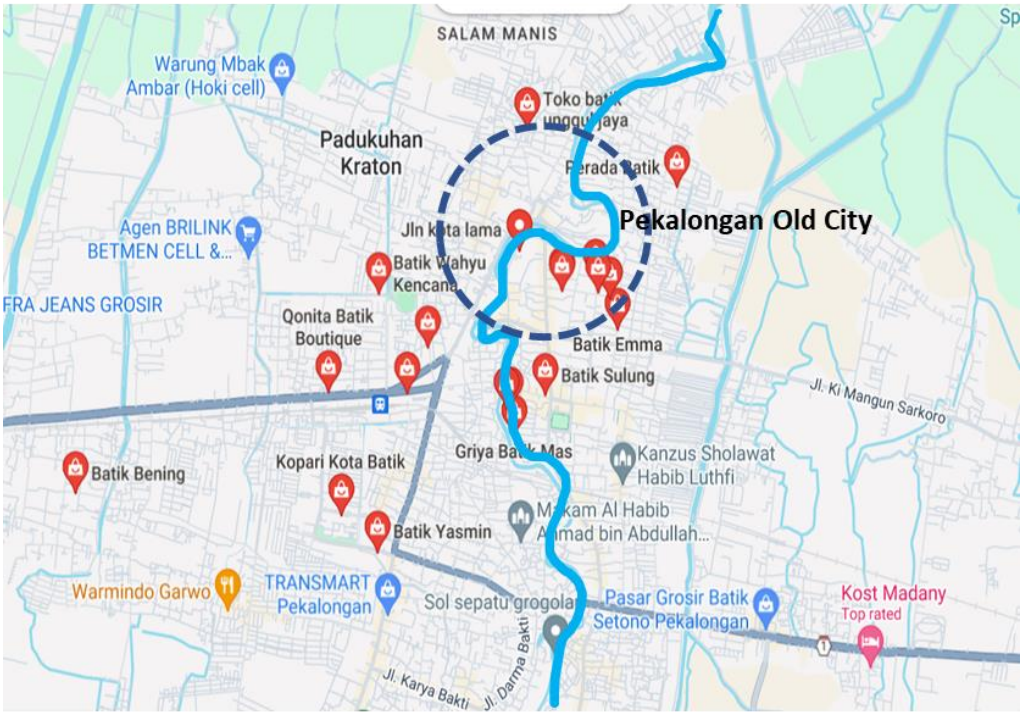


Figure 4. Batik centres around Pekalongan Old town 2024
(Google Earth, 2024)

4.2. Knowledge Transfer of Findings

Knowledge transfer to the Jakarta Old Town (Batavia)

The spatial pattern characteristics of the Old town of Jakarta (Batavia) bear resemblance to those of the Old town of Pekalongan in several respects. The estuarine water area, namely the Ciliwung River, serves as the genesis of the Old town's development. Prior to its incorporation into the Dutch colonial empire, the old town area exhibited a traditional urban layout, with the square serving as the central hub and the river estuary acting as a port for inter-island trading vessels in the archipelago (referred to as Sunda Kelapa Port). The area around the river became a melting pot for the growth of Chinese, Arab and indigenous ethnic settlements (Bugis, Makassar, Maluku, etc.), with a linear spatial pattern along the river whose development went inland. After Batavia was controlled by the VOC, the existing traditional city pattern overlapped with the VOC colonial city pattern (henceforth the government was controlled by the Dutch East Indies government). The construction of the

fort at the river's mouth and the erection of a number of monuments along the coastline marked the initial assertion of the VOC's control over the trade monopoly.

The city's centralized orientation to open space was consistently maintained, with the function of open space as a multipurpose space to bring together public activities and government administration services. The linear residential space pattern along the river (which later became the city's canals) became an element of the old town's grid pattern, with the construction of warehousing buildings and loading and unloading facilities for inter-island and inter-state trade goods. The establishment of the city fort led to the division of the area into an inner and outer city. Residential zoning allocations were organized by ethnic groups in order to facilitate VOC control. The role of the Chinese, Hadramauts and Arabs, as well as East Asian immigrants, who were considered to be more involved in economic activities, was taken into consideration in allocating their residences inside the fort as an elite area with Europeans [24]. Meanwhile, indigenous people's dwellings were placed outside the fort closer to agricultural land and plantations. The Hadramaut ethnicity has played a pivotal role in the dissemination of Islam and has exerted a considerable influence on informal economic activities. The individual who disseminated the tenets of Islam (Al Habib Husein Bin Abubakar bin Alaydrus) during his lifetime became a model for Muslims seeking to comprehend the teachings of Islam. Following the figure's demise, pilgrimage activities have been conducted around his grave, which has had a significant impact on the growth of informal economic activities along the village road leading to the burial complex of Islamic teaching spreaders [25].

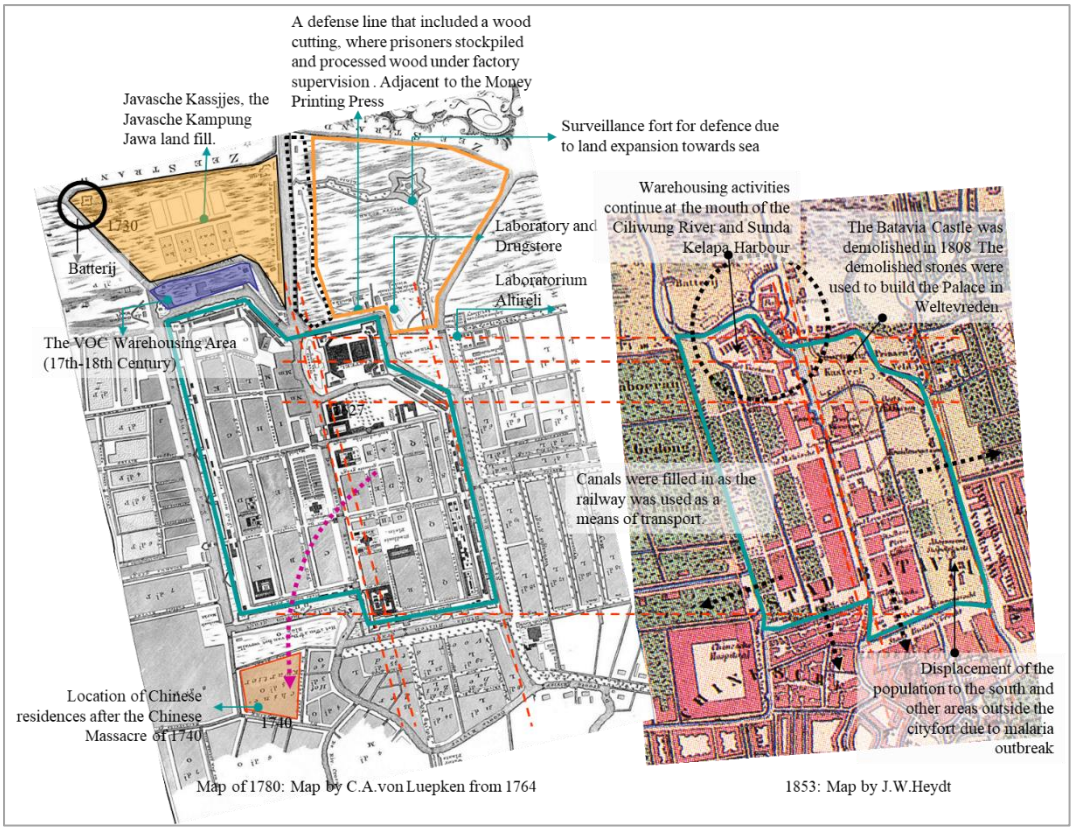


Figure 5. Jakarta Old town (Batavia), 1764 and 1853
(Addition of sketches to CA map as necessary. von Luepkeun 1764, J.W. Heydt, by Puspitasari, 2012)

The structure and spatial pattern of the old town of Batavia underwent significant changes in the aftermath of a cholera epidemic that originated from the swamps to the north of the city. This was accompanied by a decline in the quality of cleanliness of the city canals within the fort and the ethnic Chinese rebellion. The city center was relocated to the south (Weltevreden) as the European elite relocated their residences along the river/road to Weltevreden, subsequently accompanied by the establishment of economic facilities (shops, hotels, warehouses, etc.). Meanwhile, ethnic Chinese residences were relocated to the area outside the southern fort. However, in terms of functional zoning, the city's spatial structure demonstrates social stratification based on the role of ethnic groups in economic activities. In relation to this, European dwellings were situated in close proximity to elite Chinese and Arab dwellings, which were located in proximity to road infrastructure. Indigenous dwellings in the rear layer were situated in proximity to agricultural/plantation land.

Knowledge transfer to the Tangerang Old Town

The growth of the old town of Tangerang began on the banks of the Cisadane River. In 1684, a Boen Tek Bio temple was built in the Old Market Tangerang. This indicates that the Chinese have been living in this area for approximately three centuries. In 1708, a fort was built by the VOC on the Eastern side of the Cisadane River, Tangerang, which was later called "Benteng (Fort) Makasar". In 1740, the Chinese were massacred in Batavia by the Dutch. This incident prompted the issuance of a new regulation, namely Wijkenstelsel, to monitor those residing in the Chinatown (Tjiook, 2017). This was the reason the Chinese ethnic settlements in Tangerang was later designated as the Chinatown by the Dutch. The settlements were constructed in a grid pattern filled with rows of houses known as "plot nine". The Boen Tek Bio Temple is located in the middle of the area with the frontal access facing the river through the main road Cilangkap [27]. Chinese settlements expanded into the hinterland of Tangerang and along the Cisadane river. Until this research was conducted, traditional Chinese houses were still found in the sub-urban areas inhabited by Chinese people who work as farmers and traders [26].

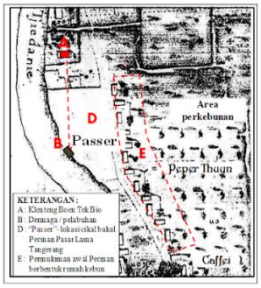
Early phase: Pre-Colonial era	Middle Phase: Colonial Era	Final Phase: Era of Independence – until now
▪ SETTLEMENT PATTERN: linear pattern ▪ URBAN ELEMENTS: A. The Boen Tek Bio Temple is a small house or hut made of bamboo and then renovated in 1772 so that its shape reflects the original Chinese building style (Dewi,P dkk., 2000). B. Pier on the side of the Cisadane river D. "Passer" - the forerunner location of Tangerang's Old Market Chinatown, is still an open space E. The residence is in the form of a single house	• URBAN ELEMENTS: grid pattern • URBAN ELEMENTS:: A. Boen Tek Bio Temple was renovated in 1844 B. Latrine Stair Pier C. Ronggeng Stairs Pier D. Traditional markets are located in street/alley corridors E. Settlements become one-two-story row houses with various styles (Chinese style, acculturation style and colonial style) and a grid-shaped area pattern.	• SETTLEMENT PATTERN: grid pattern • URBAN ELEMENTS : A. The Boen Tek Bio Temple is a place of worship, a social forum for the Boen Tek Bio association, a place for education, and is now a cultural tourism destination. B. The Tangga Ronggeng pier is extinct, the Tangga Jamban pier survives and has been revitalized as a waterfront tourist spot and traditional Pehcun ceremonies. C. Traditional markets are located along the roads/alleys on Jalan Bakti Stock, Cilame and Ki Samaun. D. Some shophouses have changed function and some have survived and been restored, such as the Benteng Heritage Museum and Roemboer owned by Mr. Udaya Halim
		

Figure 6. Tangerang Old town
(Addition of sketches to original map as necessary, by Lucia Helly, 2024)

4.3. Conceptual Model

The following conceptual model can be constructed on the basis of the findings of the study, entitled The Influence of Economic Growth on the Spatial Pattern of Old Towns in Java, which was conducted in the context of Old Towns in Pekalongan, Batavia and Tangerang. In order to develop this model, it is necessary to consider inputs from a variety of sources, including previous research results.

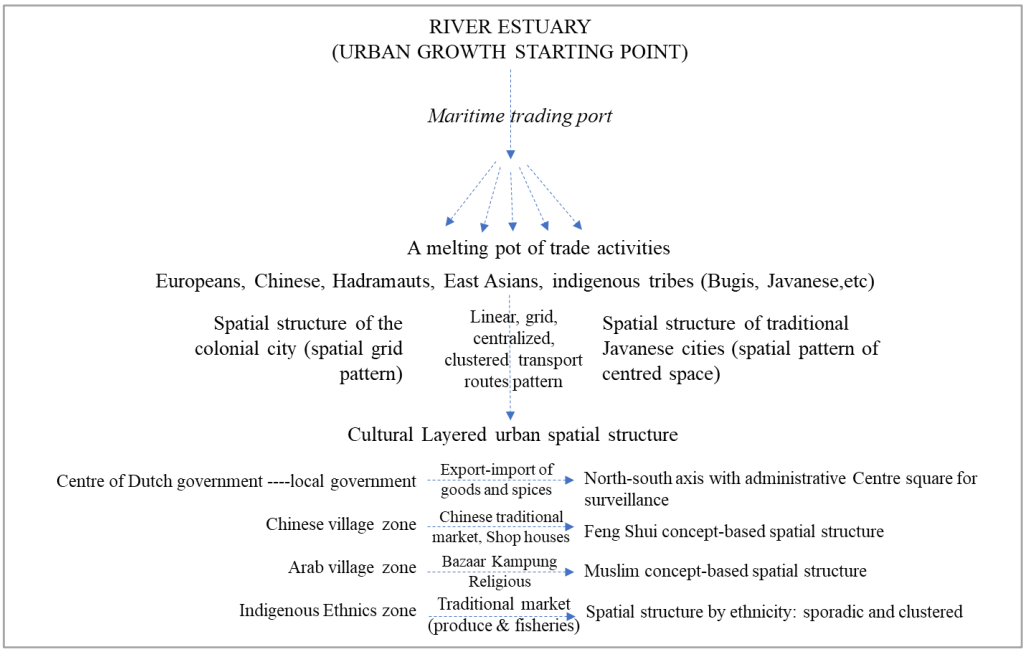


Figure 7. Conceptual Model : The Influence of Economic Growth on the Spatial Pattern of Old Towns in Java
(Puspitasari, 2024)

5. CONCLUSION

The spatial pattern of the old town is closely related to economic growth. The growth of economic activity followed the pattern of mobility infrastructure between centers for loading and unloading inter-city and country trade goods, crop production and consumption, and settlements. This formed a linear pattern with respect to rivers, canals or roads. With three cases (Pekalongan, Batavia and Tangerang), the spatial elements that persistently carry over to the spatial structure of old towns in Java are: 1) The strategic river estuary became the center of the old town's growth, followed by the growth of economic and residential activities along the river's path into the mainland. 2) The river estuary became a melting pot of various ethnicities, which then developed residential and trading activities around it. 3) The impact of VOC regulations related to the control of ethnic groups when colonizing resulted in the spatial structure of the city consisting of ethnicity zoning with the city and the city's spatial grid pattern. The center was occupied by inter-island trade activities in the archipelago and between countries. 4) Zoning of spatial functions related to social stratification, with Europeans, Chinese, Arabs and East Asians situated in the central zone of trade administration and government management, indigenous people in the area around agricultural land and plantations for crop production.

REFERENCES

[1] A. Ramadhani Maharlika, S. Prawata Hadi, Kismartini, and A. Lenty Hoya, "Tidal flooding and coastal adaptation responses in Pekalongan City," *E3S Web Conf.*, vol. 202, pp. 1–8, 2020, doi: 10.1051/e3sconf/202020206027.

[2] D. Sarah, E. Soebowo, Y. Sudrajat, N. A. Satriyo, M. H. Z. Putra, and Wahyudin, "Mapping the environmental impacts from land subsidence hazard in Pekalongan City and its correlation with the subsurface condition," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 1201, no. 1, 2023, doi: 10.1088/1755-1315/1201/1/012044.

[3] W. L. Hakim, M. F. Fadhillah, K. J. Lee, S. J. Lee, S. H. Chae, and C. W. Lee, "Land Subsidence and Groundwater Storage Assessment Using ICOPS, GRACE, and Susceptibility Mapping in Pekalongan, Indonesia," *IEEE Trans. Geosci. Remote Sens.*, vol. 61, pp. 1–25, 2023, doi: 10.1109/TGRS.2023.3324043.

[4] M. F. Ayasy, M. Helmi, M. Zainuri, K. Kunarso, and B. Rochaddi, "The Impact and Prediction of Shoreline Dynamics in Pekalongan, Indonesia," *Bul. Oseanografi Mar.*, vol. 12, no. 3, pp. 433–446, 2023, doi: 10.14710/buloma.v12i3.51455.

[5] E. Suharini, F. Hanafi, and W. Akhsin Budi Nur Sidiq, "Study of Population Growth and Land Use Change Impact of Intrusion on Pekalongan City," vol. 79, no. Icge 2016, pp. 232–238, 2017, doi: 10.2991/icge-16.2017.46.

[6] A. T. Priyanto, "The Impact of Human Activities on Coastal Zones and Strategies Towards Sustainable Development: A Case Study in Pekalongan, Indonesia," *ITC MSc Thesis*, p. 99, 2010.

[7] R. Harini, B. Susilo, T. Sarastika, S. Supriyati, M. C. Satriagasa, and R. D. Ariani, "The Survival Strategy of Households Affected by Tidal Floods: The Cases of Two Villages in the Pekalongan Coastal Area," *Forum Geogr.*, vol. 31, no. 1, pp. 163–175, 2017, doi: 10.23917/forgeo.v31i1.4259.

[8] S. A. Habibi, A. D. Pribadi, and J. E. Sitorus, "The Concept Design for Adaptation of Climate Change Through Integrated and Sustainable Flood Infrastructure in the Coastal Area of Pekalongan, Indonesia," *Geogr. Pannonica*, vol. 25, no. 2, pp. 121–135, 2021, doi: 10.5937/gp25-30852.

[9] M. Khairulbahri, "The qualitative analysis of the nexus dynamics in the Pekalongan coastal area, Indonesia," *Sci. Rep.*, vol. 12, no. 1, pp. 1–16, 2022, doi: 10.1038/s41598-022-15683-9.

[10] E. D. Astuty, "Conditions and the existence of cluster development business batik Pekalongan City, Central Java, Indonesia," *Eur. J. Bus. Manag.*, vol. 6, no. 12, pp. 1–9, 2014, [Online]. Available: http://iiste.org/Journals/index.php/EJBM/article/view/12502/12818

[11] A. Savirani, "Business and politics in provincial Indonesia: The batik and construction sector in Pekalongan, Central Java," p. 89, 2015, [Online]. Available: https://dare.uva.nl/search?identifier=f4a33876-ab86-4237-8827-aa3caa78efa0

[12] R. S. Rukayah, A. A. Wibowo, and S. H. Wahyuningrum, "Public Participation in Branding Road Corridor as Shopping Window or Batik Industry at Pekalongan," *Procedia - Soc. Behav. Sci.*, vol. 168, pp. 76–86, 2015, doi: 10.1016/j.sbspro.2014.10.212.

[13] K. Ismanto and A. Rofiq, "The Contribution of Culinary on Halal Tourism: Case Study of Pekalongan City, Central Java, Indonesia," *J. Penelit.*, vol. 14, pp. 65–80, 2022, [Online]. Available: https://e-journal.uingusdur.ac.id/Penelitian/article/view/1423%0Ahttps://e-journal.uingusdur.ac.id/Penelitian/article/download/1423/869

[14] P. Puspitasari, S. A. Djunaedi, and H. S. A. Putra, *Ritual and Space Structure: Pilgrimage and Space Use in Historical Urban Kampung Context of Luar Batang (Jakarta, Indonesia)*, vol. 36, no. June 2011. 2012. doi: 10.1016/j.sbspro.2012.03.039.

[15] E. P. Hendro and S. R. Sari, "Preserving Conservation Area as a Cultural Basis in The Planning of The City of Pekalongan," *Tataloka*, vol. 20, no. 4, pp. 384–398, 2018.

[16] N. Junara, S. Triyadi, and B. S. Budi, "Comparative Studies in Religious Spatial Physical Characteristics in Kampung Kauman Malang, Surakarta, and Pekalongan," *J. Islam. Archit.*, vol. 5, no. 3, pp. 145–150, 2019, doi: 10.18860/jia.v5i3.4384.

[17] A. S. D. Sharietta and M. G. Gunagama, "Pattern and Integration of Ethnicity Settlements in Pekalongan City's Old Town Area," in *Sakapari 7*, 2020.

[18] P. Puspitasari and S. Handjajanti, "Precedent Studies and Visual Architecture : In Search of Theoretical Concept of Chinese Facade Style (Case: Kampung Cina, Pekalongan, Central Java, Indonesia)," in *Applying Local Knowledge For Livable Space*, Jakarta: Jurusan Arsitektur, Universitas Trisakti, 2016, pp. 156–162. [Online]. Available: http://puslit.

[19] W. Indonesia, "Kota Pekalongan." Accessed: Jul. 03, 2024. [Online]. Available: https://id.wikipedia.org/wiki/Kota_Pekalongan

[20] M. Dirhamsyah, *Pekalongan Yang (Tak) Terlupakan*, 1st ed. Kota Pekalongan: Kantor Perpustakaan dan Arsip Daerah Kota Pekalongan, 2014.

[21] J. Widodo, *The Boat and the City: Chinese Diaspora and the Architecture of Southeast Asian Coastal*

Cities. Singapore: Marshall Cavendish Intl., 2004.

[22] A. Fitriyasih, "Kampung Batik Kauman Pekalongan: Dari Industri Rumahan Hingga Kampung Wisata Batik Tahun 1870-2016," Unıversıtas Islam Negerı Raden Mas Saıd Surakarta, 2023.

[23] R. Andriani, W. Astuti, and R. A. Putri, "Peran Sentra Batik Kauman Dan Pesindon Untuk Mencapai Kota Pekalongan Sebagai Kota Kreatif Kerajinan," *Desa-Kota*, vol. 2, no. 2, p. 203, 2020, doi: 10.20961/desa-kota.v2i2.31540.203-216.

[24] P. Puspitasari, A. Djunaedi, and H. Shri Ahimsa Putra, "Morphologycal Changes and Cultural Persistence in a Religious-Historic Urban Kampung: Luar Batang, Jakarta,Indonesia," 2012.

[25] P. Puspitasari and A. Djunaedi, "Kontroversi Eksistensi Kearifan Lokal dan Iklim Investasi di Kampung Bersejarah (Kasus : Kampung Luar Batang-Jakarta)," Popi Puspitasari. [Online]. Available: http://www.depsos.go.id/modules.php?name=News&

[26] P. Puspitasari, "Manifestasi Nilai-nilai Tradisional Pada Rumah Cina Sub Urban, Kasus: Curug and Legok, Kabupaten Tangerang (The Manifestation of Traditional Values on Sub Urban Chinese House, Case: Curug and Legok, Tangerang District)," 2018.

[27] Purwaningsih, L.H. Arifin, L.S. and Fauzy, B. (2022) The Character of Tangerang's Chinatown, Indonesia, ISVS e-journal, Vol. 9 (1), pp. 47-61

CHAPTER 7

Law and Social Development: A Study in Jakarta's Regional Government Regulation Related to Social Aid for The Elderly

Natasya Yunita Sugıastutı
Departement of Law, Faculty of Law, Universitas Trisakti, Jakarta, Indonesia
natasya.yunitasugiastuti@trisakti.ac.id
Orcid:0000-0002-1528-6684

Ari Wahyudi Hertanto
Faculty of Law, Universitas Indonesia, Depok, Indonesia
Orcid: 0009-0007-1726-9507

Benedetto Setyo Satrio Utomo
Faculty of Law, Universitas Indonesia, Depok, Indonesia
Orcid: 0009-0007-6563-6930

I Gede Yudi Arsawan
Departemen of Law, Faculty of Law, Universitas Trisakti, Jakarta, Indonesia

Agung Wijaya
Departemen of Law, Faculty of Law, Universitas Trisakti, Jakarta, Indonesia

Ghayana Aditya Putra
Departemen of Law, Faculty of Law, Universitas Trisakti, Jakarta, Indonesia

Maria Angelica Araujo Fernandes
Faculty of Law, The Hague University, 2501 EH The Hague, Netherlands
Orcid: 0009-0007-6563-6930

ABSTRACT

The population of Jakarta in the second semester of 2023 reached 11,337,563 people with the number of elderly reaching 1,083,720 people. Although the elderly data does not mention the profile of how large the number of poor elderly people in Jakarta is, the Jakarta Provincial Government always strives for the welfare of poor elderly people. Thus, Governor Regulation of the Special Capital Region of Jakarta Number 100 of 2019 concerning Provision of Social Aid to Fulfil Basic Needs for the Elderly which was passed in Jakarta on September 23, 2019 is a legal instrument formed and enforced in order to provide social aid services for poor elderly people. The Governor's Regulation above does not have a pre-dogmatic understanding of the preparation of a dogma, especially when interpreting the true meaning of the elderly and in the formation of regulations. Moreover, if we consider that Indonesia is a country that adheres to the Civil Law tradition. The study is normative, using secondary legal documents, qualitative analysis, and inductive findings. The results reveal that the Governor concerning Provision of Social Aid to Fulfil Basic Needs for the Elderly have not yet offered stability, and fairness nor able to reflect on how the elderly should be regulated in a government policy. Consequently, it is necessary to criticize the formation of regulations in the future so that there is no wrong mindset in a regulation that specifically regulates humans.

Keywords: Law and social development, Poor elderly, Jakarta, Indonesia.

1. INTRODUCTION

Humans as legal subjects (rechtsubject), have been the subject and object of many studies in the field of legal science, either autonomously or included in interdisciplinary studies. At the philosophical level, the discovery of humans as legal subjects is considered a fundamental aspect in the history of modernity (Zarka, 2008). In the same context, (Rosenfold 2010: 18-19) more specifically questions, who exactly is the subject of a constitution, whether the the makers of the constitution, those who are regulated and bound by the constitution (those subjected to it), or anyone who is regulated by the constitution (its subject-matter). Why is this so? Because the subjects regulated in the constitution will later be regulated in legislation products that are derived from it. The variety of discussion of humans as legal subjects is also seen when placing humans as living beings who have legal rights and freedoms since being born into the world, along with the burden of responsibility carried before the law which will distinguish them from other legal subjects other than humans, such as inanimate objects or animals (Dunbar-Brunton, 1979: 76).

Indonesia is a state based on law. This fact is in line with the content of the 1945 Constitution ("UUD 1945") in Article 1 paragraph (3) which states, the State of Indonesia is a state based on law. The state based on law (*rechtstaat*) is the antithesis of the state based on power (*Machtstaat*). When the law is held in such a high position, it is worth criticizing the competence of the lawmakers of legal norms in Indonesia when drafting regulations on humans. Concerns arise due to a mistake in comprehension upon the object regulated in the policy, namely the elderly, so it is necessary to criticize how the concept of the elderly is actually regulated in positive legal instruments in Indonesia. The aspect that will be the focus of analysis is how the lawmakers in Indonesia comprehend the ontology and concept of the elderly in Indonesia, namely in order to reach the reality of the daily lives of the elderly.

In order to understand how the elderly are placed as legal subjects in Indonesia's positive legal repertoire, a critique of the concept of elderly Nuriman et al (2018) was carried out. Initial observations found that the concept of what the elderly are as legal subjects is not described in detail in the text of the 1945 Constitution. The absence of terminology or text of the elderly in the text of the 1945 Constitution on the one hand can be understood because the constitution regulates everything in general. Simply by mentioning humans or people, the meaning of the text also includes the elderly. However, this is not the case when it comes to the establishment of government policies at the implementation level. The lack of academic texts and studies on the elderly can have serious consequences, especially when the subject being regulated is human.

The Indonesian people are firmly guided by the statement, "Then to form an Indonesian state government that protects the entire Indonesian nation and the entire Indonesian blood sphere and to promote general welfare, educate the nation's life, and participate in implementing world order based on independence, eternal peace and social justice." This excerpt from the "preamble of the 1945 Constitution" is the essence of the purpose of the Republic of Indonesia. The very substance of the sentence reflects Indonesia as a country that is fully oriented in caring for all its citizens without discrimination. Indonesia currently has Law No.13 of 1998 on the Welfare of the Elderly ("Law No.13/1998") which contains the technical and operationalization of the elderly in national positive law. However, it is still necessary to scientifically criticize the operational text of the Elderly as a result of the

formation of norms about the elderly. The primary assumption is that any regulatory material that contains welfare certainly contains ideal norms.

Indonesia is an archipelago divided into 38 provinces. According to Worldometer, Indonesia's population is estimated to reach 279,798,049 on July 2, 2024. Jakarta as the capital city of the country is the most densely populated area compared to the availability of space. The total population of Jakarta in the second semester of 2023 reached 11,337,563 people with the number of elderly reaching 1,083,720 people. Although the elderly data does not mention the profile of how much the number of poor elderly in Jakarta is, the DKI Jakarta Provincial Government always strives for the welfare of poor elderly. Thus, the Governor Regulation of the Special Capital Region of Jakarta Province Number 100 of 2019 concerning Provision of Social Aid to Fulfill Basic Needs for the Elderly which was passed in Jakarta on September 23, 2019 ("Pergub 100/2019") is a legal instrument that was formed and enforced in order to provide social aid services for poor elderly. The Governor Regulation above lacks a pre-dogmatic understanding in the formulation of a dogma, especially when interpreting the actual meaning of elderly and in the formation of regulations. Especially when considering that Indonesia is a country that adheres to the Civil Law tradition.

Criticism of the Elderly human text in legal products in Indonesia is not just limited to the concepts of interpretation that have been running and are very positivistic, such as by means of grammatical and systematic interpretation. However, it goes further than that, where the Elderly text will be uncovered layers of meaning and seen the reality of its current legal products. One of the problems with texts is that they have a long lifespan. Regarding the distance and time of the text's existence, B. Arief Sidharta argues that the problem is also experienced by the juristic text (law) Sidharta (39: 2003). This shows that the formation of juristic texts is within the framework of the horizon of the law-former in relation to social realities that are deemed to require legal regulation with reference to the legal ideals adopted in society, as emphasized in Gadamer's hermeneutic view. Rachmani (138: 2009).

Having presented some ideas as an introduction in the previous section, it is indisputable that humans (Roestandi et al 1986) are the most important element in a state organization. It is also humans who contribute to the growth and development and even the collapse of a state. Notes on humans as subjects who form the state at the conceptual level in the 1945 Constitution are also explored for further analysis, with particular emphasis on how Pergub 100/2019 is able to translate the welfare of the elderly in relation to the enactment of Law No.13/1998. Moreover, a critique will be conducted on the regulation of elderly people in Pergub 100/2019 with regard to the fundamental rights of the elderly.

2. LITERATURE REVIEW

2.1. Human Concept in the 1945 Constitution

Human concepts in the (Indonesian) constitution have different degrees of existence (Zuchron 2017: 8). In its understanding, the difference is intended so that we can distinguish between the concept of human as a subject and the arrangement of objects in the constitution. Other differences that appear are in terms of number, namely quantity, and quality, namely some vocabulary that refers to Indonesian society are people Article 1 paragraph (2); citizen Article 26 paragraph (1); resident Article 26 paragraph (2); person Article 28A; human Chapter XA; community Article 28J; nation in the Preamble of the 1945 Constitution; and

human kind Article 31 paragraph (5) (Zuchron 2017: 29). In his critical research, Daniel explicitly puts forward the idea of human in the constitution as a concept. The understanding of human as a concept that he offers, which in this context he agrees with Miriam Budiardjo's ideas, seeks to lead his readers' comprehension to become more profound on the matter of why the 1945 Constitution generally only comprises fundamental rules.

Interpretation of human concept will not be found in the constitution. This situation will become a philosophical problem, when there is a misconception that arises as a form of failure to understand or someone's mistake in interpreting terms/words/terminology in the constitution. Until it can be imagined, how the impact occurs on the products of legislation that are passed. Do not in the end, the interpretation of elderly welfare will only be limited to the provision of limited rights in the form of material benefits.

The concept of humans as legal subjects in Indonesian legal products needs to be criticized theoretically, whether the concept has represented every phase (life) passed by humans and whether the actualized concept is in accordance with the needs of the times. Exploring the understanding of the right philosophical analysis of the rationale in the preparation of legal products in Indonesia through a legal theory approach is important, especially to find out about how legal products in Indonesia have positioned humans (Elderly) as a whole. Especially in the role and contribution given by the state to its citizens. This statement is in line with Simorangkir's opinion (205: 1984), which is as follows:

Indeed, to investigate the constitutional law (droit constitutionelle) of a country, it is not enough to investigate the articles of the Constitution (loi constitutionelle) alone, ...but must also investigate how the practice and the inner atmosphere (geistlichen Hintergrund) of the Constitution. The Constitution of any country cannot be understood if only the text is read. In order to understand what the Constitution of a State really means, we must also study how the text came into being, the details of the text, and the atmosphere in which the text was drafted.

The limitations and narrow nature of the critical thinking competence of the authors of legal products in understanding the ideas of the makers of the constitution in the Indonesian constitution is very fundamental. Due to such poor understanding of the concept of the elderly, either due to simplification or misinterpretation, which will have a real impact on the legal products issued by the government, therefore it is necessary to have a well- targeted approach to the knowledge of the ideal concept of the elderly, which is based on the results of a critical analysis of the text of the constitution and legal products that exist and apply in Indonesia.

2.2. Fusion of Horizons and Critical Hermeneutic

In the discussion of legal theory, the author has a different way of using the hermeneutic approach. Hermeneutics in this paper will be used only by emphasizing the theme of the discussion and the center is not on the scholar. The meaning of this sentence is that if our focus is on discussing a scholar, then the logical consequence is that we must discuss the entire thought of the scholar we are discussing. That will not happen in this research. Because Gadamer will only be borrowed his theoretical instrument on the fusion of horizons (Gadamer 2004: 367) and for Habermas only be borrowed his hermeneutic instrument of criticism in the formation of a legal norm (Rehg 1998: 971). This paper is a legal theory research that essentially intersects with legal philosophy and legal dogmatics. But it cannot be equated as

ansigh research on legal philosophy or legal dogmatics. The theme is emphasized as the basis for comprehending the overall topic of the study. The study carried out is a critical study, where the hallmark of a theoretical study is in the form of a critical effort. This is then used as a basis, that the critical hermeneutic in this research is a reflection of critical studies, which are used in conducting theoretical studies.

With Gadamer's theory, an interpretation will be made of how the definition of the elderly text is understood in its regulation in Pergub 100/2019. Whether the text of the Elderly according to Pergub 100/2019 has the thickness of understanding when drawn to the 1945 Constitution and Law No.13/1998. The use of Gadamer's theory is also because he has a special concern for history. The awareness of the influence of history is shown by Gadamer through the concept of "Horizontverschmelzung" or "the fusion of horizons. Hardiman (180: 2015) Elderly, must be considered especially in relation to legal texts and between legal texts.

The use of the concept of fusion of horizons in analyzing and criticizing the constitution and its derivative legal products is not just talking about legal certainty, but the essence is how the legislator fully understands the meaning of human nature. By using analysis with the concept of fusion of horizons, it seeks to contribute knowledge in the field of law so that conceptual and epistemological discussions occur about how to conceptualize the ideal elderly and how the results of this conceptualization can be used practically by stakeholders in formulating various legal products in Indonesia.

2.3. Social Aid in the Indonesian Legal Framework

Social aid is given to people who experience social risks. Social aid can be distributed in the form of money or goods. In general, the legal basis for social aid is regulated in Law No.14 of 2019 concerning Social Workers which amends Law No.11 of 2009 concerning Social Welfare. The provisions on social aid are then followed up by Presidential Regulation No.63 of 2017 concerning Non-Cash Distribution of Social Aid ("Perpres No.63/2017"). In Article 1 paragraph (1) of Perpres No.63/2017, it is stated:

"Social aid is support in the form of money, goods, or services to a person, family, group or community that is poor, incapable, and/or vulnerable to social risks."

While the definition given to social risk is as stipulated in Article 1 paragraph (2) which states as follows:

"Social Risk is an event or event that can lead to the potential for social vulnerability borne by a person, family, group, and/or community as a result of social crises, economic crises, political crises, natural phenomena, and disasters that if not provided with social aid will be worse off and unable to live in reasonable conditions."

The management of social aid is regulated in the Regulation of the Minister of Home Affairs of the Republic of Indonesia (Permendagri) Number 77 of 2020. This regulation revokes Permendagri Number 99 of 2019 concerning the Fifth Amendment to Regulation of the Minister of Home Affairs Number 32 of 2011 concerning Guidelines for Granting Grants and Social Aid sourced from the Regional Revenue and Expenditure Budget. Based on

Permendagri Number 77 of 2020, social assistance providers are work units in ministries or agencies in the central government and/or regional work units in regional governments whose duties and functions are to implement poverty reduction programs which include social protection, social security, social empowerment, social rehabilitation, and primary services.

2.4. Pergub 100/2019

Pergub 100/2019, one of whose objectives is to help alleviate poverty for poor elderly residents who live in Jakarta. Article 3 of Pergub 100/2019 stipulates the following: The provision of PKD social aid for the elderly aims to:

a. prevent the elderly from the risk of social shocks and vulnerabilities so that their survival is fulfilled;
b. supporting the elderly to be able to fulfill their primary needs and access basic services reasonably in accordance with the provisions;
c. improving the welfare of the elderly; and
d. realizing a higher quality of life for the elderly, fair, physically and mentally prosperous, independent and dignified.

The implementation of this Pergub needs to be examined in more depth, especially in relation to Law No.13/1998. Why does the Jakarta Government have the initiative to issue a special regulation on the Elderly in the context of social aid distribution. How is the realization or implementation of social aid distribution as stipulated in Pergub 100/2019? The Jakarta Government uses the method of providing automated teller machine - ATM cards to the elderly who have been recorded in the Village database system. The bank that manages PKD social aid funds for the elderly is PT Bank DKI. The process of distributing ATM cards is still being carried out so that there is an even distribution to all poor elderly residents who live in the Jakarta area.

3. RESEARCH METHOD

The elderly are not part of the trending topics in the dynamics of legal discussions in Indonesia. This situation is inversely opposite to the field of economic law. In fact, reflection and understanding of the concept of defining humans in the 1945 Constitution must be carefully conceived. It is important to remember that when a policy regulates humans, especially human rights, the mindset that must be understood by policy makers is that humans are not used as objects of norms. Humans must still be positioned as subjects. Why is this important, none other than because it then rolls on how policy makers interpret the concept and text of the definition of human (Elderly) which is regulated in the constitution and Law No.13/1998. According to Prof. Bambang Sugiharto, in law interpretation is a critical concern, hermeneutics becomes more relevant, especially when our focus is not only on the ideal of 'certainty', but especially on 'justice' and 'usefulness' of the law. Hermeneutics is important in law primarily because ultimately the legal world is a field of human destiny. This means that it is not just a matter of what the law 'means' but also what the law 'does'. That is why for the field of law, hermeneutics is not only relevant as a 'method' for interpretation, but especially as a more fundamental and further reflection on what it means to 'interpret', what

the furthest risks are, and what factors need to be taken into account. The problems that constitute the critique are:

1. How is the critical understanding of the lawmakers of Pergub 100/2019 in comprehending the elderly as legal subjects theoretically?
2. How is Pergub 100/2019 able to reflect Law No.13/1998 and the 1945 Constitution as a whole in its articles?

Henceforth, the reasons why the Hermeneutics of Hans-Georg Gadamer and Habermas are used in this study:

3.1. Relevance of Hermeneutics to Interpretation in Law

Hermeneutics is used to explore the understanding of the concept (text) of humans (elderly) as defined in the 1945 Constitution, Law No.13/1998 and Pergub 100/2019. With hermeneutic theory, the reality of the elderly text in the future is expected to not be narrowly interpreted, which is solely limited to the concept of being a citizen. Instead, the presence of hermeneutics seeks to criticize if there is an imperfection of understanding. Therefore, interpretation of the legal text is needed.

Interpretation of elderly texts in law is not solely based on the norms in positive law. The aim is to identify and apprehend the main ideas about human beings in the legal texts to be reflected upon and critiqued. The notion of theory here is not only to designate a methodological exposition of the rules that guide the interpretation of texts. However, the term theory also refers to philosophy in a broader sense because it includes the task of analyzing all fundamental phenomena in the process of interpretation or human understanding (Susanto 2010: 113). The concept that is then formulated in a legal formulation is a form of communication between the lawmakers and the legal objectives to be achieved. This means that legal formulation is a language. As a language, then a legal formulation is the object of hermeneutics. Sumaryo 1999: 28.

3.2. A Critical Approach to the Interpretation of Legal Texts

One of the main tasks of a jurist is to conduct legal theoretical studies. In legal theory, the scope of legal theoretical studies includes the fields of juridical analysis, the teaching of legal methods, legal dogmatics and ideological criticism of law (Manullang 2007: 17). In the repertoire of research in the field of legal science, scholars have known that Critical Legal Studies (CLS) conducts similar criticism. At the same time, Habermas also did the same thing. In summary, this research does not address ideology per se as in CLS (because it does not depart from the problems of liberalism) and neither does Habermas (because it does not address the epistemology of knowledge). The researcher's critique emphasizes more on concepts, especially on what the concept of human is.

Critical hermeneutics is motivated by the critical theory promoted by the Frankfurt school which is basically a reaction to the problems after the modern era. Critical hermeneutics is used as part of an effort to build bridges from the tense atmosphere that arises. Habermas can show the misunderstanding of logical positivism which thinks it can unite the sciences under one methodology. (Rachmani: 50). CLS views law as a phenomenon that is not universal but is very much related to what happens in society, or people's understanding of the law. Therefore, the phenomena that occur in Indonesia cannot be homogenized with a universal

concept of legal subjects. CLS serves to critically explain this. CLS cannot be separated from the strong influence of Marx. Including the teaching of ideology as a dogma. At this point Habermas does not per se view ideology as a dogma, but he views ideology as something that must be questioned. Ideology here emphasizes ideas. While the idea to be criticized here is the elderly.

Habermas introduced the term critical hermeneutics, which was taken from philosophers who were members of the Frankfurt school. Habermas is one of its members. The scholars and thinkers who are members of the Frankfurt school are Marxian groups, but they take a position to ask (critical) but not to believe in Marx's concept. Marx's thoughts were taken by them (Habermas) to be questioned, hence the term critical hermeneutics. Indeed, no claim has ever emerged from Habermas that what he did was a critical interpretation. However, Hardiman, Manullang and Rachmani in their writings concluded that Habermas worked to interpret in criticism. Here are Habermas' main thoughts in distinguishing between ordinary and critical hermeneutics, namely:

Table 1. Ordinary and critical hermeneutics

Ordinary Hermeneutics	**Critical Hermeneutics**
Reproduce the meaning intended by the author of the text	Liberating the author of the text from systematically orchestrated communication
Aims for the reader to understand the text	Aims for the author to understand the text he/she is writing himself/herself

Source Budi Hardiman : 224

Habermas in positioning hermeneutics as an attempt to restore critical theory that encounters a deadlock (Rachmani: 53). According to him, the human sciences will be prevented from communication congestion. Hermeneutics positions itself in two important dimensions. First, to avoid communication bottlenecks in the individual's own life history and the social tradition in which the individual lives. The second is to bridge between different traditions of individuals, groups, and cultures. According to Habermas, this function is very important to maintain the survival of an individual and society. In the extreme, if there is a disruption of communication and interaction, it will trigger violence and destruction (Rachmani: 55). Rachmani emphasized that hermeneutics is a concept that concerns language, action and experience, which are closely related to each other and cannot be separated.

What kind of critical interpretation will be built in this thesis is by means of using dialectical patterns and intertextuality. The intertextuality intended here is to find a common thread about the concept of the text of the elderly human Pergub 100/2019 with the 1945 Constitution and Law No.13/1998 in the interdependence of one text with the previous text, in the form of intersections, both formed in the form of quotations and expressions, where one with the other contents and complements each other. This correlation thread will be explored.

4. RESULT AND DISCUSSION

Ismail Saleh, in his writing "Faham Negara Hukum Yang Dianut di Indonesia, which is published in the book Mengenang Padmo Wahyono," states that building a complete Indonesian human being, namely not only building his physical welfare but simultaneously building his intellectual welfare in harmony, harmony and balance, the national legal system must also depart from this principle. The problem now is the harmony, compatibility and balance of what is to be applied in the National Legal System. The sentences in the 1945 Constitution, if not interpreted, will have no value and are just a series of words. There needs to be a commitment from lawmakers to realize that they are the pen of the ruler who will determine the fate of the Indonesian people and nation through their legal products.

The Indonesian public understands that the second highest hierarchy is the law after the 1945 Constitution. The law in this case regulates general matters and is used as a dogma and main principle for regulations that are hierarchically lower in position, so it has a significant aspect in determining the direction of policy. In the technical order, Government Regulations (PP) are considered as an interpretation of the law, while in the implementation of policies that are then translated into Ministerial Regulations. Therefore, effective regulatory arrangements must be at the level of the Law or at least PP (Lukito, 2017). The hierarchy and order of laws and regulations in Indonesia are pointed to the following laws and regulations:

Table 2. Hierarchy/order of laws and regulations

Tap MPRS No. XX/MPRS/1966	**Tap MPR No. III/MPR/2000**	**Law No. 10/2004**	**Law No.11/2011**	**Law No.12/2011**
1945 Constitution	1945 Constitution	1945 Constitution	1945 Constitution	1945 Constitution
MPR(S) Decree	Decree of the People's Consultative Assembly of the Republic of Indonesia		Decree of the People's Consultative Assembly of the Republic of Indonesia	Decree of the People's Consultative Assembly of the Republic of Indonesia
Law / Government Regulation in Lieu of Law	Law	Law / Government Regulation in Lieu of Law	Law / Government Regulation in Lieu of Law	Law / Government Regulation in Lieu of Law
	Government Regulation in Lieu of Law (Perpu)		Government Regulation in Lieu of Law (Perpu)	
Government Regulation	Government Regulation	Government Regulation	Government Regulation	Government Regulation
Presidential Decree	Presidential Decree	President Regulation	President Regulation	President Regulation
Ministerial Regulation				
	Regional Regulation	Regional Regulations which include: a. Provincial Regional	Provincial Regulation	Provincial Regulation

Tap MPRS No. XX/MPRS/1966	Tap MPR No. III/MPR/2000	Law No. 10/2004	Law No.11/2011	Law No.12/2011
		Regulations b. Regency/City Regional Regulations c. Village Regulation		
Other Implementing Regulations			District/City Regional Regulation	District/City Regional Regulation

Source: researcher's processed results from various reference sources

The legal force of the above laws and regulations is in accordance with this hierarchy and lower laws and regulations must not conflict with higher laws and regulations. If there is a conflict between one provision and another, the principle used must be based on the principle of enactment of the provision. Important principles in understanding the constellation of laws and regulations are as follows:

a. *lex superior derogat legi inferiori* (higher provisions override lower provisions).
b. *lex specialis derogat legi generali* (a more specific provision overrides a more general one).
c. *lex posteori derogat legi priori* (newer provisions override older provisions).

The fundamental principles which are the principles used as guidelines in the formation of laws and regulations are determined to always be in accordance with:

a. Indonesian legal ideals which are none other than Pancasila (the precepts in this case act as ideals, which act as guiding stars);
b. The fundamental norm of the state which is also none other than Pancasila (the precepts in this case apply as norms);
c. The principles of the state based on law which places the Law as a typical regulatory instrument in the primacy of law (der Primat des Rechts); and
d. The principles of government based on a constitutional system that places the law as the basis and limit of government activities.

When read carefully, Law 13/1998 is not cited as the basis for the enactment of Law No.14/2019 on Social Workers which amends Law No.11/2009 on Social Welfare ("Law No.14/2019"). Whereas Law No.14/2019 also regulates elderly welfare, social aid and is the basis for the issuance of Pergub 100/2019. The fact is that there is no information contained, either in the reminding or considering sections. As a result, Pergub 100/2019 also does the very same deviation. Each of these laws directly subordinates itself to the provisions of the relevant articles of the 1945 Constitution. The meaning of this subjection is the policy of the legislator/legislative drafter, when determining which provisions of the 1945 Constitution will be used as the basis for making laws. The drafting of this policy product is carried out without having to pay regard to the fact that there has been another law that regulates the subject matter of the elderly, where the law has previously referred to certain articles of the 1945

Constitution, but only refers to provisions that have a direct correlation with the topic / main title of the regulation concerned.

4.1. Criticism of the Formulators of Pergub 100/2019 in Understanding the Elderly as Legal Subjects Theoretically

The welfare of the elderly in Indonesia has not been optimally implemented. This condition occurs because this law is not a populist law. Apart from that, the scope of regulation is also still limited to providing social services for the elderly. Whereas the needs of elderly people are not only limited to welfare. But it must also be considered for its existence as a human being. That essence is actually contained in the 1945 Constitution but not reflected in UUNo.13/1998. It is true when it is mentioned that the 1945 Constitution does not specifically regulate the elderly, but if the ideas in the constitution are interpreted in depth the substance of the articles relating to Indonesian humans, it should not be that Law No.13/1998 sees the elderly as fully human. Humans are social beings, and their existence needs to be recognized. Regulations should not humanize the elderly and not place them as a pawn. That is why the formation of positive legal norms by lawmakers in legislation becomes very decisive.

Policies on the Elderly have a weight that is not different from technical, operational or administrative policies that are formed to anticipate or overcome an event. One of the findings is in Pergub 100/2019. The DKI Jakarta Government has the initiative to issue special regulations on the elderly in the context of social aid distribution. In reality, it cannot be denied that Pergub 100/2019 has been running and has made a concrete contribution in order to support the welfare of DKI Jakarta citizens. Interestingly, Pergub 100/2019 does not refer to Law No.13/1998 but to legislation related to regional government. Meanwhile, the local government law does not regulate what the elderly are and why their welfare needs to be considered. Meanwhile, related to social assistance referred to is Law No.14/2019, which does not narrate the elderly in essence, but positions the elderly as parties who need to get social assistance distribution with various reasons behind it in the context of humanizing humans. Without touching the most fundamental idea of why the elderly and why they must be prospered.

In interpreting the text (elderly) in the law, according to Bernard Arief Sidharta, it must be understood first the authoritative text, interpreting the authoritative text (rule of law) in the context of answering the question what is the rule of law with respect to an event? Authoritative text with an event is an interpretation in legal science or legal dogmatics. Legal scientists are encouraged to take action, namely determining the range of areas of validity of the rule of law from the point of its own establishment in discourse with fellow experts or legal scientists.

The purpose of the range of applicability of rules is the discourse of philosophy and legal theory. The essence of knowing the range of applicability is to understand not to determine what law will be applied to an event. Determining the scope of the rule of law's applicability means conducting an assessment of the rule of law in the context of an event, which means applying the rule of law to reality (the event). In other words, if the context of the event is connected to how to interpret the authoritative text, it appears that the authoritative text referred to will lose its objectivity.

To be able to understand the range of applicability of the Elderly rule in forming a solid intertextuality with human understanding in the 1945 Constitution is through a process of philosophical and theoretical discourse. The essence of knowing the range of applicability is to understand not to determine what law will be applied to an event. Intertextuality is interrupted when the operational definitions of potential and non-potential elderly in Law No.13/1998 and Pergub 100/2019 do not refer to Law No.13/1998. Whereas the claim of the legislator is not only based on the 1945 Constitution, but also pays attention to the authoritative text issued by the PPB. In the UN Declaration of Human Rights of 1948, Article 40 states as follows:

Everyone has the right to standard of living adequate for himself and his family including food, clothing, housing and medical care and- necessary, social service, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of Iivehood in circumstances beyond his control.

See also Article 27(1) of the 1945 Constitution, which reads:

All citizens are equal before the law and government and shall uphold the law and government with no exceptions.

According to Prof. Andrew, a human rights lecturer at UNSW Faculty of Law, Australia, he said that the most important thing for the elderly is how legal rights and access to legal are still attached to them. The government takes the role of ensuring from time to time that the enforcement of legal rights and access to legal is carried out properly without any discrimination at all. The legal subject as the bearer of rights contextually in Pergub 100/2019, the emphasis is driven on embedding the title of ability and incapacity of the elderly.

The elderly cannot be generalized within the scope of the notion of "rights and obligations" alone. Rather, there must be a different understanding of the elderly as legal subjects. The meaning of the legal subject is actually correct and appropriate, but disparities arise. This disparity occurs due to the writing of the text which is simply understood that the elderly become impressed as objects in the distribution of social aid. It needs to be addressed that as a legal subject, the elderly must obtain assurances to be free from fear, avoid anxiety.The basis for these differences can be described in the following criteria:

a. Discussion of man in the pre-dogmatic stage, before the formulation of a dogma

This stage is a state before the formation of dogma (legal rules). In the process of forming dogma, studies are carried out, which can be divided into (a) theoretical studies (which include philosophical, theoretical and juridical fields), whose function is to understand ideas and concepts about what will be regulated and how to formulate it. Comprehending the concept is the initial stage before continuing the process of forming dogma, for example the preparation of academic papers and roadmaps for the welfare of the elderly in Indonesia; (b) the formation of dogma only within the scope of operational techniques. The perspective of the need for rules stems from the urgency to form a series of dogmas that are expected to be able to overcome technical and operational problems, so there is no need for in-depth theoretical studies. When the rules are enacted, the technical operational obstacles can be overcome immediately, for example the regulation on the retirement age limit.

Ideally, the lawmakers should have been able to identify the depth of the concept to be dogmatized from the very beginning. Thus, they are able to determine the direction of whether an in-depth theoretical study is needed or whether it is sufficient to conduct a technical operational study.

b. Dogmatic discussion, after the formation of dogma. Interest-based popularity or repeated cases.

Elderly is a far-reaching discussion, compared to discussing disputes and cases involving the legal standing of legal subjects (in a production chain in various fields of law). In practice, perspectives on people and legal subjects will be interpreted dogmatically and seen from the perspective of the case. In short, there is partiality. Partisanship is then interpreted because of interests, for example to be able to win a case. Dogma about humans/persons or legal subjects in legal practice leans towards means/instruments. In other words, to handle a case, the legal standing of the legal subject is not seen broadly in the context as a whole understanding, but is narrowed in its interpretation for the benefit of the litigant.

Through this legal theory study, it looks from 2 sides, namely from the aspect of lawmakers and the elderly regulated in the law. From this research, it is understood that the formation of laws can be categorized in 2 forms of output, namely legislation that contains global and broad regulations with a very deep scope of regulatory detail; and legislation that is administratively operational. Meanwhile, the regulation of potential elderly with non-potential elderly is very instrumentalistic and discriminatory. There is a tendency that the legislators place their stance, that the elderly are sufficiently regulated administratively operational without the need to be regulated more broadly.

4.2. Absence of intertextuality of Pergub 100/2019 with Law No.13/1998 and the 1945 Constitution

The interesting part of Pergub 100/2019 is in the "consideration" section. None of the regulations that are the basis of reference mention Law No.13/1998 as the main reference, some of the references are precisely to regulations on regional government. We all need to know that in the formation of Indonesian government policies in the preamble before entering into the regulating articles, it must be preceded by the " Recalling and Considering" section. The two parts of remembering and weighing are intended so that readers of the policy are clearly informed of the basis of reference for the enactment of a policy. It is clear that the basis of reference is the constitution and also the basis of reference for applicable laws which are the implementation of the constitution and regulate the objects to be made in a government policy. In addition, the same section also refers to laws and regulations that have been in force before and even in this section the government usually also states the validity status of previously applicable policies.

This finding reinforces that policymakers do not need to pay attention to the hierarchical flow of legislation that has a direct relationship with the regulations to be formed. It is clear that this submission to the regional government law emphasizes technical, operational and administrative aspects rather than seeking to understand the nature of elderly welfare.

Perhaps for the public knowing this kind of information is not important, but what is more important is the realization of the social aid distribution policy. Was this Pergub

100/2019 indeed formed without any connection to the applicability of Law No.13/1998 as a form of failure of understanding, ignorance or deliberately not paying attention to Law No.13/1998 for the implementation of Social Aid. This is only for one regional level policy located at the center of government. One can only imagine how other regions would fare in making policies regarding the elderly.

This finding is evidence that there is no fusion of horizons between the 1995 Constitution, Law 13/1998 and the enactment of Pergub 100/2019, especially in relation to the aspect of ignoring the hierarchical order of laws and regulations in Indonesia which has an impact on intertextuality. However, it is understood that the official function of the governor is to carry out his duties as a regional government. That is why for the preparation of regional government policies, it is determined to refer to the regional government law as the basis of reference. The issue of the welfare of citizens in the region is a priority of the performance achievement of a regional head and part of the administrative bureaucracy. It is thus clear that the subject of the elderly, who are part of the local community, needs attention from the local government. It is just that there is no stigma to considering Law No.13/1998 as a reference because the regulation of social aid for the elderly regulates the technical operation of the distribution of aid based on the recipient group.

Sri Kusumastuti Rahayu, as an activist for the elderly and also drafted the proposed amendment to Law No.13/1998. She revealed that at that time there were already regional regulations that also regulated the elderly. However, the concern that occurred was that one regional regulation did not conduct an in-depth study of the various factors that needed to be regulated about the elderly, but the local government only copied and pasted from regional regulations that were already in effect. On this occasion, she did not mention which local regulation was the main source or which local regulation did the copy and paste process. This information is very much due to the fact that lawmakers not only do not understand the urgency of the meaning or read the contents of the 1945 Constitution and other related laws. This is clearly a tradition that ignores the rules of drafting laws and regulations.

The intertextuality (Nordquist: 2021) of the elderly texts in the 1945 Constitution with Law No.13/1998 and Pergub 100/2019, should be clearly visible, in the form of intersections, both formed in the form of quotations and expressions, where one with the other contents and complements each other. According to Kristeva (Helt: 2016), every text is automatically intertextual so that it is always productive, meaning that the author as a subject who has intentions, disappears, so that the text becomes a projection space for intertextual play. The text here never displays a clear and stable meaning, as it represents the dialogic conflicts of society through the meaning of words. Therefore, intertextuality does not only look at a text through its emergence from a social text, but also its continued existence in society and history. A text does not have a unified meaning in its body, it is always connected to ongoing social and cultural processes. Meaning is both inside and outside the text.

The translation of texts in intertextuality requires careful interpretation skills because it will refer to the appropriate recontextualization. In addition, the discussion of intertextuality cannot be separated from the context. Intertextuality is a reference used as a bridge between critical interpretation efforts and Gadamer's Hermeneutic theory. Especially to help in examining the fusion/melting of horizons (Horizontverschmelzung or fusion of horizons) from efforts to read old texts with contemporary texts, which in this dissertation will be used

as a meeting of history in the past with the present. This interrelation and non-interrelation of texts will be the topic of this dissertation research. The finding of no meeting of horizons will not essentially be a problem, when there are several factors that lead to the formation of a fallacy of thought or even a lack of conformity between a system that applies and is accepted together by the community.

The absence of intertextuality is contrary to the spirit of human rights protection contained in the Constitution. Researchers at the attitude that the legislators have failed to understand the meaning of human beings as fully contained in the 1945 Constitution, which is marked by the existence of human categorization groups which, if interpreted critically, is a form of discrimination by the law applied to its citizens. In fact, the legitimacy of elderly rights stipulated in the 1945 Constitution provides confirmation that it is appropriate for the state to provide protection and assurance upon fundamental rights of the elderly as citizens without discrimination.

If we rely on Bernard Arif Sidharta's thinking in viewing the relationship between intertextuality and interpreting the law, then the critique that emerges from this reflection process is:

a. The contextuality that must be understood first is the 1945 Constitution as the authoritative text. Furthermore, interpreting the authoritative text (rule of law) in the context to regulate the principles of law. The drafters of Law No.13/1998 should have taken action, namely determining the range of areas of validity of the principles of law from the point of its own establishment. Understanding the human text with the Elderly is essentially not a difference in seeing the context of its wholeness as a description of the human self. In the discourse with fellow legislators, there should be a record kept as an archive to know the historical background of the emergence. However, in the case of the formation of Law No.13/1998, it was not found.
b. Authoritative text that is formed due to an event is an interpretation in legal science or legal dogmatics. There is a strong suspicion that the formation of the Elderly text in Pergub 100/2019 is based on an event. The criteria of "able" and "unable" in relation to economic issues. It is as if this terminology creates an understanding as if there is a class difference. In fact, people who are capable or not capable will eventually grow old. It is understood that in formulating an abstract conception, it is sometimes constrained due to articulation or diction limitations. Because ideas in the form of ideas and conceptions sometimes when poured into text form will experience obstacles due to the very limited diction they have.

Another result is that there is no intertextuality due to limitations (time and expertise) that can determine the range of areas of validity of legal rules, so what happens is that the authoritative text is a reflection of the act of assessing legal rules in the context of an event, which means applying the legal rules to reality. In other words, if the context of the event is connected to how to interpret the authoritative text, it appears that the authoritative text referred to will lose its objectivity.

5. CONCLUSION AND RECOMMENDATIONS

Critical ability is needed in order to reflect on the idea of human beings (elderly) as a whole and how to place humans when being normed, especially before and in formulating the outline of the legal norms that will be formed, so that philosophically and theoretically it does not cause discriminatory meanings and intertextuality still occurs. Lawmakers, generally the legislature and especially the team formed specifically to draft laws, in carrying out their mandate are absolutely determined to have an educational background in the field of law, the aim is to understand the scientific flow of thought in the field of law in carrying out the process of drafting and forming laws and regulations. Furthermore, in the preparation of laws, philosophical, historical and theoretical studies are important to be carried out to form a solid law.

Recommendations

Establish a special institution in charge of understanding the content, substance and regulation of the 1945 Constitution which is an office employee. The function of this institution is to serve as an expert in the field of constitution and is a team that will work during the formation of legislation by assisting representatives who sit in the people's representative council and regional representative council.

The formation of laws and regulations is intended to create order and overcome problems from developments that occur in society. In drafting laws and regulations, a distinction should be made between the substance to be regulated, namely:

a. policies on human rights upholding; and
b. policies that are technical, operational or administrative in nature.

For the formation of policies governing human beings and human rights, it is necessary to pay attention to how the formulation of texts that are able to reflect the depth of meaning and meaning of a term, word or sentence used. The text is able to determine the range of areas of applicability of the rule of law. Unlike the case with policies that are technical, operational or administrative in nature, because the policy is formed solely to anticipate or overcome an event whose solution needs to be resolved technically, operationally or administratively.

REFERENCES

Budiardjo, Miriam. *Dasar-dasar Ilmu Politik*. Jakarta: PT Gramedia Pustaka Utama, 1992.

Departemen Pendidikan dan Kebudayaan. *Kamus Besar Bahasa Indonesia (KBBI)*. Jakarta: Balai Pustaka, 1988.

Dewan Perwakilan Rakyat Republik Indonesia. *Naskah Akademis Rancangan Undang-Undang Republik Indonesia tentang Kesejahteraan Lanjut Usia*. Jakarta: Komisi VIII DPR RI, 2020.

Gadamer, Hans-Georg. *Philosophical Hermeneutics.* London: University of California Press, 2008.

Gadamer, Hans-Georg. *Truth and Method*. London: Continuum, 2004.

Gjerdingen, Donald H. "The Future of Legal Scholarship and the Search for a Modern Theory of Law," *Buffalo Law Review.* Vol. 35, No. 2 (1986): 381-477.

Grondin, Jean. *The Philosophy of Gadamer*. Chesam: Acumen Publishing Limited, 2003.

Habermas, Jurgen. *The Theory of Communicative Action Vol. 1: Reason and the Ratuonalization of Society.* Boston: Beacon Press, 1984.

Hardiman, Budi F. *Seni Memahami: Hermeneutik dari Schleiermacher Sampai Derrida.* Yogyakarta: Penerbit PT Kanisius, 2015.

Hardiman, F. Budi. *Demokrasi Deliberatif: Menimbang 'Negara Hukum' dan 'Ruang Publik' dalam Teori Diskursus Jurgen Habermas.* Yogyakarta: Penerbit Kanisius, 2009.

Indonesia. *Peratuan Pemerintah tentang Pelaksanaan Upaya Peningkatan Kesejahteraan Sosial Lanjut Usia*, PP No. 43 Tahun 2004, LN No. 144, Tahun 2004, TLN No. 4451.

Indonesia. *Peraturan Presiden tentang Penyaluran Bantuan Sosial Secara Non Tunai*, Perpres No. 63 Tahun 2017, LN No. 156. Tahun 2017.

Indonesia. *Rancangan Undang-Undang tentang Kesejahteraan Lanjut Usia.*

Indonesia. *Undang-Undang Dasar Negara Republik Indonesia Tahun 1945 Amandemen IV*.

Indonesia. *Undang-Undang tentang Cipta Kerja*, UU No. 11 Tahun 2020, LN No. 245 Tahun 2020, TLN No. 6573.

Indonesia. *Undang-Undang tentang Kesejahteraan Lanjut Usia*, UU No. 13 Tahun 1998, LN No. 190 Tahun 1998, TLN No. 3796.

Indonesia. *Undang-Undang tentang Kesejahteraan Sosial*, UU No. 11 Tahun 2009, LN No. 12 Tahun 2009, TLN No. 4967.

Indonesia. *Undang-Undang tentang Pekerja Sosial*, UU No. 14 Tahun 2019, LN No. 182 Tahun 2019, TLN No. 6397.

Indonesia. *Undang-Undang tentang Perubahan atas Undang-Undang Nomor 12 Tahun 2011 tentang Pembentukan Peraturan Perundang-Undangan*, UU No. 12 Tahun 2011, LN No. 183, Tahun 2019, TLN No. 6398.

Koesnardi, Moch., dan Zul Afdi Ardian, *Tata Negara.* Jakarta: Gaya Media Pratama, 1994.

Krisnayuda, Backy. *Pancasila dan Undang-Undang: Relasi dan Transformasi Keduanya dalam Sistem Ketatanegaraan Indonesia*. Jakarta: Kencana, 2016.

Kuswarini, Prasuri. "Penerjemahan, Intertekstualitas,Hermeneutika dan Estetika Resepsi," *Jurnal Ilmu Budaya.* Vol. 4, No. 1 (Juni 2016): 20-45.

Lawn, Chris, dan Niall Keane. *A Companion to Hermeneutics.* New Jersey: John Wiley & Sons, Inc., 2016.

Manullang, E. Fernando M. *Menggapai Hukum Berkeadilan: Tinjauan Hukum Kodrat dan Antinomi Nilai*, Jakarta: PT Kompas Media Nusantara, 2007.

Prananingrum, Dyah Hapsari. "Telaah Terhadap Esensi Subjek Hukum: Manusia dan Badan Hukum," *Refleksi Hukum: Jurnal Ilmu Hukum.* Vol. 8, No. 1 (April 2014): 73-92. https://doi.org/10.24246/jrh.2014.v8.i1.p73-92.

Rehg, William. "Habermas's Constitution: A History, Guide, and Critique Between Facts and Norms: Contributions to a Discourse Theory of Law and Democracy by Jurgen Habermas," *Law & Social Inquiry.* Vol. 23, No. 4 (Autumn, 1998): 940-971.

Roestandi, Achmad, dan Zul Afdi Ardian. *Tata Negara*. Bandung: CV Armico, 1986.

Rosenfeld, Michel. *The Identity of the Constitutional Subject: Selfhood, Citizenship, Culture, and Community*. London: Routledge, 2009.

Sidharta, Arief B. *Apakah Teori Hukumt.* Yogyakarta: Genta Publishing, 2003.

Sidharta, Arief B. *Ilmu Hukum Indonesia: Upaya Pengembangan Ilmu Hukum Sistematik Yang Responsif Terhadap Perubahan Masyarakat.* Yogyakarta: Genta Publishing, 2003.

Simorangkir, J.C.T. *Penetapan UUD: Dilihat dari Segi Ilmu Hukum Tata Negara Indonesia.* Jakarta: PT Gunung Agung, 1984.

Slapper, Gary. dan David Kelly. *The English 8th Edition Legal System.* Oxon: Routledge-Cavendish, 2006.

Soemarsono, Maleha. "Negara Hukum Indonesia Ditinjau Dari Sudut Teori Tujuan Negara." *Jurnal Hukum Pembangunan.* Vol. 37, No. 2 (April-Juni 2007): 300-320.

Sumaryo. *Hermeneutik Sebuah Metode Filsafat.* Yogyakarta: Kanisius, 1999.

Suradji, H., Pularjono, dan Tim Redaksi Tata Nusa. *Undang-Undang Dasar Negara Republik Indonesia UUD 1945 Beserta Perubahan ke-I, II, III, & IV Dilengkapi Dengan Dekrit 5 Juli 1959, Piagam Jakarta, UUD Sementara, Konstitusi RIS.* Jakarta: PT Tata Nusa, 2002.

Susanto, Anthon F. *Ilmu Hukum Non Sistematik: Fondasi Filsafat Pengembangan Ilmu Hukum Indonesia.* Yogyakarta: Genta Publishing, 2010.

Suyanto, B. *Filsafat Sosial*. Yogyakarta: Aditya Media Publishing, 2013.

Tim Pengajar Mata Kuliah Ilmu Negara Fakultas Hukum Universitas Indonesia. *Materi Kuliah Ajar Ilmu Negara*. Depok: Fakultas Hukum Universitas Indonesia, 2001.

Tim Pengajar Mata Kuliah Ilmu Negara Fakultas Hukum Universitas Indonesia. *Buku Ajar Ilmu Negara*. Depok: Fakultas Hukum Universitas Indonesia, 2001

CHAPTER 8

Technology for Processing Products from Household Organic Waste as a Global Challenge for the Future

Rini Setiati
Departement of Master of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
rinisetiati@trisakti.ac.id
Orcid: 0000-0001-9243-062X

Qurrotu Aini Besila
Department of Architecture Landscape, Faculty of Landscape Architecture and Environmental Engineering,
Universitas Trisakti, Jakarta, Indonesia
qurrotu@trisakti.ac.id
Orcid: 0009-0008-0536-6163

Wahyu Sejati
Departement of Civil Engineering, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
wahyu.sejati@trisakti.ac.id
Orcid: 0000-0002-1189-7541

Astri Rinanti
Departement of Environmental Engineering, Faculty of Landscape Architecture and Environmental Engineering,
Universitas Trisakti, Jakarta, Indonesia
astririnanti@trisakti.ac.id
Orcid: 0000-0001-8649-6307

Widia Yanti
Environment, Development, and Sustainability - Faculty of Graduate School, Chulalongkorn University,
Thailand

ABSTRACT

Household organic waste is a product that has always existed as long as human life has existed. This waste will increase over time and become a problem if it is not handled properly and correctly. Piles of waste will create air pollution, disturb health and disturb the view. For this reason, a way of handling and processing these household waste products is needed. Household organic waste consists of vegetable remains and fruit peels that have been consumed. In this community service program, demonstrations and training on processing organic waste into various products can be provided. This organic waste can be made into eco enzymes, compost, making fertilizer in biopores and so on. The implementation of this community service program is carried out using a method of sorting organic and non-organic waste which is managed in the form of a waste bank. This separated waste will make it easier to manage. In making eco enzymes, organic waste that is still fresh and has not rotted can be used, with added palm sugar or molasses dissolved in clean water. If the organic waste is no longer fresh, it can be made into compost. Home yard waste in the form of wild grass or dry leaves can also be made into compost. By making a biopore, household yard waste can be put into the biopore which will later be fermented into fertilizer to fertilize the soil. In this community service program, it can be concluded that organic waste can be managed by the community through the waste bank method. The waste bank will distribute waste submitted by the community as savings which can become additional income for the community. Apart from being used for personal use, organic waste products can also be sold, thus providing additional income for the community. This household organic waste processing program is also a solution to create a clean and healthy environment.
Keywords: Organic waste, Vegetable waste and fruit peels, Eco enzymes, Compost, Biopore.

1. INTRODUCTION

Starting from observations of several community activities in RW 12, Sawah Lama, Ciputat, which involve the youth of the Karang Taruna organization. There are quite a few teenagers with varying ages and educational backgrounds. In the situational analysis, it was found that the Karang Taruna teenagers are quite agile in helping with community activities, as seen in the image below, but they do not yet have the skills to better manage waste from cleaning the field, yards, and so on. Partner's Problem: From these activities, a problem arises, namely the piles of waste that are burned, producing smoke that is harmful to the environment and health. The burning of grass and plant waste is clearly seen during field cleaning for preparations for Eid al-Fitr and Eid al-Adha prayers. Similarly, kitchen waste has not been properly managed so far. This organic kitchen waste is simply collected in trash bins and then discarded. Waste disposal management has also not been socialized to the community and the Karang Taruna teenagers of RW 12. As seen in the image below, where there is smoke from burning grass waste in the field.

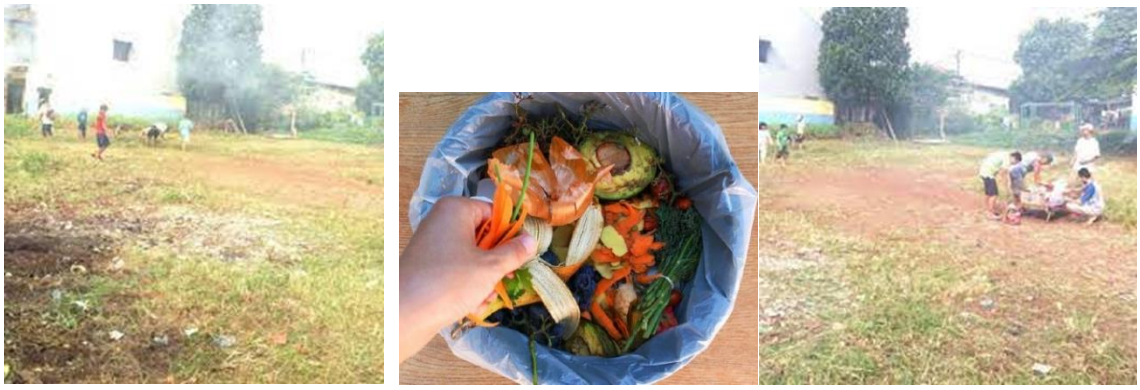


Figure 1. Burning of waste and organic kitchen waste

Based on the findings in the environment, a community service program was created. This Community Service Program is carried out with the partner Karang Taruna Youth of RW 12, located in Sawah Lama, Ciputat, South Tangerang. This group is a non-productive community group with environmental problems, namely the lack of skills to process yard waste and kitchen waste into various useful products.

The second problem is the low ability to manage waste properly, including the marketing of the products. Therefore, this partner community needs assistance to improve these skills. The various products that will be produced can also be sold to increase family income and can help provide services in all areas. The third problem is the presence of abandoned vacant land, which is only overgrown with trees but has the potential to be used as a place for fish farming using biofloc or biopore techniques.

The main priority problem is providing knowledge, skills, and training in household waste processing. This includes training on processing waste into eco-enzyme, compost fertilizer, making fertilizer with biopores, fish farming with biofloc, or making fish food pellets. This can be done by providing regular training and demonstrations for each product. Additionally, the activities can be complemented by establishing a waste bank managed by the Karang Taruna youth. Furthermore, training on marketing using digital marketing methods suited to the current situation and conditions should be included. These activities

should also include monitoring and evaluation to determine the success of the training provided. If the community acquires these skills, various products from kitchen waste processing can be utilized or even sold to increase community income. Having skills to process waste into economically valuable products can also be a solution to maintaining a clean environment, thus improving health, tranquility, and even the economy, ultimately leading to a healthier and happier quality of life.

The purpose of this Community Service Program (PkM) is to help provide solutions to the existing problems in the partner community while also enhancing and developing the potential of the Karang Taruna youth in Sawah Lama, Ciputat. This activity can increase the knowledge and skills of community members, which can be used as an effort to improve the income of the community and the Karang Taruna youth group. To solve the partner's problems, the proposed solutions that can be implemented are:

1. Providing training on processing fruit and vegetable peels into eco-enzyme.
2. Providing training on compost fertilizer production.
3. Providing training on biopore creation.
4. Providing training on biofloc production.
5. Providing training on making fish food pellets from household waste.
6. Providing simple training for calculating the capital required for household waste processing businesses.
7. Providing training on digital marketing methods for marketing.
8. Establishing and managing a good waste bank.

The solutions offered align with the existing issues faced by the partner, with the primary focus on addressing the problem of vegetable and fruit peel waste through the production of five different products: eco-enzyme, compost fertilizer, biofloc, biopore, and fish food pellets. These various processed products can be directly utilized by the community and expanded for sale, thereby creating a new source of income for the Karang Taruna RW 12 group. Therefore, the proposed solutions can effectively resolve the issues present in the partner community.

2. LITERATURE REVIEW

Organic waste can be processed in several ways, such as being turned into compost fertilizer, eco-enzyme, fish food pellets, and others. Organic waste, typically discarded into trash bins, can be processed as organic cleaners (Maurilla Imran, 2019). Eco-enzyme appears in the form of a dark brown liquid with a strong acidic or fresh aroma, fermented with sugar in a tank and left for three months until it becomes an active solution. Eco-enzyme is a liquid that does not contain chemical compounds that can harm the environment (Klasika Kompas, 2021). Eco-enzyme can be used to clean entire household areas, clothes, vegetables, and fruits, to fertilize plants, eliminate pests, and improve plant quality. Eco-enzyme is also very effective in repelling plant pests (Zero Waste Indonesia, 2021). Due to its natural composition, after being used as a floor cleaner, this liquid can also be utilized for watering plants. The description below explains the processing of various products from organic waste.

2.1.Training on processing fruit and vegetable peels into eco-enzyme

Eco enzyme is made from leftover vegetable waste and fruit peels mixed with clean water and brown sugar or molasses. The production of eco-enzyme uses a ratio of 1:3:10, where 1 represents sugar (1 kg), 3 represents organic matter (3 kg), and 10 represents water (10 liters), adjusted to fit various containers by filling 60% of the container with water and adding organic matter and sugar (in the ratio), leaving 20% of space in the container for the eco-enzyme fermentation process (Yayasan Buddha Tzu Chi Indonesia, 2021). The ingredients used (Metro, 2019):

1. 500 ml water
2. 50 gram of sugar/molasses
3. 150 gram of fruit peels

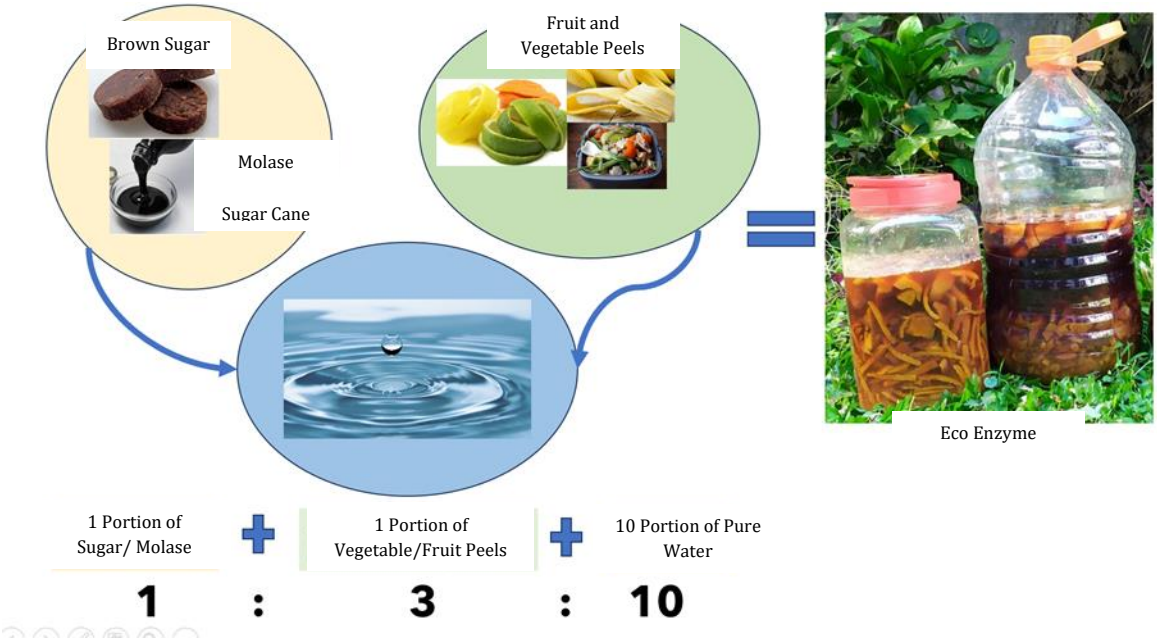


Figure 2. Scheme and composition of eco-enzyme production (Maurilla Imran, 2019)

Ingredients used (Metro, 2019):

1. 500 ml water
2. 50 grams sugar/molasses
3. 150 grams fruit peels

Tools used:

1. 1-liter plastic jar
2. Weighing scale
3. Blender
4. Funnel

Method:

1. Pour all ingredients into the jar, mix sugar and water.
2. Store in a dry and cool place at room temperature.
3. Let it sit for 3 months, and open it every day in the first 2 weeks to release the gas formed.
4. Sometimes there is a white layer on the surface of the solution; add a handful of sugar, stir well, then close.
5. After 3 months, filter the eco-enzyme using cheesecloth or a strainer.

6. Then transfer it into bottles and it is ready to use.
7. The residue can be reused by adding fresh waste. The residue can also be dried, blended, and buried in the soil as fertilizer.

Figure 3. Eco Enzyme Product

In addition to eco-enzyme, vegetable scraps and leaf litter can also be used to make compost fertilizer.

2.2. Providing training on compost fertilizer production

Compost fertilizer is made from vegetable scraps and leaf litter.

Materials for compost:

1. Household waste
2. Soil
3. Water
4. Rice husk charcoal
5. Activator, activates decomposing organisms to accelerate the decomposition of organic materials.

Equipment:

1. Chopping tool/chopper.
2. Container for waste storage (old paint buckets, plastic sacks, etc.)
3. Mixing tool and gloves
4. Bucket for dissolving activator.

How to make:

1. Chop household organic waste.
2. Add soil/manure/sawdust as inoculum.
3. Dissolve activator in water. Pour the activator solution into the compost materials, mix well.
4. Place in a composting container and seal tightly.
5. Stir once a week to ensure good aeration in the container.
6. During composting, the temperature inside the container will rise, indicating that microorganisms are active.
7. By weeks 7-8, composting is complete, and the temperature inside the container will return to normal.
8. The finished compost can be sifted and is ready for use. Good compost is dark brownish, smells like soil, and has a fine texture.

Compost fertilizer is made from organic waste, such as vegetable scraps, leaves, and others. Compost fertilizer is derived from the decomposition of organic waste like leaves and can be made in relatively simple containers readily available in the community environment.

Figure 4. Simple example of compost fertilizer production
(Kompas, 2021)

2.3. Construction of biopores for household waste utilization

Biopores are vertical holes drilled into the ground, typically 10 to 30 cm in diameter, used for burying vegetable scraps and fruit peels. The function of these biopores is to bury organic waste (vegetable scraps and fruit peels). Filling biopores with organic waste aims to provide food for soil organisms, such as worms, small animals in the soil, and even plant roots. Therefore, besides serving as a means of disposing of organic waste, biopores also act as food storage for soil organisms (Abdullah Usman, 2018).

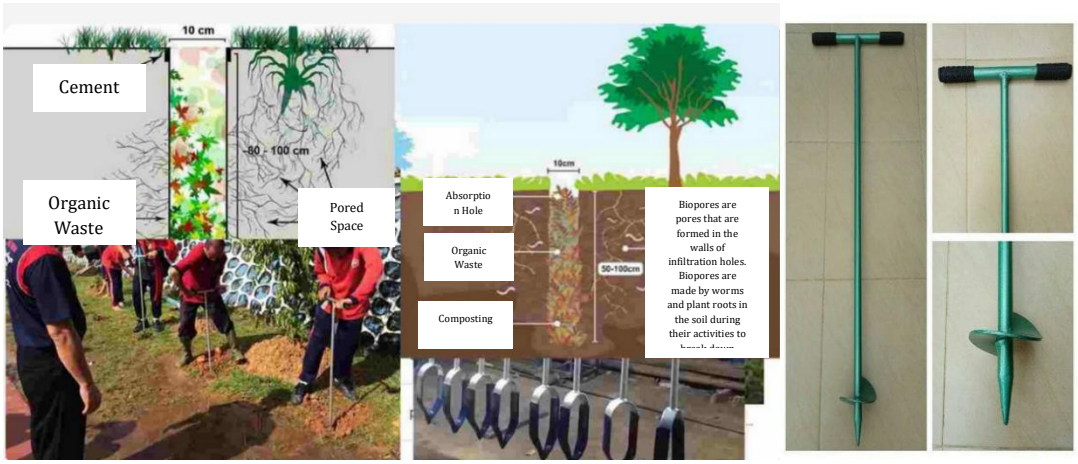


Figure 5. Example of biopore construction and biopore tool
(Dimas, 2020)

Tools and Materials:

1. Biopore drill or soil auger
2. PVC pipe with a perforated cap on the edge
3. Organic waste
4. Water
5. Wire/cover with holes

How to Make Biopores:

1. Determine the soil location for the biopore.
2. Water the soil to soften it and make it easier to drill.

3. Drill the soil vertically with a biopore drill.
4. Create a 1 meter deep hole with a diameter of 10-30 cm.
5. Line the hole with a PVC pipe of the same diameter as the prepared hole.
6. Fill the hole with organic waste such as leaves, grass, fruit peels.
7. Close the hole with iron wire or a perforated PVC pipe cap.

How to Maintain Biopores:

1. Fill the biopore hole gradually with organic waste every 5 days.
2. Let the filled waste in the hole and let it sit for 3 months until it turns into compost.
3. Remove the finished compost and refill the hole with new organic waste

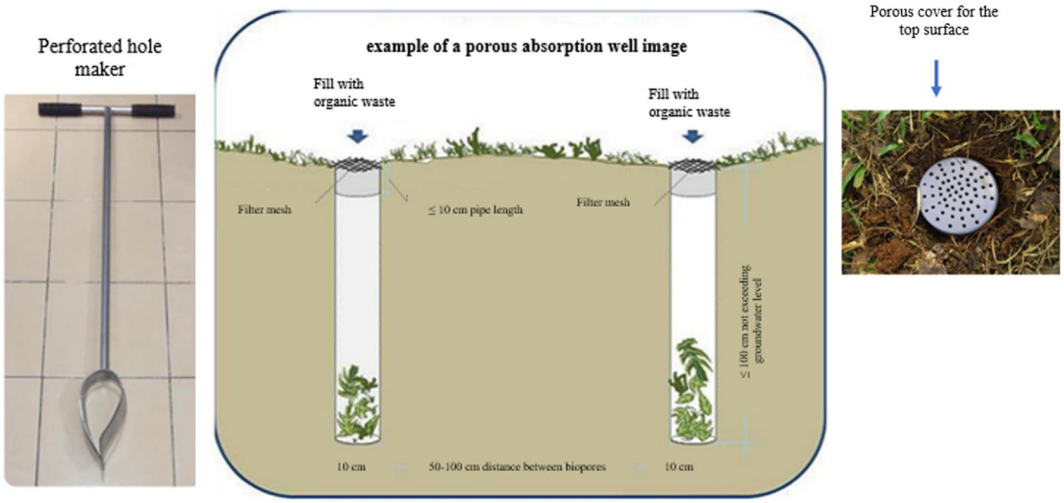


Figure 6. Biopore hole and equipment
(Depok Lestari, 2023)

2.4. Providing training on making fish food pellets from household waste

Pellets are food made to help enhance the nutrition so that fish can develop to the maximum. The raw materials of fish pellets can also come from organic waste, such as jackfruit skin, banana peel. The raw materials are dried first so that they can be ground into flour and mixed with other raw materials.

Making fish food pellets: to process waste into animal feed, first the waste is sorted from inorganic materials, such as plastic. Then it is put in a sack container and given probiotic liquid and fermented for a week. Then it is filtered, dried, and made into flour. After that, it is mixed with protein, carbohydrates, etc., and then molded into pellets (Dinas Kelautan & Perikanan (DKP) Kulonprogo, 2020).

Figure 7. Fish pellet molding machine
(Tokopedia, 2024)

How to make fish pellets:

1. Prepare the raw materials for making fish feed.
2. Add binding agents such as tapioca flour, about 10-20% of the total feed mixture used.
3. Add enough water to bind the dough.
4. Combine all ingredients together, mix evenly.
5. After formulation and mixing with water, steam briefly (about 30 seconds) to heat the mixture so that the binding agent melts and becomes adhesive, which will bind the pellets together.
6. Use a pellet molding machine.

Figure 7. Shape of ready-to-use fish pellets

2.5. Making biofloc for utilizing vacant land

Biofloc is a fish farming technique aided by beneficial bacteria. Biofloc comes from bio (life) and floc (cluster) or cluster of life. Biofloc can be applied in vacant land areas.

The environmental conditions of this Partner, besides a lot of piles of vegetable waste, also have a lot of vacant land without buildings, which are only overgrown with trees, there is a pond where residents keep fish, there are also dry and neglected ponds. This becomes potential that can be processed and utilized as a place to process waste, for example making biofloc, biopores, making compost or making fish food pellets.

Figure 8. Vacant land in the residents' yard

Figure 9. Biofloc pond materials
(Dinas Kelautan & Perikanan, 2020)

Biofloc is a fish farming maintenance system by growing microorganisms that function as waste processors from catfish cultivation. Waste in catfish cultivation is processed into

small clumps or can be called floccules which will then be used as natural catfish feed. Vacant land without buildings is a suitable place for biofloc.

Making biofloc cultivation:

The pond used for biofloc fish farming should ideally be circular, with a diameter of 1-3 meters and a minimum height of 2 meters. The pond must be sterilized, have drainage and water inlet channels, and complete aeration. The pond is filled with clean water, left to settle overnight to evaporate harmful substances.

Biofloc materials:

1. 1 kg/m³ rock salt
2. 150 grams/m³ dolomite/lime
3. Probiotics (specifically for fish)
4. 1 bottle of Yakult
5. Prebiotics, can use molasses 350 ml/m³ or palm sugar 500 ml/m³

How to make:

1. Mix the ingredients into one container, then stir.
2. Add to settled water, wait for 14 days.
3. When adding ingredients, start aerating the system so that microorganisms work optimally.
4. Perform daily checks by observing water color (optimal brown), pH (optimal 6-8), dissolved oxygen (optimal 3 mg/L).
5. After 14 days or when the biofloc is ready for use, introduce the fish to be raised.

In addition to improving water quality, biofloc functions to optimize the fish's digestive system, making the nutrients from feed more efficiently absorbed.

Figure 10. Biofloc pond ready for use
(Dian, 2022)

3. METHODOLOGY

Implementation methods for each problem consists of three points, namely processing various products from fruit and vegetable peels, utilization of vacant land and waste bank management. The method for implementing this community service program is carried out in stages by grouping material consisting of education on a healthy and well-organized

environment with sorting of types of community waste including waste bank management. Then proceed with training on organic waste that has been properly separated, where this organic waste is processed into eco enzymes, compost fertilizer and fish pellets. Finally, the youth community of Karang Taruna are also equipped with techniques for making biopores which can function as a place to make organic fertilizer which is directly beneficial for the plants around them. Because organic waste is processed into fish pellets, training in making biofloc is also provided.

The solutions found by these partners are then packaged into the form:

1. Socialization of a good and healthy environment and waste management which is applied to waste bank management
2. Training in making eco enzymes, compost and fish pellets from organic waste
3. Training on making biopores and biofloc

The following flow diagram explains the steps taken to implement this community service program.

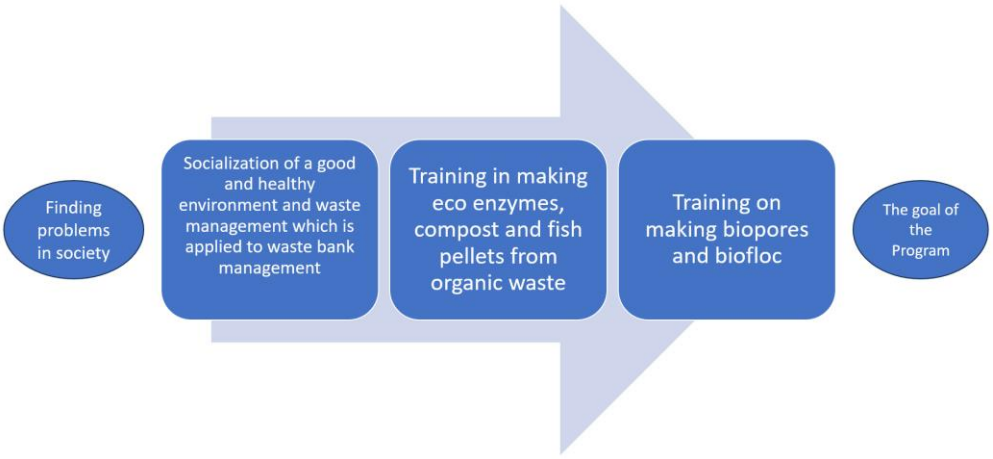


Figure 11. Program implementation scheme

The program begins with findings in the community. Then the program ends with the achievement of the goal of creating a clean, good and healthy environment as well as increasing skills to process organic waste into various products.

4. RESULT AND DISCUSSION

With the various processed organic waste products from household waste, the partners have products that can be used either independently or sold to those in need. This effort aims to increase community income as well. As part of the effort to enhance community income, several trainings need to be provided:

1. Providing basic training on calculating the capital required for processing household waste into various processed products.

In the business world, profit is defined as the difference between total sales value and production costs. Profit is considered profit if the difference between total sales value and production costs is positive, and loss if it is negative.

Profit and Loss Formulas:

- Profit = Selling Price - Cost Price

- Loss = Cost Price - Selling Price

Formulas for profit and loss percentages are:

- Profit Percentage (P%) = (Profit / Cost Price) x 100
- Loss Percentage (L%) = (Loss / Cost Price) x 100

Information about the profit and loss of a business can usually be found in the company's financial statements. These financial statements include various financial information useful for evaluating financial health and business performance. The income statement is the primary document that presents details of a business's revenue, expenses, and net profit or loss for a specific period, typically one fiscal year.

This report includes information such as sales revenue, production costs, operating expenses, gross profit, operating profit, and net profit. In the business scale, there are two main elements in financial statements that you can pay attention to when calculating profit and loss:

- Total Revenue
  The total amount of money generated by a business from the sales of goods or services is its total revenue. To determine how much money is earned, multiply the price of the product or service by the quantity of products or services sold.
- Total Cost
  All expenses incurred in making and selling goods or services are included in the total cost of business. There are two types of costs: fixed costs and variable costs. Fixed costs are expenses that do not change regardless of the quantity of products or services produced. Rent, salaries, and insurance are examples of fixed costs. Variable costs change in relation to the quantity of goods or services produced. Raw materials, labor costs, and shipping costs are examples of variable costs. To determine the total cost, you need to add together all fixed costs and variable costs over time. This basic training on calculating business capital can serve as a guide for Mitra Karang Taruna in running their business, utilizing various products made from household waste through the skills of the local Youth Community Organization.

2. Providing training in digital marketing methods

Digital marketing can be defined as marketing or promotional activities of a brand, product, or service conducted through digital media aimed at reaching as many customers as possible in an efficient and relevant manner. Digital marketing offers ease in evaluating conversion data from implemented strategies compared to conventional marketing methods, and it generally costs less than traditional approaches. Digital marketing is the effort to market products utilizing digital media and internet networks.

Figure 12. Digital Marketing Solutions

If in the past, marketing relied on flyers or billboards, today we can easily utilize platforms available on smart devices for digital marketing. For its own reasons, why should we use digital marketing strategies to develop our business? Here are several reasons you can consider:

- Digital marketing can be applied to all types of businesses.
- It effectively increases revenue.
- It can reach a more specific target market or consumer base.
- All gadgets can be used to execute digital marketing.
- It helps in building the brand of the business owned.

3. Management of Waste Sorting and Establishment of a Waste Bank

Waste bank management uses Masaro Technology, which involves waste management training to achieve zero waste, transforming the paradigm of waste from merely a cost center (collect - transport - dispose) to a profit center (sort - transport - process - sell). Mixed waste is a burden, but sorted waste becomes a high-value economic asset. In this community engagement program (PkM), the youth of Karang Taruna are provided with socialization on waste management, where waste is sorted by type to facilitate household and community waste processing.

Figure 13. Sorting waste according to type of waste
(Sumber Rejo, 2022)

According to Regulation of the Minister of Environment and Forestry (LHK) No. 14 Year 2021 Chapter 1 Article 1, "Waste is the residue of human daily activities and/or natural processes that is solid in form".

Among the negative impacts of improperly managed waste are unpleasant odors, potential for causing various diseases, etc. Therefore, proper waste management is necessary in any environment. One effort to manage waste is through a waste bank. According to Regulation of the Minister of Environment and Forestry (LHK) No. 14 Year 2021 Chapter 1 Article 1 number 6, a waste bank is defined as follows:
"A waste bank is a facility for managing waste based on the principles of 3R (reduce, reuse, and recycle), serving as an educational tool, promoting behavior change in waste management, and implementing Circular Economy practices, established and managed by communities, businesses, and/or local governments. The primary purpose of establishing a waste bank is to manage environmental waste. Recyclable waste is sorted and then sold to collectors or recycling facilities. Organic waste, meanwhile, can be utilized in compost production".

Sorting and selecting waste is the most basic step that needs to be done, considering not all types of waste can be accepted at a waste bank. At this stage, waste sorting is categorized into two types:

1. Organic Waste: Waste that originates from living organisms such as plants, animals, etc.
2. Inorganic Waste: Waste that originates from non-living organisms such as plastic, metal, etc.

The types of waste that can be sold for recycling include used cardboard, glass bottles, PET plastic bottles, paper, and metal. Implementing waste sorting education, therefore, requires the provision of waste bins in various sections tailored to their types, such as organic waste bins, non-organic waste bins, reusable items bins, and so on.

Because the concept of a waste bank involves customers depositing waste, there is a need for a record book to record customer balances and so on. The components required in the waste bank record book are as follows:

1. ID (Identification Number), for example, with the format Code RT-Serial Number, for example: 07-001.
2. Customer Name
3. Amount of waste deposited in kilograms
4. Price per kilogram
5. Total amount of balance owned

Figure 14. Waste Separation
(Abidin, 2021) (Memo Indonesia, 2019)

To establish a Waste Bank, it essentially does not require extensive management; with just 6 officials, a Waste Bank can already be formed. The lineup is as follows:

1. Chairperson
2. Treasurer
3. Recording Division
4. Administrative Division
5. Weighing Division
6. Packaging Division

The workflow for implementing a Waste Bank is quite simple as follows:

1. Household waste is sorted and selected.
2. Weighed at the Waste Bank.
3. Recorded.
4. Collected by collectors.
5. Profit sharing (between customers and management).

The mechanism for managing a Waste Bank in a simple manner:

Figure 15. Waste Bank Mechanism
(Unilever, 2021)

5. CONCLUSION AND RECOMMENDATIONS

The largest sources of waste come from household waste. Waste can be turned into economic resources, thus the implementation of the 3R (reuse, reduce, and recycle) principles is necessary. Apart from eco-enzymes, leftover fruits and vegetable waste can also be processed into compost, used for making compost with biopores, biofloc, or fish food pellets. Community service activities can increase community knowledge and skills in managing waste effectively and processing it into various useful products and need monitoring and evalua Sort Wastes at Home Deposit Waste to Waste Bank Waste Stored in Waste Bank Waste Weighing Results are Carefully Noted Waste Will be Delivered to Recycling Centers pro ech it

REFERENCES

Akhmad Zainal Abidin, (2021), Pengelolaan Sampah Organik dengan Metode Masaro ITB, Media Indonesia, https://www.itb.ac.id/files/dokumentasi/1620356560-MI_14485_200421_007.pdf

Abdullah Usman, (2018), Ini Keuntungan Budidaya Ikan di Kolam Bioflok, TribunJambi.com https://jambi.tribunnews.com/2018/07/10/ini-keuntungan-budidaya-ikan-di-kolam-bioflok.

Depok Lestari, (2023), Manfaat Sumur Resapan dan Biopori untuk Konservasi Air Tanah, https://depoklestari.com/manfaat-sumur-resapan-dan-biopori-untuk-konservasi-air-tanah/

Dian Aprillia, (2022), Bioflok, Sistem Budidaya Ikan Lele dan Nila yang Menguntungkan Peternak, https://www.goodnewsfromindonesia.id/2022/02/04/bioflok-sistem-budidaya-ikan-lele-dan-nila-yang-menguntungkan-peternak

Dimas, (2020). BIOPORI: Solusi Konservasi Tanah Yang Memiliki Segudang Manfaat, Dinas Lingkungan Hidup Kota Semarang, https://dlh.semarangkota.go.id/biopori-solusi-konservasi-tanah-yang-memiliki-segudang manfaat/

Dinas Kelautan & Perikanan (DKP) Kulonprogo, (2020), Budidaya Ikan Nila Menggunakan Sistem Bioflok, https://dkp.kulonprogokab.go.id/detil/201/budidaya-ikan-nila-menggunakan-sistem-bioflok

Klasika Kompas, (2021), Cara membuat Eco enzyme, pembersih serbaguna dari sampah organik, https://klasika.kompas.id/baca/cara-membuat-eco-enzyme/

Kompas, (2021). Cara Memanfaatkan Limbah Sayuran dan Buah untuk Pupuk Kompos, https://www.kompas.com/homey/read/2021/12/16/125100776/cara-memanfaatkan-limbah-sayuran-dan-buah-untuk-pupuk kompos? Kompas.com , https://kmp.im/plus6 , Download aplikasi: https://kmp.im/app6

Maurilla Imran, (2019), Eco Enzyme, https://zerowaste.id/zero-waste-lifestyle/eco-enzyme/

Memo Indonesia, (2019), Pemilahan Sampah di Bondowoso Belum Merata, https://memoindonesia.com/berita/pemilihan-sampah-di-bondowoso-belum-merata/

Metro, (2019), Kecamatan Cigombong Kembangkan Potensi Pertanian, https://kecamatancigombong.bogorkab.go.id/post/kecamatan-cigombong-kembangkan-potensi-pertanian

Sumber Rejo, Tim Editor, (2022), Cara Mendirikan Bank Sampah untuk Mengelola Masalah Sampah Lingkungan, sumberrejosid.slemankab.go.id, https://sumberrejosid.slemankab.go.id/first/artikel/125-Cara-Mendirikan-Bank-Sampah-untuk-Mengelola-Masalah-Sampah-Lingkungan

Tokopedia, (2024), https://www.tokopedia.com/find/mesin-pembuat-pelet-ikan

Unilever. 2021. Pilar Lingkungan Mengenal Kemasan Plastik dan Pengelolaannya.
https://www.unilever.co.id/planet-and-society/yayasan-unilever-indonesia/program-lingkungan/

Yayasan Buddha Tzu Chi Indonesia, (2021), Ekoenzim: Larutan Ajaib dari Sampah Organik, http://www.tzuchi.or.id/ruang-hijau/ekoenzim-larutan-ajaib-dari-sampah-organik/13

Zero Waste Indonesia, (2021) Cara Simpel Buat Eco Enzyme dari Sampah Organik di Rumah, https://www.liputan6.com/lifestyle/read/4541153/cara-simpel-buat-eco-enzyme-dari-sampah-organik-di-rumah. Jumat, 23 April 2021.

CHAPTER 9

Can Digital Transformation Enhance Innovation in Green Technology Transition Capabilities?

Rizka Amalya Umayaksa
Faculty of Economics and Business, Universitas Trisakti, Jakarta, Indonesia
Orcid: 0009-0008-8241-3584

Nurhastuty Kesumo Wardhani
Departement of Doctoral Program in Economics, Faculty of Economics and Business, Universitas Trisakti, Jakarta, Indonesia
nurhastuti@trisakti.ac.id
Orcid: 0000-0002-2020-6802

Sekar Mayangsari
Departement of Master in Accounting, Faculty of Economics and Business, Universitas Trisakti, Jakarta, Indonesia
sekar_mayangsari@trisakti.ac.id
Orcid: 0000-0002-0787-5323

Nabila
Faculty of Economics and Business, Universitas Trisakti, Jakarta, Indonesia

Zahra Ayunita Mulia
Faculty of Economics and Business, Universitas Trisakti, Jakarta, Indonesia

Jia Jessica Xu
Bond University, Australia
Orcid: 0000-0003-2900-6345

ABSTRACT

This study aims to explore how much digital transformation is promoted green technology transition innovation. This research presents a study of digital transformation and sustainable development based on empirical evidences. Systematic literature analysis was carried out based on text analysis. This research using energy sector companies listed on the Indonesia Stock Exchange for the 2019 to 2022, the mechanism of the impact of digital transformation on the company's environmentally friendly technological innovation capabilities (green technology). The collected data was analyzed using statistical methods, including correlation and regression analysis. The results of digital transformation research have a positive and significant influence on environmentally friendly technology transition innovation. This research shows that digital transformation mechanisms can encourage environmentally friendly technological innovation in companies. Digital transformation allows companies to reorganize innovative elements such as design and development, aswell as technological processes with representative digital technologies, innovate in environmentally friendly energy-saving technologies, increase product added value and markets competitiveness, and encourage companies to innovate in green technologies. This research can help companies in the process of creating technology to support environmental friendliness, create value, and understand the challenges they have to face.
Keywords: Green technology innovation, Digital transformation.

1. INTRODUCTION

Indonesia is actively engaged in combating climate change through various regulations and actions, such as Law No. 6 of 1994, Law No. 17 of 2004, and Law No. 16 of 2016. Another approach to promoting sustainable development is the adoption of green technology, which merges technology with environmental science to ensure the sustainability of natural resources. Both the government and the business sector are continuously working to advance green technology.

Digital transformation can drive corporate technological innovation, particularly in the field of green technology, thereby enhancing corporate contributions to environmental protection and sustainable development. It also increases information transparency, helping companies improve governance and fulfill their social responsibilities more effectively.

Several studies have analyzed the factors influencing green technology innovation, including digital transformation, executive background in IT, the role of the chief information officer, and green dynamic capabilities. However, most research has focused on the impact of digital technology on innovation capabilities or the concept of innovation capability itself. Few studies have examined how the process of digital transformation affects green technology innovation within companies. For example, a study by Zhang, G., et al. found that the application of digital transformation in companies, moderated by the green dynamic capability variable, can reduce costs associated with the digital transformation process, enabling environmentally friendly development and cost reduction through green technology innovation.

This study aims to investigate the extent to which digital transformation promotes green technology innovation. It presents an analysis of digital transformation and sustainable development, grounded in empirical evidence. A systematic literature review was conducted using text analysis. The research focuses on energy sector companies listed on the Indonesia Stock Exchange from 2019 to 2022, examining the mechanisms by which digital transformation impacts their environmentally friendly technological innovation capabilities (green technology). This study offers valuable insights into how digital transformation can drive green technology innovation and contribute to sustainable development.

2. LITERATURE REVIEW

2.2. Schumpeter's innovation theory

Joseph A. Schumpeter (1883–1950) argued that innovation can cause economic fluctuations. He defined innovation as "a new combination of means of production, resources, labor, and other factors." Schumpeter's innovation theory is categorized into five types: product innovation, technological innovation, market innovation, resource allocation innovation, and organizational system innovation. When applied to environmentally friendly innovation, Schumpeter's theory can encompass eco-friendly product innovation and green technological innovation. Environmentally friendly technological innovation refers to any technological changes or adjustments in a work process that help reduce environmental pollution generated during production. This includes the application of new technologies, innovative eco-friendly patents, and similar advancements. Such technological innovation is also believed to enhance organizational productivity and flexibility for companies.

2.2. Influence Transformation Digital to Green Technology TransitionsInnovation

The concept green technology innovation first time stated by Fussler and James on year 1996. Innovation technology friendly environment is strength pusher main for lead development company which friendly environment and give support important for development economy overall high quality as well as leading a new technological revolution in new situations are important ideas. Environmentally friendly technological innovation can effectively help companies realize the symbiotic value of ecological performance and economic performance, and ultimately make resource allocation achieve conditions which optimal. Therefore, the study about factors which influence the company's environmentally friendly technological innovation has become a hot topic nowadays (Xue, L., *et al* , 2022). Most academic research uses this approach qualitative (text analysis, interviews).

The digitalization of companies enables environmentally friendly collaborative innovation. In the IT era, the introduction of artificial intelligence and other technologies can help deeply explore and analyze business data, transform green innovation models, and inform decision-making. Additionally, digital platforms facilitate the exchange of information between organizations, reducing information asymmetry and increasing transparency. This enhances investor and company collaboration, improving eco-friendly innovation capabilities (Shang, Y., et al., 2023).

Digital transformation promotes technological innovation, particularly in environmentally friendly technology, thus increasing a company's contribution to the environment and sustainable development. It also helps reduce information asymmetry, improving governance and enabling companies to better fulfill their social responsibilities (Zhu, Y., and Jin, S., 2023).

Based on previous research by Xue, L., et al. (2022) and Tang, L., et al. (2023), digital transformation significantly positively impacts green technology innovation. This means that digital transformation encourages environmentally friendly technological innovation capabilities and enhances environmentally friendly and low-carbon economic development.

The concept of green technology innovation was first introduced by Fussler and James in 1996. Environmentally friendly technological innovation is a key driver for developing eco-friendly companies and supporting high-quality economic development, leading to a new technological revolution. Such innovation helps companies achieve the symbiotic value of ecological and economic performance, ultimately optimizing resource allocation. Consequently, the study of factors influencing environmentally friendly technological innovation in companies has become a popular research topic (Xue, L., et al., 2022). Most academic research on this topic uses qualitative approaches such as text analysis and interviews.

H1: Digital transformation positively influences the innovation of green technology transitions.

2.3. Framework Study

This research will examine the factors that influence green technology transition innovation on company sector energy which registered in Indonesian Stock Exchange through one independent variable, namely digital transformation which is controlled by

asset liability ratio variable. Based on the explanation above, depicted with conceptual framework on study this as following:

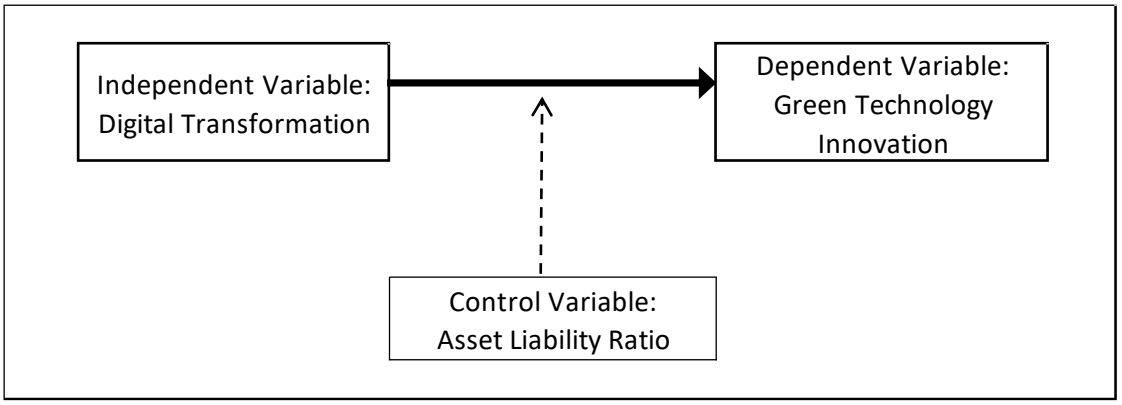


Figure 1. Framework study

3. RESEARCH METHOD

3.1. Election data and sample

The type of data used in research is secondary data sources, in the form of financial reports of energy sector companies listed on the IDX for the 2019 - 2022 period. Secondary data was obtained through the official website, namely the website of each company, IDX website (www.idx.co.id). The form of data used is periodic data (time series) namely data arranged based on time sequence, as for time used in this study is annual data. Data analysis method in this research use method Statistical Package for the Social Sciences (SPSS).

3.2. Definition Variable

Table 1. Definition variable

Variable	Definition Operational
Green technology innovation (Innovation technology friendly environment)	Referring on study Li, W.J., and Zheng, M N (2016) and Xue, L. et al (2022) Innovation technology friendly environment be measured with use content analysis which there is in report annual with count amount technology which created for environmentally friendly contribution in the year the which then in logarithm natural and plus 1.
Digital Transformation	This study compile dictionary terminology related transformation digital company recorded based on the method development dictionary. Six key word such as digital economy, transformation digital, artificial intelligence, blockchain, computing cloud, and big data in financial reports then added up 1 or take natural logarithm (Zhang, Ge., et al, 2023).
Asset Liability Ratio	Total Liabilities/Total assets (Xue, L., Zhang, et al., 2022))

3.3. Design Model Empirical

To effectively identify the relationship between digital transformation green companies and technology innovation, this research sets the benchmark measuring the following regression showed on models:

LNGTIit = α + α 1 LNDCit + ε

LNGTI is innovation technology friendly environment, LNDC is level transformation digital.

4. RESULT AND DISCUSSION

4.1. Statistics descriptive

In Table 4.1, the average value of digital transformation degree (LNDC) is 22.90, show that company sector energy own level awareness towards digital transformation is quite high, the minimum and maximum value of technology green innovation (LNGTI) of 1.00 and 7.00 respectively with standard deviation 1,941, show that level innovation technology very varies between company.

Table 2. Results test statistics descriptive

	Variables	N	Mean	Min	Std. Dev
Dependent Variable:	GTI	68	1,93	1,00	1,94181
Independent Variable:	DT	68	22,9	1,00	3,14885
Control Variable:	ALR	68	0,45	1,01	0,22863

Source: Outpus SPSS 20

4.2. Regression Analysis

Table 4.2 shows the regression results of the company's digital transformation level to innovation technology friendly environment. In model regression, researchercontrol assets liability ratio, the regression coefficient of digital transformation is respectively equal to 0.081, 1.000 and each significant on level 1%. This results confirm formation hypothesis and answer question, which show that transformation digital company has a significant promotional impact on friendly technology transition innovation environment. In particular, digital transformation possible company for reorganize innovative elements such as product, design and development, as well as technological processes with representative digital technology, deep innovation environmentally friendly energy saving technology, increasing the added value of products and market competitiveness, as well as encouraging companies to increase their level of green technological innovation.

Table 3. Results test analysis regression multiple

Variables	Unstandardized Coefficients	Sig. t
(Constant)	-1,926	0,029
DT	0,176	0,081
ALR	0,162	1,000

Source: Outpus SPSS 20

From results test regression linear simple on table 4.2 is known influence digital transformation variable, on the dependent variable the dependent variable, namely green technology innovation then you can arranged equality regression simple linear as following:

$Y = -1.926 + 0.176LNDC + \varepsilon$

From equality regression linear simple on can explained as follows:

b0 = -1.926 meaning that if the digital transformation value is equal to zero (0), then green technology innovation value as big as -1,926.

b1 = 0.176 means that digital transformation has increased by one unit so green technology innovation go on as big as 0.176 unit with assumption variable others are constant.

4.3. Test Coefficient Determination (R2)

Table 4. Results test coefficient of determination (R2)

Model	Adjusted R Square	Std. Error of the Estimate
1	0,688	0,85485

Source: Outpus SPSS 20

a. Predictors: (Constant) : *Transformation Digital*

b. Dependent Variables : *Green Technology Innovation*

The results of the regression analysis carried out, the adjusted R square value was obtained amounting to 0.688 or 68.8%, which means that the influence of the independent variable, namely transformation digital to green technology Innovation as big as 68.8% while the rest 31.2% were affected by other factors that are not included in model study. Standard error of estimate worth 0.85485 which in matter this means that the smaller the standard error of estimate, the more precise the model will be regression predict variable dependent. Influence transformation digital to green technology innovation can be identified from the results of the analysis that has been carried out that the digital transformation variable partially has a significant influence towards green technology innovation which is listed on the Indonesia Stock Exchange (BEI) 2019-2022 period.

Based on the results of the hypothesis test, it can be concluded that digital transformation influential positive and significant to green technology innovation. Base on study previously results study, there is no theoretical connection whatsoever in studying the impact of digital transformation on environmentally friendly technological innovation. The author adds by linking the results of the analysis to the "Schumpeterian" theory.

4.4. Test Hypothesis

Table 5. Results test by partial (t-test)

Variables	Unstandardized Coefficients	Sig. t
(Constant)	-1,926	0,029
DT	0,176	0,081
ALR	0,162	1,000

Source: Outpus SPSS 20

Table 4.4 reports the regression results of the company's level of digital transformation to green technology innovation. In model regression, researcher control with the asset liability ratio (ALR). Digital transformation has a beta value of 0.176. The significance value is 0.081, meaning there is a positive and significant influence between digital transformation variables and green technology innovation. This result confirm formation and answer hypothesis, which show that the company's digital transformation has a significant promotional impact on green technology innovation. Digital transformation allows companies to arrange repeat elements innovative like design and development, as well as process technology with technology digital which representative, innovate in environmentally friendly energy saving technology, increasing the added value of products and power competitive market, as well push company for innovate on green technology.

5. CONCLUSION AND FURTHER RESEARCH

Based on data from energy sector companies listed on the Stock Exchange between 2019 and 2022, this study empirically investigates the extent of digital transformation. The empirical findings highlight the significant role of digital transformation in promoting environmentally friendly technological innovation within companies.

The theoretical significance of this study offers a new perspective on exploring how digital transformation mechanisms influence eco-friendly technological innovation in companies. Practically, the study uncovers these mechanisms to drive eco-friendly technological innovation, providing insights for policy makers to enhance the promotion of enterprise digital transformation towards fostering eco-friendly innovation.

This study suggests that companies should prioritize increasing their awareness of digital transformation, enhancing data infrastructure, and promoting the deep integration of advanced technologies such as artificial intelligence, blockchain, cloud computing, big data, and others with their business operations. These steps are crucial for advancing the level of digitalization within companies and fostering environmentally friendly technology adoption.

REFERENCES

Anwar, M, S. "green technology menuju pembangunan nasional berkelanjutan". 2021. https://digitalbisa.id/artikel/green-technology-menuju-pembangunan-nasional- berkelanjutan-rYhX4.

Choi, I., Chung, S., Han, K., & Pinsonneault, A. (2021). CEO Risk-Taking Incentives and IT Innovation: The Moderating Role of a CEO's IT-Related Human Capital. MIS Quarterly, 45(4). https://doi.org/10.25300/misq%2F2022%2F15606.

Fussler, C., James, P "Driving Eco-Innovation: A Breakthrough Discipline for Innovation and Sustainability" Pitman Publishing: London, UK . 1996. https://doi.org/10.1002/(SICI)1099-0836(199711)6:5<297::AID- BSE128>3.0.CO;2-R

Li, J., Ren, H., Zhang, C., Li, Q., & Duan, K. (2020). Substantive innovation or strategic innovation? Research on multiplayer stochastic evolutionary game model and simulation. Complexity, 2020, 1-15.

Li, WJ, and Zheng, MN "Substantive innovation or strategic innovation?—The impact of macro industrial policy on micro-enterprise". innovation. Econ. Res. J. 2016, 51, 60–73. https://doi.org/10.1155/2020/9640412

Saputra, I., Murwaningsari, E., & Augustine, Y. (2023). The Role of Enterprise Risk Management And Digital Transformation On Sustainable Banking In Indonesia. Neo Journal of economy and social humanities, 2(1), 17-30.

Shang, Y., Raza, S. A., Huo, Z., Shahzad, U., & Zhao, X. (2023). Does enterprise digital transformation contribute to the carbon emission reduction? Micro-level evidence fromChina. International Review of Economics & Finance, 86, 1-13. https://doi.org/10.1016/j.iref.2023.02.019

Xue, L., Zhang, Q., Zhang, X., & Li, C. (2022). Can digital transformation promote green technology innovation?. Sustainability, 14(12), 7497. https://doi.org/10.3390/su14127497.

Zhang, G., Gao, Y., & Li, G. (2023). Research on digital transformation and green technology innovation—evidence from China's listed manufacturing enterprises. Sustainability, 15(8), 6425. https://doi.org/10.3390/su15086425

Zhang, T., Shi, Z. Z., Shi, Y. R., & Chen, N. J. (2022). Enterprise digital transformation and production efficiency: Mechanism analysis and empirical research. Economic research-Ekonomska istraživanja, 35(1), 2781-2792. https://doi.org/10.1080/1331677X.2021.1980731

Zhong, Y., Zhao, H., Yin, T. "Resource Bundling: How Does Enterprise Digital Transformation Affect Enterprise ESG Development?". Sustainability. 2023, 15, 1319. https://doi.org/10.3390/su1502131

Zhu, Y., & Jin, S. (2023). How Does the Digital Transformation of Banks Improve Efficiency and Environmental, Social, and Governance Performance?. Systems, 11(7), 328.https://doi.org/10.3390/systems11070328

Zuo, L., Strauss, J., Zuo, L. "The Digitalization Transformation of Commercial Banks and Its Impact on Sustainable efficiency Improvements through Investment in Science and Technology". Sustainability. 2021, 13.11028.

CHAPTER 10

Raising Awareness Stunting Among Teenagers

Kireyna Dini Nurcahyani
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
091301900033@std.trisakti.ac.id
Orcid: 0009-0000-5509-1155

Menul Teguh Riyanti
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
menul.teguh@trisakti.ac.id
Orcid: 0009-0005-6631-2140

Wegig Murwonugroho
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
wegig@trisakti.ac.id
Orcid: 0000-0002-3231-1300

Bambang Tri Wardoyo
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
bambangtri@trisakti.ac.id
Orcid: 0000-0002-6336-6574

Wan Juliana Emeih binti Wahed
Fakulti Seni Lukis dan Seni Reka, Universiti Teknologi MARA, Malaysia

Virginia Suryani Setiadi
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
virginia@trisakti.ac.id
Orcid: 0009-0005-5555-1218

ABSTRACT

Enhancing Awareness of Stunting among Adolescents. This research aims to investigate and analyze the effectiveness of strategies in enhancing awareness of stunting among adolescents. With the rapid growth and development occurring during adolescence, awareness of nutritional issues such as stunting becomes crucial to prevent long-term impacts. Through a combination of qualitative and quantitative research methods, data were collected from adolescent samples across various societal strata. Surveys were conducted to measure their initial knowledge levels about stunting, and they were engaged in educational interventions. Public campaigns, workshops, and the use of social media were integrated as part of efforts to increase awareness. The research results indicate a significant improvement in adolescents' understanding of stunting after participating in educational activities. Social, economic, and cultural factors influencing awareness levels were also identified. Additionally, parental and community involvement played a crucial role in enhancing awareness. This study contributes to a better understanding of effective ways to increase awareness of stunting among adolescents, with practical implications in designing more focused and relevant intervention programs. The conclusions drawn from this research are expected to pave the way for innovative stunting prevention strategies in the future, particularly in addressing public health challenges in this global era.
Keywords: Awareness, Stunting, Teenager.

1. INTRODUCTION

Stunting is a linear growth disorder caused by multifactors which is likely to disrupt metabolism. Stunting is caused by a lack of nutritional intake from various types of food, including milk. Stunting can also be caused by consuming unhealthy foods such as carbonated drinks which disrupt metabolic processes in the bones. Other factors such as socio-economic factors that influence the incidence of stunting are food expenditure, parents' education, parents' income, and parents' employment status (Astri LD et al, 2006; Riyadi H et al, 2006; Arnelia et al, 2010 in Rahmawati & Briawan, 2018)

Another cause of stunting is that children often suffer from infectious diseases. Stunting causes irreversible or irreversible growth disorders (Moxin et al., 2022). WHO states that malnutrition for a long time and frequently suffering from infectious diseases are the causes of failure to thrive, especially in the first 1000 days of birth. Nutritional problems in the Lamahu period: Journal of Integrated Community Service P-ISSN: 2828-6839 | E-ISSN: 2828-6677 Vol. 2, no. 2 August 2023 DOI:

10.34312/ljpmt.v2i2.21400 139 this will affect growth and have an impact on children's cognitive abilities (Rahayu et al., 2022).

Stunting does not occur suddenly but over a long period of time when children experience inadequate nutrition, the problem of stunting occurs in children. The occurrence of stunting can affect the lives of children and adults because it is related to a decrease in productivity and affects intelligence which will ultimately have an impact on the economy, poverty and lead to inequality (Muchtar et al., 2021). Stunting events can last a lifetime and have an impact on the next generation (Muchtar et al., 2021).

Stunting in children can also affect verbal and cognitive motor skills (Muchtar et al., 2023 as cited by Yadika et al., 2019). Children who experience stunting will cause a decrease in productivity as well as a low level of intelligence. The impact of stunting is visible in adulthood with short body posture and can also influence the incidence of several types of non-communicable diseases such as obesity, diabetes during pregnancy (gestational diabetes), insulin resistance and can cause reproductive disorders (Metasari et al., 2022).

Raising awareness of stunting is a crucial aspect in efforts to prevent adverse health impacts during the adolescent period. Stunting, which refers to stunted body growth due to chronic malnutrition, can have serious consequences on adolescents' physical and cognitive development. In facing this challenge, scientific research is an important basis for developing effective intervention strategies (Adha, 2023).

Adolescents are an age group that is very vulnerable to stunting because this period is a phase of rapid growth. This condition can affect their productivity and quality of life in adulthood. Therefore, increasing awareness of stunting among teenagers is important to prevent long-term detrimental impacts (Lina et al., 2022).

Previous research has provided basic knowledge, but there is still a need for more depth, especially in the adolescent context. The unique social, economic, and cultural factors of this group require deeper understanding to design effective intervention programs.

Through this scientific journal, we aim to analyze and present new findings that can help increase awareness of stunting among teenagers. By detailing the factors that play a role and encourage increased awareness, it is hoped that this research can make a significant

contribution to the development of stunting prevention strategies that are sustainable and relevant for adolescents in various social and cultural contexts.

2. LITERATURE REVIEW

Raising awareness refers to efforts or actions taken to expand a person's or group's knowledge, understanding, or attention to a particular issue, topic, or situation. This can involve various methods and strategies to convey information, educate, or generate interest so that individuals or society are more aware of certain things (Huriah et al., 2022).

In a health context, such as increasing awareness about stunting among teenagers, these efforts can include outreach, information campaigns, interactive learning, distribution of educational materials, as well as the use of social media and other communication platforms. Increasing awareness aims to create a better understanding of the health issues or social problems faced and encourage positive changes in behavior or action (Hidayah & Marwan, 2020).

Stunting refers to a condition where a child's growth failure results in a child's height being low for their age. This condition generally occurs in children who experience chronic malnutrition, especially during the early growth period, namely in the first 1,000 days of life, from pregnancy to 2 years of age (Resmiati, 2021).

Stunting can have a long-term impact on a child's physical and cognitive development. Children who experience stunting tend to have a higher risk of disease, delayed cognitive development, and other health problems. Therefore, preventing and treating stunting involves efforts to provide adequate nutrition and appropriate health care during critical periods of child growth. Increasing awareness about stunting among teenagers can help prevent and overcome this problem by educating the public about the importance of good nutrition during the child's growth phase (Astuti et al., 2021).

Teenagers can make a positive contribution in increasing awareness of stunting, nutritional problems during childhood. They can spread information about the importance of good nutrition, engage in social actions such as food donation campaigns, and support health policies that improve accessibility to nutritious food. Through balanced food education and the promotion of variety in eating patterns, youth can act as agents of change in their communities, providing support for children's optimal growth. Even though they are not directly involved in the care of young children, adolescent participation can have a positive impact in preventing stunting (Ruaida, 2018).

Adolescents are an age group that is between childhood and adulthood. In general, adolescents cover the age range from early puberty to early or middle adulthood. This age range varies, but it is often accepted that adolescence covers the period from approximately 10 to 19 years. During adolescence, individuals experience significant physical, emotional, social and cognitive changes as part of the development process towards maturity. During this time, they begin to identify themselves, develop values, and undergo various experiences that shape their personality and identity (Ernawati et al., 2021).

Social media has a significant role in increasing the effectiveness of raising awareness, including awareness of health issues such as stunting. Through this platform, information can be quickly and widely disseminated to users. Stunting awareness campaigns through social media accounts such as Indonesiabaik.id can reach teenage audiences more effectively.

Social media allows users to access information instantly. Visual content, such as infographics and videos, can be used to convey messages in a way that is engaging and easy for teens to understand. In this way, awareness about stunting can be spread more quickly and efficiently (Schober et al., 2016).

Technological advances and the availability of social media have increased the popularity of photography, especially among the younger generation. This group has greatly benefited from technological developments, with many of them actively competing to create an attractive image on social media platforms. They actively participate in sharing photos, hoping to get recognition in the form of 'likes' and appreciation from fellow social media users. This phenomenon creates an environment where young individuals feel the need to express themselves through images, forming a digital identity that is valued by their online communities (Murwonugroho, 2020).

Direct interaction through comments, likes, or shares allows discussions to occur between social media users. This can create a space to exchange information, experiences and support regarding the issue of stunting, having a positive impact in increasing understanding and awareness of teenagers. Social media allows the delivery of personal and relevant messages. Stunting awareness campaigns can be tailored to the preferences and characteristics of the teenage target audience, so that the messages conveyed are easier to receive and absorb (Murwonugroho, 2020).

Increasing access and use of social media by teenagers can play an important role in efforts to prevent stunting. Social media can be an effective tool for raising awareness about health problems, including stunting, among teenagers. Through this platform, information and educational campaigns can be easily accessed and distributed to various levels of society (Gabriel & Rohrs, 2017).

Teenagers, as the main users of social media, can be empowered to spread health information and healthy lifestyles to their peers. Content presented via social media can be designed to be interesting and relevant to teenagers, so that they are more likely to engage and share the information. In this way, social media can be an effective means of communication in building awareness about stunting and prevention efforts among teenagers (Latif & Safiee, 2015).

Apart from that, social media also allows the formation of online communities that care about health issues, including stunting. Teenagers can join groups or online campaigns that focus on education and stunting prevention, thereby creating collaboration between teenagers to support healthy lifestyles and provide positive information to the community (Green et al., 2018).

Color grading has a crucial role in the process of creating stunt posters for social media, because it can help create a special atmosphere and direct the emotions you want to convey. The relationship between color and emotion is a very important concept in color psychology. By understanding color psychology theory, poster designers can identify the influence certain colors have on human perception. In the context of making stunting posters on social media, the use of color psychology becomes very relevant because the aim is to evoke emotions in the audience. Coloring chosen wisely can increase the attractiveness of the poster and make it more effective in conveying messages related to stunting (Oktaviandry & Setiadi, 2023).

For example, the color blue, which is often associated with calm and peace, can be used to give the impression that knowing more about stunting is a calm and wise step. On the other hand, the color red, which is often associated with feelings of joy or anger, can be used to highlight the urgency of the stunting problem. It is important to remember that the influence of color on emotions is not necessarily universal and can vary depending on cultural background and individual experiences. However, by using the principles of color psychology correctly, poster designers can create attractive and effective visuals in attracting attention and conveying messages about stunting to audiences on social media (Oktaviandry & Setiadi, 2023).

By utilizing social media effectively, stunting awareness campaigns can reach a wider target audience, increase youth participation in stunting prevention efforts, and in turn, have a positive impact on public health. In the context of researchers using diagrams as a reference to measure research results with the theory explained as follows:

3. Independent Variable:
   Educational Interventions: Representation of the various strategies used in interventions, such as interactive workshops, public campaigns, education through schools, and partnerships with local communities.
4. Mediator Variables:
   Social Media: Playing a mediator role between educational interventions and adolescent stunting awareness. Social media has become a primary communication channel for disseminating information, facilitating interaction, and building supportive online communities.
5. Dependent Variable:
   Stunting Awareness: Representation of the level of understanding and awareness of adolescents about stunting before and after intervention. This level of awareness is measured through surveys, observations and post-intervention evaluations.
3. With theory, this diagram illustrates the relationship between the independent variable (educational intervention), the mediator variable (social media), and the dependent variable (stunting awareness). Educational interventions act as a factor that directly influences stunting awareness, with social media helping to amplify and distribute these educational messages to youth. Thus, stunting awareness is expected to increase as a result of the interaction between these variables (Naomi, 2019).

In this research, the following are several health theories that the author used for this research:

Health Behavior Theory. In this context, this theory can be used to understand adolescent behavior related to nutrition and eating patterns which influence the risk of stunting. The use of the Theory of Planned Behavior or Planned Attitude Theory can help in designing more effective interventions by understanding the factors that influence adolescent behavior.

Ecological Health Theory. This theory is important for understanding the social, environmental and cultural context in which awareness about stunting develops. The Health Ecology Model can help identify social and environmental determinants that influence adolescents' awareness of stunting.

Behavior Change Theory, Given that increased awareness is the result of behavior change, this theory can provide insight into how adolescents go through stages of behavior

change related to understanding stunting. By understanding the stages of behavior change, this research can design interventions that suit the needs of adolescents at each stage.

Social Determinants of Health Theory. This theory considers social, economic and environmental factors that influence the health of individuals and populations. By using this theory, this research can identify influencing social factors awareness of stunting among adolescents and designing interventions that address health inequalities that may exist.

By strengthening the research with a strong theoretical framework, this research can provide a deeper understanding of the factors that influence stunting awareness among adolescents and design more effective interventions to increase it.

Furthermore, the author also uses the theory of lifestyle in psychology, referring to the understanding of how a person's behavior, habits and lifestyle influence psychological well-being and overall health. This theory recognizes that an individual's lifestyle can have a significant impact on various aspects of their life, including physical health, mental health, interpersonal relationships, and life satisfaction.

One theory that is relevant in this context is the Theory of Behavior Change. This theory describes how individuals make changes in their behavior and why they may or may not be successful in changing that behavior. In the context of lifestyle, this theory can explain why someone might start or stop certain habits, such as smoking, eating healthy, or exercising, and what factors influence their success or failure in making these changes (Ambasari et al., 2021).

In addition, the Stress and Adjustment Theory is also relevant because a person's lifestyle is often influenced by stress and the way the individual responds to that stress. This theory considers how stress can influence behavior, sleeping habits, eating patterns, and the use of adaptation strategies in overcoming daily challenges (Ambasari et al., 2021).

The Ecological Theory of Health can also be used to understand a person's lifestyle in the context of their environment. This theory considers how environmental factors, such as where one lives, work, and social environment, can influence an individual's lifestyle choices and their health. (Ambasari et al., 2021).

Using this theoretical framework, research in lifestyle psychology can explain the complexity of the interactions between psychological, social, and environmental factors that influence a person's lifestyle, as well as design more effective interventions to promote positive changes in their lifestyle and well-being. By utilizing the potential of social media wisely, it can be hoped that teenagers as agents of change can participate in efforts to prevent stunting and create a positive impact on public health at large.

Apart from the health theory above, the author also uses Maslow's theory as a research reference. In general, Maslow's theory states that there are five levels of needs which are arranged hierarchically:

1. Physiological Needs:
   These are basic human needs, such as food, drink, air, shelter, sleep, and other biological needs.
2. Security Needs:
   Once physiological needs are met, individuals seek a sense of security and stability in their lives, including physical protection, financial security, health, and job stability.
3. Social Needs/Belongingness:

Once the need for security is met, individuals seek meaningful social relationships, love, and a sense of acceptance by others.

4. Reward/Esteem Needs:
   This is the need for self-esteem and respect from others. This includes the need for achievement, appreciation, recognition.
5. Self-actualization needs:
   This is the highest need in Maslow's hierarchy. This includes the desire to achieve personal potential, grow and develop personally, achieve meaningful goals, and realize oneself.

In Maslow's theory, each level of need must be met before an individual can move on to the next level in the hierarchy. This theory provides an important view of human motivation and needs, and has become one of the most famous theories in psychology and human behavioral science (Maharani & Indrawati 2023).

Extension and training activities in the community have the aim of increasing public understanding regarding awareness of something. These activities are designed to be more interesting and effective in conveying information to participants. Consisting of three main phases - preparation, implementation, and evaluation - this activity begins with the preparation of the necessary materials and technology before it is held. During the implementation, participants were invited to be actively involved with the use of AR and VR technology, while learning about the habitat and role of microalgae. After the activity is completed, an evaluation is carried out to assess its effectiveness and collect feedback from participants for future improvements. It is hoped that this activity can make a positive contribution in increasing public awareness about the importance of awareness of health issues circulating in society to make it better (Murwonugroho & Suryani, 2022).

The main characteristic of the play of visual elements is the identification with striking symmetrical compositions, marking the uniqueness of the visual approach adopted. The existence of symmetry in visual compositions, which is often considered a static aspect, is actually capable of displaying impressive dynamics when supported by visual elements that support each other. The dynamics resulting from a symmetrical composition can be interpreted as the result of a harmonious interaction between visual elements that are visually connected, either through shape, color, texture, or their relative position within the composition (Setiadi, 2021).

In this context, it is important to understand that symmetry does not only imply static balance, but is also capable of creating dynamic visual movement through interacting visual elements. For example, symmetry can be used to create a flowing or spiraling effect of motion, where symmetrically paired elements direct the observer's attention through the composition in an organically flowing manner.

Additionally, when visual elements support each other in a symmetrical composition, it can also create a sense of greater depth and dimension. By exploiting the visual relationships between these elements, a visual work can create compelling depth, where the observer perceives deeper layers and complexity than might be seen at first glance.

Thus, the integration of visual elements that support each other in a symmetrical composition can provide interesting visual dynamics, making the work more impressive and inviting observers to explore it more deeply.

3. RESEARCH METHOD

This research adopted a mixed approach combining qualitative and quantitative methods to investigate the effectiveness of efforts to increase stunting awareness among adolescents. The research stages involved an initial survey to measure youth knowledge about stunting, followed by educational interventions, and ending with an evaluation to assess increased awareness. The study population consisted of adolescents aged 13-19 years from various walks of life, randomly selected to cover social and economic diversity. Data collection instruments include structured questionnaires for initial surveys, as well as workshops, public campaigns and social media as educational methods.

Data analysis was carried out through a qualitative approach with thematic analysis and descriptive statistical analysis for quantitative data. Implementation of the intervention involved interactive workshops, public campaigns using printed materials, and use of social media to reach a wider audience. Ethical aspects of research include obtaining ethics clearance, maintaining participant confidentiality, and ensuring participant or guardian understanding and consent when necessary. This research is expected to provide an in-depth understanding of the effectiveness of strategies to increase awareness of stunting among adolescents and become the basis for developing further intervention programs.

Object of research

The research objects include adolescents aged 13-19 years from various levels of society, taking into account social and economic diversity. Apart from teenagers, parents, guardians, workshop facilitators, campaigns, as well as campaign materials and social media are also research objects.

The research involved an initial survey to measure youth knowledge about stunting, followed by educational interventions, including workshops and public campaigns. Evaluation is carried out through qualitative and quantitative data analysis, including subjective responses, participant views, and statistics on intervention results.

By involving various research objects, it is hoped that this research can provide holistic insight into the effectiveness of strategies to increase stunting awareness among teenagers and the factors that influence the results.

4. RESULT AND DISCUSSION

3. Initial Survey:

   Adolescents' Initial Knowledge Level: Initial surveys show that most adolescents have a limited level of knowledge about stunting. Most of them cannot identify the factors that cause stunting and its impact on growth.

   Quantitative Scores: Quantitative data highlighted low average scores on the initial survey, indicating an urgent need to improve their understanding of stunting.

4. Post-Intervention Evaluation Survey:

   Increased Knowledge: After the intervention, there was a significant increase in adolescents' knowledge about stunting. Questions that were previously difficult to answer now receive more accurate responses.

Attitude Change: The evaluation survey also showed positive changes in youth attitudes towards the importance of nutrition and its impact on body growth. They are better able to identify factors preventing stunting.

5. Statistical Measurements: Quantitative scores show consistent improvements in various aspects of stunting knowledge. Statistical analysis confirmed the significance of these results.
6. Focus Group Interview:
   Adolescent Perceptions and Responses: Focus group interviews highlighted changes in adolescent perceptions and responses to stunting after engaging in intervention activities.
   Main Themes: Identification of main themes included an increased sense of responsibility for personal health and awareness of the importance of good nutrition.
7. Social Media Content Analysis:
   Active Online Participation: Data shows that campaign content on social media has succeeded in attracting the attention of teenagers, with active participation through likes, comments and shares.
   High Reach: The reach of online content reaches a wide target audience, with the dissemination of information through significant digital platforms.

Survey results show that educational interventions, especially through workshops and social media campaigns, have succeeded in significantly increasing teenagers' knowledge about stunting. This improvement includes understanding risk factors, long-term impacts, and steps to prevent stunting. These findings provide a strong basis for concluding that this strategy is effective in achieving the goal of increasing stunting awareness among adolescents.

Strategy to Increase Stunting Awareness among Adolescents

3. Interactive Workshop
   Objective: Organizing an interactive workshop on the topic of stunting, involving discussions, presentations and participatory activities to directly increase youth understanding.
4. Public Campaign:
   Social Media: Leverage social media to spread information about stunting through visual content, infographics and hashtag campaigns to increase youth reach and participation.
5. Education Through Schools:
   Additional Curriculum: Insert educational material about nutrition, stunting, and the importance of a balanced diet into the school curriculum to reach more teenagers on a regular basis.
   Parent Education Sessions: Hold special education sessions for parents to provide additional understanding and support the knowledge their children are gaining.
   Collaboration with Local Communities: Collaborating with local communities to organize outreach activities at the community level, involving teenagers and parents together.
6. Educational Webinars:
   Online Sessions: Organize educational webinars involving nutritionists and doctors to provide more in-depth information about stunting and provide opportunities for teenagers to ask questions.

7. Partnership with Mass Media: News and Health Programs: Collaborate with mass media to provide information about stunting through news, health programs and expert interviews to reach a wider audience.

   By implementing this strategy holistically and sustainably, it is hoped that awareness of stunting among teenagers can increase, having a positive impact on the diet and health of future generations.

The influence of social media on the level of stunting awareness among teenagers

The correlation with the influence of social media on the level of stunting awareness among teenagers includes various aspects that can influence their perceptions and behavior regarding this problem. First of all, social media provides a platform that can be used to disseminate information about stunting, including its causes and how to prevent it. The type of information most accessed by teenagers can be an indicator of the extent to which social media contributes to increasing their awareness of stunting (Yuniarti, 2020).

Apart from that, social media also has a role in shaping teenagers' food consumption patterns. Trends and lifestyles that are often promoted on these platforms can influence their food choices. Therefore, analysis can be carried out to determine whether information related to stunting on social media also has an impact on teenagers' eating patterns, whether they tend to choose nutritious foods or vice versa.

Perceptions of stunting can also be formed through social media, which can influence teenagers' attitudes and behavior towards this problem. Analysis can discuss the extent to which social media plays a role in shaping whether stunting is considered a serious issue or considered trivial by teenagers (Setiawan et al., 2023).

Furthermore, collaboration with health campaigns and related organizations can be an important part of the influence of social media on stunting awareness. Through social media, this collaboration can increase the distribution of campaign messages and invite teenagers to get involved in stunting prevention activities.

By analyzing these various aspects, a deeper understanding can be gained about how social media influences stunting awareness among teenagers, and how this information can be used to design more effective communication strategies. Local communities that focus on preventing stunting through the social media Instagram have succeeded in proving their positive impact in increasing public awareness and participation, especially among teenagers.

This action involves a number of activities and strategies that support the goal of stunting prevention. First of all, this community uses Instagram as the main platform to disseminate educational information about stunting. With informative posts, infographics and captions, they present information in an interesting way that is easy for teenagers to understand. This campaign focuses on the causes of stunting, its impacts, and preventive measures.

Furthermore, the community collaborates with health experts and related organizations to provide more reliable and in-depth information. They also create interactive activities such as quizzes, polls and challenges related to stunting prevention, increasing youth participation and providing a fun learning experience. Local communities also share experiences and testimonials via Instagram Stories or IGTV, involving individuals who have real experience with stunting or have successfully implemented preventive measures. This strategy provides a deeper and more personal understanding (Trinanda et al., 2021).

Gathering support from local influencers who have influence among teenagers is a strategic step. Collaborating with them to support stunting prevention campaigns can reach a wider audience and have a greater impact. The formation of an online community on Instagram is a means to enable teenagers to share experiences, ask questions and provide support to each other. This creates strong social bonds and provides support for those who have questions or concerns about stunting.

The community actively monitors and evaluates the impact of their campaigns through statistical analysis and feedback from followers. This holistic approach creates positive momentum in preventing stunting among teenagers, building awareness, and providing ongoing education through social media, especially Instagram, as the main tool (Ainiyah, 2018).

The government's role in increasing awareness of stunting among teenagers

The government has a significant role in increasing awareness of stunting among teenagers through the Instagram account Indonesiabaik.id. In an effort to provide a better understanding of stunting, the government has become the main producer of educational content on Instagram, providing information about the causes, impacts and steps to prevent stunting. The campaign was specifically designed to raise awareness among teenagers, utilizing visuals such as posters, infographics and short videos on the platform. The government is also collaborating with health experts and specialists to increase the credibility of the information conveyed. Active interaction is carried out through comments features and live broadcast sessions to open up space for discussion and questions from followers.

Creative media, such as images, graphics and short videos, are used to visualize stunting prevention messages in an attractive way. Collaboration with public figures or local influencers is also a strategy to reach a wider audience among teenagers. The government regularly monitors the performance of the Indosiabaik.id account, measures the impact of the campaign, and evaluates its effectiveness using analytical data. All of these roles are part of the government's efforts to ensure the health of the younger generation and prevent the problem of stunting in society (Putri & Nurwanti, 2016)

The Indosiabaik.id social media account is an initiative from the Indonesian Ministry of Communication and Information (Kominfo) which aims to provide education regarding stunting among teenagers with the aim of increasing public awareness. This program reflects the government's efforts to overcome public health problems, especially stunting, by utilizing social media as a means to convey information and positive messages.

Through the social media account Indonsiabaik.id, Kominfo tries to provide educational content that is easy to understand and interesting for teenagers. By utilizing social media platforms, like Instagram, Twitter, or other platforms, this program tries to reach its target audience with an approach that suits the characteristics of teenage users.

The various types of content presented through this account include information about the causes of stunting, its impact, and preventive measures. Apart from that, Indonsiabaik.id may also utilize creative elements, such as infographics, short videos, or animated images, to enrich the way information is presented and make it more interesting.

Collaboration with health experts, influencers, or public figures who have appeal among teenagers can also be part of a strategy to expand the reach and impact of educational

messages about stunting. By involving them, this program can be more effective in conveying stunting prevention messages to teenagers.

Additionally, social media platforms also enable two-way interaction between the program and its followers. Kominfo can utilize comment features, questions and answers, or even live question and answer sessions to increase youth involvement in the topic of stunting and build an online community that cares about this health problem (Khansa & Putri, 2022)

Thus, the Indosiabaik.id social media account can be considered as a concrete manifestation of the Indonesian government's commitment to providing education regarding stunting among teenagers, and at the same time as an effort to create public awareness of the importance of preventing stunting in order to achieve a healthier and more qualified generation.

The effectiveness of social media in increasing awareness of stunting among teenagers

Social media has proven its effectiveness in increasing awareness of stunting among teenagers. In this analysis, several factors can be identified that explain why social media, such as Instagram, Twitter, or other platforms, can play an effective role in promoting understanding and action to prevent stunting among teenagers (Marlinawati et al., 2023).

First, social media provides easy and fast access to information. Teenagers who actively use social media platforms can quickly access educational content about stunting without geographical restrictions. This information can be presented in various formats such as text, images, videos and infographics, making the learning process more interesting and easy to digest.

Second, social media allows two-way interaction between government or health institutions and teenagers. Comment features, direct messages, or even live sessions allow teenagers to actively participate, ask questions, and discuss stunting. This creates deeper and more personal engagement, which can increase their understanding of the issue.

Furthermore, the presence of influencers and public figures on social media can have a significant impact. Collaboration with them allows messages about stunting to reach a wider audience and be well received by teenagers. The existence of idolized figures can increase the appeal of educational messages and make them stick more in the minds of teenagers.

Social media is also effective in creating creative and trendy campaigns. Through the use of visual elements, interesting content and challenges, stunting prevention messages can be presented in a way that is more interesting and easy for teenagers to remember. Creativity in presenting messages can help break through the information noise that often surrounds teenagers in the digital world.

Social media analytics provide deep understanding of campaign performance and user response. Analytics data can provide insight into the extent to which messages reach the target audience, how many interactions occur, and whether there are changes in attitudes or behavior among teenagers.

Overall, social media is a very effective tool in increasing awareness of stunting among teenagers. With a combination of easy access, two-way interaction, the presence of influencers, campaign creativity and in-depth analytics, social media can be a positive force in shaping understanding and action to prevent stunting among teenagers.

Discussion Analysis

Through case studies, IndonesiaBaik.id, through social media accounts, takes an active role in raising awareness about stunting among teenagers. Comprehensive analysis covers various aspects, such as communication strategy, content, user engagement, social impact and partnerships. IndonesiaBaik.id's communication strategy is determined by clear objectives related to stunting awareness among teenagers. Audience targeting becomes the focus, ensuring messages match the characteristics of teenagers, parents or the general public. The content presented tries to provide interesting education. The use of images, graphics and short stories are integrated to increase the attractiveness of the content. Positive and inspiring messages are the choice to create a positive impact.

User involvement is sought through interactive and participatory content. Quizzes, polls and challenges are used to stimulate user participation and understanding of stunting issues. Positive feedback from users is given special attention to create a community focused on positive change. A campaign's social impact is measured by monitoring follower growth, content sharing, and behavior changes. This evaluation is important to assess the extent to which the campaign influences youth attitudes and behavior regarding stunting.Collaboration with health institutions, non-governmental organizations and influencers is a key element in the strategy. This partnership is expected to expand the reach of the campaign and ensure the sustainability of the initiative.

A positive response from the government or community leaders is recognized as an important factor in building public trust in the campaign. This support can strengthen the influence of the campaign in increasing awareness of stunting among teenagers.

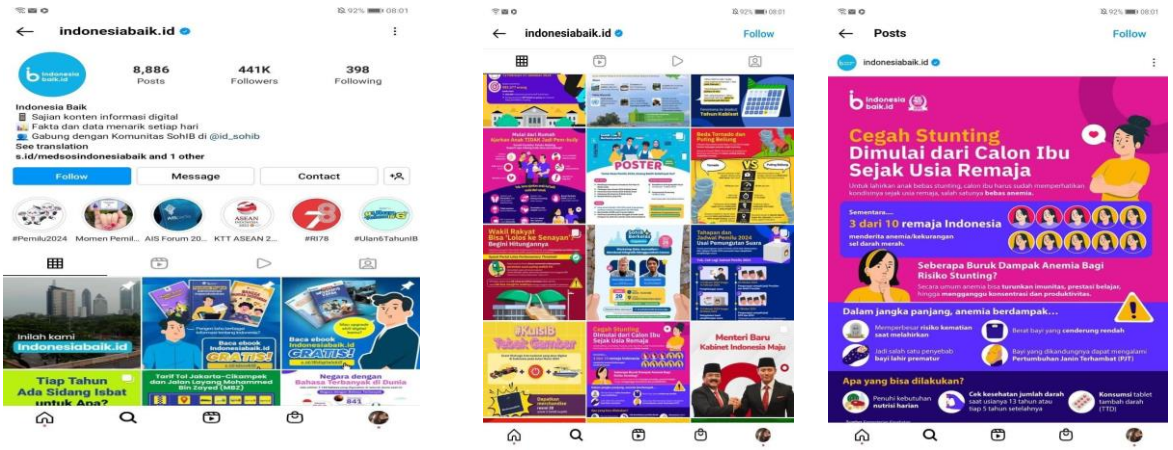


Figure 1. Account instagram Indonesiabaik.id (https://www.instagram.com/indonesiabaik.id)

Figure 2. Postingan akun instagram Indonesiabaik.id
(Source: https://www.instagram.com/indonesiabaik.id)

IndonesiaBaik.id proactively takes an important role in raising awareness about stunting among teenagers through social media accounts. In-depth analysis involves a number of key aspects, including communications strategy, content types, user engagement, social impact, and strategic partnerships.

1. Communication Strategy

   Clear Goals: IndonesiaBaik.id sets clear goals regarding stunting awareness among teenagers. The focus is to ensure the message conveyed is relevant to the characteristics of the audience, such as teenagers, parents and the general public.

   Precise Targeting: Determining the target audience is key in developing a communication strategy. By understanding audience preferences and needs, IndonesiaBaik.id can design more effective messages.

   Content Type: Content is packaged attractively using images, graphics and short stories. This approach aims to make information about stunting easier for teenagers to understand and remember.

   Positive and Inspirational Messages: Content is carefully selected to convey positive and inspirational messages, aiming to create a positive emotional impact on users.

2. User Engagement:

   Interactive Content: Efforts are made to encourage user engagement through interactive content, such as quizzes, polls and challenges. This creates active participation and increases user understanding of the stunting issue.

   Response Monitoring: User responses and participation are carefully monitored. Positive feedback is given special attention, and constructive criticism is used as a basis for improvement.

3. Social Impact:

   Monitoring Follower Growth: The growth of social media account followers is the first indicator of social impact. The rise in followers reflects a growing level of interest and awareness.

   Behavioral Changes: Apart from growth, changes in adolescent behavior are related to stunting

also measured. This data is the basis for evaluating the effectiveness of the campaign.

4. Strategic Partnerships:
   Collaboration with Health Institutions: IndonesiaBaik.id establishes partnerships with health institutions, non-governmental organizations and influencers. This aims to expand the reach of the campaign and ensure that the information conveyed can be scientifically justified.
5. Support from Government and Community Figures:
   The Importance of External Support: A positive response from the government or community leaders is recognized as a crucial factor in building public trust in the campaign. This support can strengthen the influence of the campaign in increasing awareness of stunting among teenagers.

IndonesiaBaik.id continuously evaluates and adjusts strategies based on data and user feedback to ensure the continued effectiveness of stunting awareness campaigns. Overall, IndonesiaBaik.id continues to evaluate and adjust strategies based on data and user responses to increase the effectiveness of stunting awareness campaigns.

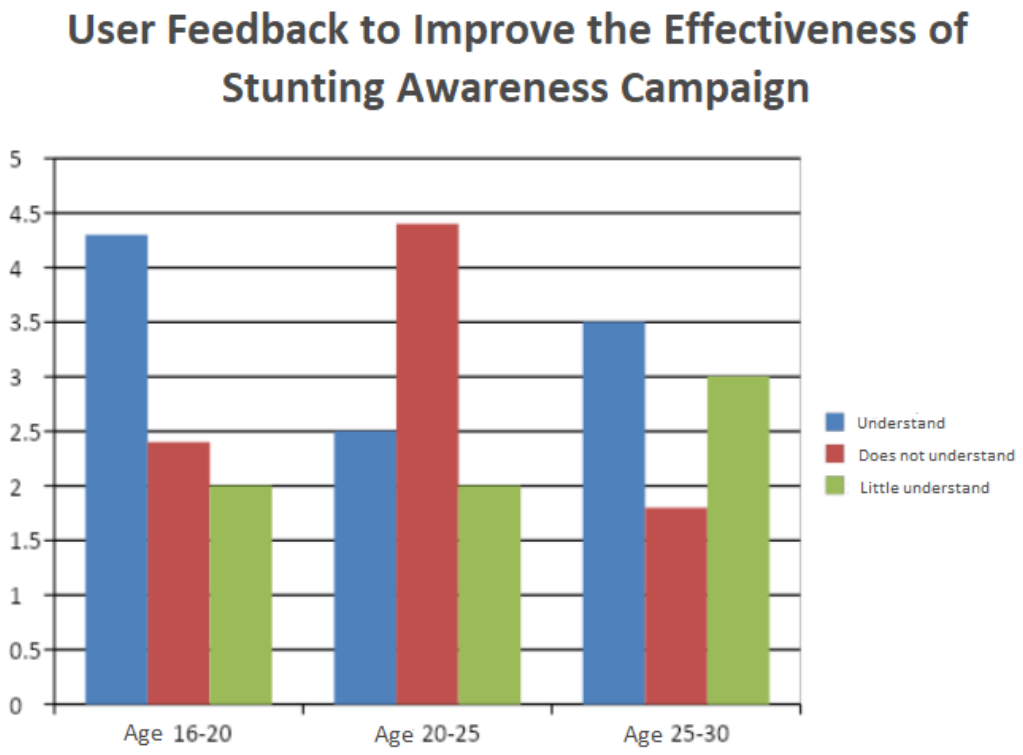


Figure 3. User feedback to ımprove the effectiveness of stunting awareness campaign (Kireyna Dini Nurcahyani, 2024)

This diagram illustrates the age range of teenagers and the level of understanding of stunting awareness in each age range. It can be seen that there are variations in the understanding of stunting awareness between adolescent age groups.

Understanding of stunting awareness tends to increase as teenagers get older. Older age groups tend to have a better understanding of stunting and the factors that influence it compared to younger age groups.

The results of this analysis provide valuable insight into how stunting awareness develops as adolescents age. This suggests that different intervention approaches may be needed for each age group of adolescents to increase their awareness about stunting.

By understanding differences in understanding of stunting awareness between adolescent age groups, this research can design intervention strategies that are more appropriate and appropriate to the needs of each adolescent age group, thereby increasing the effectiveness of stunting prevention programs among adolescents as a whole.

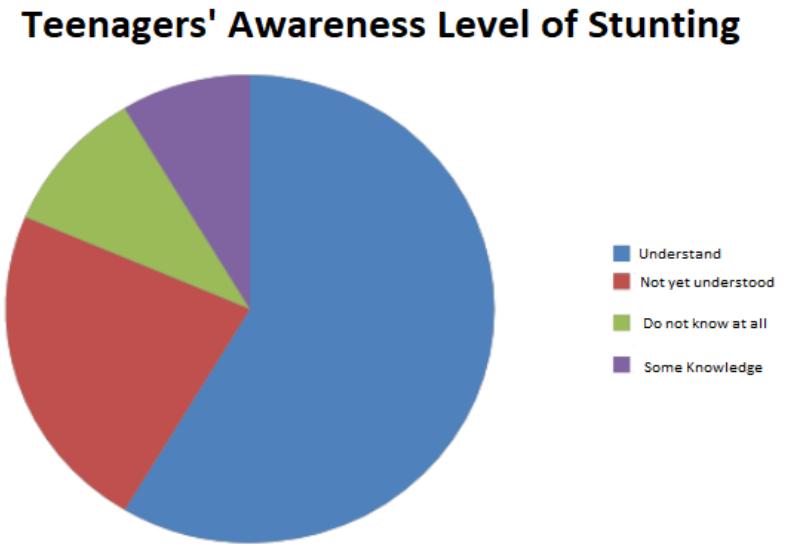


Figure 4. Teenagers' Awareness level of Stunting
(Kireyna Dini Nurcahyani, 2024)

The diagram depicts the increase in the percentage of adolescent awareness from before the intervention to after the intervention. This increase reflects the success of the outreach and training strategies implemented in the research. Apart from that, there has also been an increase in teenagers' understanding of the important role of nutrition and diet in preventing stunting. Apart from that, the diagram shows the active participation of adolescents in intervention activities. The percentage of adolescents involved in activities such as workshops, public campaigns and group discussions increased significantly after the intervention. This shows that the intervention strategy is not only effective in increasing awareness, but is also able to mobilize active participation from teenagers in efforts to prevent stunting.

The results of the discussion analysis using this diagram provide concrete evidence of the success of the intervention in increasing awareness of stunting among teenagers. An increase in the percentage of awareness, understanding and active participation of adolescents is a positive indicator of the effectiveness of the intervention strategy implemented in this research.

5. CONCLUSION AND RECOMMENDATIONS

From the results and discussion that have been described, we can finding that efforts to increase awareness of stunting among teenagers through social media, especially through the IndonesiaBaik.id account, have had a significant positive impact. The strategies implemented, such as interactive workshops, public campaigns on social media, education through schools, webinars, and partnerships with mass media, have proven successful in increasing teenagers' understanding of stunting.

Through post-intervention evaluation surveys, consistent increases in youth knowledge, positive attitude changes, and active online participation were found. Implementation of this strategy creates changes in adolescents' perceptions and responses to stunting, including an increased sense of responsibility for personal health and awareness of the importance of good nutrition.

The influence of social media, especially Instagram, on the level of stunting awareness has also proven to be effective. The combination of interesting educational content, collaboration with local influencers, quizzes, polls, and collaboration with online communities via Instagram creates strong awareness among teenagers. The role of the government, as seen through the Indonsiabaik.id account, shows that the government has an important role in conveying educational messages about stunting through social media. Collaboration with health experts, creative content production, and two-way interaction with followers are the main factors in achieving stunting awareness goals.

Overall, the effectiveness of social media in increasing stunting awareness among teenagers can be seen from various indicators, such as follower growth, active participation, and changes in teenagers' attitudes and behavior. By involving teenagers directly through social media platforms, information about stunting can be spread quickly and reach the target audience in a creative and interesting way. This strategy has a positive impact in creating a society that is more aware of the importance of preventing stunting, as well as establishing healthy eating patterns and lifestyles among future generations.

The existence of the IndonesiaBaik.id account on social media, especially Instagram, is positively related to increasing awareness of stunting among teenagers. This account provides easy access for teenagers to obtain information related to stunting by presenting structured and informative educational content. Stunting prevention messages are delivered in an interesting and relevant way to teenagers' daily lives, helping to arouse their interest and attention.

Through Instagram, the IndonesiaBaik.id account can launch educational campaigns focused on the issue of stunting. By utilizing visuals such as images, infographics, or videos, these messages become more effective in being conveyed and received by teenagers. Active engagement is also built by using interactive features on Instagram, such as questions, polls, or question and answer sessions, which motivate youth participation and increase their understanding of stunting.

Collaborating with public figures or local influencers in stunting prevention campaigns can have a bigger impact. This collaboration broadens the reach of the message and increases appeal, especially if the influencer has a large following among teenagers. IndonesiaBaik.id accounts can use analytical tools on Instagram to monitor campaign performance and gain insight into the extent to which stunting prevention messages reach and influence teenagers.

With analytical data, the account can adjust its communications strategy to increase its impact.

Apart from that, this account can also play a role in building an online community on Instagram that cares about stunting prevention. Through interaction and discussion in the comments, teenagers can support each other and become part of the stunting awareness movement. Overall, the correlation between the IndonesiaBaik.id account and increasing awareness of stunting among teenagers lies in the way the account provides easy access, relevant messages, active involvement, and the formation of a caring community. Through this strategy, the account can act as a positive agent in spreading awareness and knowledge about stunting among teenagers.

REFERENCES

Abate, B. B., Kassie, A. M., Kassaw, M. W., Zemariam, A. B., & Alamaw, A. W. (2020). Prevalence and determinants of *stunting* among adolescent girls in Ethiopia. Journal of pediatric nursing, 52, e1- e6.

Adha, A. (2023). Pola Komunikasi Kesehatan Kader Posyandu Dalam Program Penanggulangan Stunting Di Desa Pabuaran Kecamatan Bojong Gede Kabupaten Bogor (Doctoral dissertation, Universitas Nasional).

Ainiyah, N. (2018). Remaja milenial dan media sosial: media sosial sebagai media informasi pendidikan bagi remaja millenial. Jurnal Pendidikan Islam Indonesia, 2(2), 221-236.

Ambarsari, L. S., Puspitasari, W., & Syahrina, A. (2021). Perancangan Modul Landing Page Dan Pembayaran Pada Website Pahamee Tentang Kesehatan Mental Menggunakan Metode Extreme Programming. eProceedings of Engineering, 8(5).

Asatuti, N. B., Sumardi, R. N., Ngardita, I. R., & Lusiana, S. A. (2021). Pemantauan Status Gizi Dan Edukasi Gizi pada Remaja Sebagai Upaya Pencegahan *Stunting*. ASMAT: Jurnal Pengabmas, 1(1), 46-56.

Daracantika, A., Ainin, A., & Besral, B. (2021). Pengaruh negatif stunting terhadap perkembangan kognitif anak. *Jurnal Biostatistik, Kependudukan, Dan Informatika Kesehatan*, *1*(2), 124-134.

Ernawati, R., Fadzlul Rahman, F., Khoiroh M, S., Rahmah F, D., Milkhatun, M., & Sulistiawati,

J. (2021). The effectiveness of web-based audiovisual media applications in monitoring children's growth to prevent *stunting*.

Gabriel, R., & Röhrs, H. P. (2017). Social Media. Springer Berlin Heidelberg.

Green, D. D., Martinez, R., Kadja, A., Evenson, L., MacManus, L., & Dirlbeck, S. (2018). In a world of social media: a case study analysis of Instagram. American Research Journal of Business and Management, 4(1), 1-8.

Hidayah, N., & Marwan, M. (2020). Upaya pemberdayaan masyarakat dalam menciptakan generasi milenial sadar gizi yang bebas *stunting* melalui kegiatan 1000 HPK. Journal of Community Engagement in Health, 3(1), 86-93.

Huriah, T., Suci, R. A. E., & Puspita, D. (2022). Pre-Marital Education (PME) Program Through Online Media to Improve Behavior on *Stunting* Prevention. Jurnal Aisyah: Jurnal Ilmu Kesehatan, 7(S2), 291-296.

Khansa, S. D., & Putri, K. Y. S. (2022). Pengaruh Sosial Media Tiktok Terhadap Gaya Hidup Remaja. Ekspresi Dan Persepsi: Jurnal Ilmu Komunikasi, 5(1), 133-141.

Kurniawati, S., Riska, N., & Rusilanti, R. (2023). Pengembangan Media Video Animasi Bagi Remaja Putri Untuk Pencegahan Bayi Lahir *Stunting*. Journal of Comprehensive Science (JCS), 2(8), 1278-1291.

Latiff, Z. A., & Safiee, N. A. S. (2015). New business set up for branding strategies on social media–Instagram. Procedia Computer Science, 72, 13-23.

Lina, L., Sulistany, E., Elfida, E., Helm, A., Alchalidi, A., Arbaiyah, A., & Supriyanti, S. (2022). The Use of Media in *Stunting* Extension to Adolescents at Senior High School, Langsa City. Open Access Macedonian Journal of Medical Sciences, 10(E), 1-7.

Maharani, A. F., & Indrawati, I. (2023, July). Penerapan Kandungan Surah Ad-Dhuha pada Desain Rumah Tinggal guna Meningkatkan Kesehatan Mental. In Prosiding (SIAR) Seminar Ilmiah Arsitektur (pp. 30-39).

Marlinawati, D. A., Rahfiludin, M. Z., & Mustofa, S. B. (2023). Education Media about *Stunting* Prevention on Adolescents in Islamic Boarding Schools. Journal of Educational, Health & Community Psychology (JEHCP), 12(3).

Metasari, A. L., Mufida, Y. I., Aristin, S. I., Dwilucky, B. A., Wulandari, A. T., Agustina, N., & Fahrudin, T. M. (2022). Sosialisasi bahaya pernikahan dini sebagai upaya konvergensi pencegahan stunting di SMA Negeri 1 Ngoro. *Budimas: Jurnal Pengabdian Masyarakat*, *4*(2), 305-310.

Moksin, M. V., Muslim, R., & Ishak, S. N. (2022). Pencegahan Stunting Di Wilayah Ternate Melalui Perubahan Perilaku Wanita Hamil. *Jurnal Serambi Sehat*, *15*(1), 27-35.

Muchtar, F., Rejeki, S., Elvira, I., & Hastian, H. (2023). Edukasi Pengenalan Stunting Pada Remaja Putri. *Lamahu: Jurnal Pengabdian Masyarakat Terintegrasi*, *2*(2), 138-144.

Murwonugroho, W. (2020). Pelatihan fotografi dasar sebagai media visual promosi wisata indonesia timur. Jurnal AKAL: Abdimas dan Kearifan Lokal, 1(1).

Murwonugroho, W., Suryani, V., Akkapurlaura, A., Aryo, L., & Rinanti, A. (2022). Penguatan Pembelajaran Jarak Jauh Praktikum Mikrobiologi Lingkungan Berbasis Augmented Reality dan Virtual Reality. Aksara: Jurnal Ilmu Pendidikan Nonformal, 8(1), 677-686.

Naomi, M. (2019). Analisa Dan Perancangan Sistem Pengaduan Mahasiswa Berbasis Web (Studi Kasus: Universitas Mercu Buana Kranggan). JUSIBI (Jurnal Sistem Informasi dan Bisnis), 1(5).

Oktaviandry, S. R., & Setiadi, V. S. (2023). IDENTIFIKASI SKEMA WARNA PADA COLOR GRADING SEBAGAI PEMBANGUN MOOD DALAM FILM ANIMASI PIXAR

"COCO". Jurnal Dimensi DKV: Seni Rupa dan Desain, 8(2), 151-166.

Putri, W. S. R., Nurwati, N., & Santoso, M. B. (2016). Pengaruh media sosial terhadap perilaku remaja. Prosiding Penelitian dan Pengabdian kepada Masyarakat, 3(1).

Resmiati, R. (2021). Efektifitas aplikasi edukasi gizi remaja berbasis android untuk pencegahan

stunting. Jurnal Endurance, 6(2), 443-451.

Rahayu, E. D., & Wulandari, M. D. (2022). Analisis perkembangan kemampuan kognitif anak dengan metode belajar Home Schooling. *Jurnal Basicedu*, *6*(4), 5664-5672.

Rahmawati, R., Tanziha, I., & Briawan, D. (2018). Prevalensi dan Faktor Risiko Kejadian Stunting Remaja Akhir. *Window of Health: Jurnal Kesehatan*, 90-96.

Ruaida, N. (2018). Gerakan 1000 hari Pertama Kehidupan Mencegah Terjadinya *Stunting* (Gizi Pendek) di Indonesia. Global Health Science, 3(2), 139-151.

Schober, M. F., Pasek, J., Guggenheim, L., Lampe, C., & Conrad, F. G. (2016). Social media analyses for social measurement. Public opinion quarterly, 80(1), 180-211.

Setiadi, V. S., Riyanti, M. T., Indralaksemi, I., & Triwardoyo, B. (2021). Pelatihan Kain Shibori Untuk Membuat Kreasi Masker Dan Tas Belanja. Jurnal Abdi Masyarakat Indonesia (JAMIN), 3(1).

Setiawan, A. S., Budiarto, A., & Indriyanti, R. (2023). Eating behavior of adolescent girls in countries with a high prevalence of *stunting* under five: a systematic review. Frontiers in Psychology, 14, 1228413.

Trianandа, S. F., Dewi, D. A., & Furnamasari, Y. F. (2021). Peranan Media Sosial Terhadap Gaya Hidup Remaja. Jurnal Pendidikan Tambusai, 5(3), 9106-9110.

Marlinawati, D. A., Rahfiludin, M. Z., & Mustofa, S. B. (2023). Education Media about *Stunting* Prevention on Adolescents in Islamic Boarding Schools. Journal of Educational, Health & Community Psychology (JEHCP), 12(3).

Metasari, A. L., Mufida, Y. I., Aristin, S. I., Dwilucky, B. A., Wulandari, A. T., Agustina, N., & Fahrudin, T. M. (2022). Sosialisasi bahaya pernikahan dini sebagai upaya konvergensi pencegahan stunting di SMA Negeri 1 Ngoro. *Budimas: Jurnal Pengabdian Masyarakat*, *4*(2), 305-310.

Moksin, M. V., Muslim, R., & Ishak, S. N. (2022). Pencegahan Stunting Di Wilayah Ternate Melalui Perubahan Perilaku Wanita Hamil. *Jurnal Serambi Sehat*, *15*(1), 27-35.

Muchtar, F., Rejeki, S., Elvira, I., & Hastian, H. (2023). Edukasi Pengenalan Stunting Pada Remaja Putri. *Lamahu: Jurnal Pengabdian Masyarakat Terintegrasi*, *2*(2), 138-144.

Murwonugroho, W. (2020). Pelatihan fotografi dasar sebagai media visual promosi wisata indonesia timur. Jurnal AKAL: Abdimas dan Kearifan Lokal, 1(1).

Murwonugroho, W., Suryani, V., Akkapurlaura, A., Aryo, L., & Rinanti, A. (2022). Penguatan Pembelajaran Jarak Jauh Praktikum Mikrobiologi Lingkungan Berbasis Augmented Reality dan Virtual Reality. Aksara: Jurnal Ilmu Pendidikan Nonformal, 8(1), 677-686.

Naomi, M. (2019). Analisa Dan Perancangan Sistem Pengaduan Mahasiswa Berbasis Web (Studi Kasus: Universitas Mercu Buana Kranggan). JUSIBI (Jurnal Sistem Informasi dan Bisnis), 1(5).

Oktaviandry, S. R., & Setiadi, V. S. (2023). IDENTIFIKASI SKEMA WARNA PADA COLOR GRADING SEBAGAI PEMBANGUN MOOD DALAM FILM ANIMASI PIXAR

"COCO". Jurnal Dimensi DKV: Seni Rupa dan Desain, 8(2), 151-166.

Putri, W. S. R., Nurwati, N., & Santoso, M. B. (2016). Pengaruh media sosial terhadap perilaku remaja. Prosiding Penelitian dan Pengabdian kepada Masyarakat, 3(1).

Resmiati, R. (2021). Efektifitas aplikasi edukasi gizi remaja berbasis android untuk pencegahan *stunting*. Jurnal Endurance, 6(2), 443-451.

Rahayu, E. D., & Wulandari, M. D. (2022). Analisis perkembangan kemampuan kognitif anak dengan metode

belajar Home Schooling. *Jurnal Basicedu*, *6*(4), 5664-5672.

Rahmawati, R., Tanziha, I., & Briawan, D. (2018). Prevalensi dan Faktor Risiko Kejadian Stunting Remaja Akhir. *Window of Health: Jurnal Kesehatan*, 90-96.

Ruaida, N. (2018). Gerakan 1000 hari Pertama Kehidupan Mencegah Terjadinya *Stunting* (Gizi Pendek) di Indonesia. Global Health Science, 3(2), 139-151.

Schober, M. F., Pasek, J., Guggenheim, L., Lampe, C., & Conrad, F. G. (2016). Social media analyses for social measurement. Public opinion quarterly, 80(1), 180-211.

Setiadi, V. S., Riyanti, M. T., Indralaksemi, I., & Triwardoyo, B. (2021). Pelatihan Kain Shibori Untuk Membuat Kreasi Masker Dan Tas Belanja. Jurnal Abdi Masyarakat Indonesia (JAMIN), 3(1).

Setiawan, A. S., Budiarto, A., & Indriyanti, R. (2023). Eating behavior of adolescent girls in countries with a high prevalence of *stunting* under five: a systematic review. Frontiers in Psychology, 14, 1228413.

Triananda, S. F., Dewi, D. A., & Furnamasari, Y. F. (2021). Peranan Media Sosial Terhadap Gaya.

CHAPTER 11

Farmer's School for Farmer's Work Groups Using Environmentally Friendly Rat Repellent

Wahyu Sejati*
Departement of Civil Engineering, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
wahyu.sejati@trisakti.ac.id
Orcid: 0000-0002-1189-7541

Daisman Purnomo Bayyu Aji
Department of Mechanical Engineering, Faculty of Industrial Technology
Universitas Trisakti, Jakarta, Indonesia
daisman.aji@trisakti.ac.id
Orcid: 0000-0001-6132-3936

Tjhwa Endang Djuana
Department of Electrical Engineering, Faculty of Industrial Technology,
Universitas Trisakti, Jakarta, Indonesia
edjuana@trisakti.ac.id
Orcid: 0000-0002-2530-521X

Maïssa Bigué NGOM
Polytech Nantes, France

ABSTRACT

Rats are one of the pests that cause damage which causes huge losses for farmers because rats can attack all phases of rice plant growth, even during the storage phase. The worst damage occurs in the generative phase, because rice plants are no longer able to form new tillers. Analysis of the situation: In general, mice attack at night while during the day the mice hide. In rice cultivation in the Bendung sub-district, Bendung sub-district, specifically in Cibomo village, the presence of rats is very numerous, causing a lot of losses for farmers, especially rice farmers. Farmers have carried out control of rat pests from an early age, namely from before planting until the time leading up to harvest. Some of the rat pest control techniques that farmers have used are by using pesticides and this is only done if the rat attack has reached a very worrying stage. The method of implementing community services of program for farmer schools for the Karya Tani Farmers Group uses rat repellent devices socialization, training, application of technology, mentoring and evaluation as well as program sustainability. The farmer group achievement targets are explained in terms of the target partners' achievement targets in terms of 2 aspects, namely the production aspect and the marketing aspect with the hope of increasing farmers' income. The result of this community service activity is a tool that uses ultrasonic waves with a frequency that can be adjusted between 25 kHz-90 kHz. (14) This tool will make mice leave the inhabited area or when they are in that area. This tool will also kill mice if the ultrasonic wave frequency is set very high and varied (70-90 kHz).

In this community service program, it can be concluded that This environmentally friendly rat repellent tool can repel and kill rat pests so that it can increase rice production. This will increase the income of farmers.

Keywords: Rat, Environmentally Friendly, Farmer, Production, Income.

1. INTRODUCTION

Rats are one of the pests that cause damage that causes huge losses to farmers because rats can attack all phases of rice plant growth even in the storage phase. The worst damage occurs in the generative phase, because rice plants are no longer able to form new tillers. **Analysis of the situation** in general, rats attack at night while during the day rats hide. In rice plantations in the Bendung Sub-district area, precisely in cibomo village, the presence of rats is very much so that it causes a lot of losses for farmers, especially rice farmers. Control of rat pests has been carried out by farmers since early on, namely from before planting until the period leading to harvest. Some rat pest control techniques that have been carried out by farmers are by using pesticides and it is only done if the rat attack has reached a very worrying stage.

Figure 1. Rat holes in rice fields

A number of farmers in Bendung Village, Kasemen Subdistrict, complained about rats attacking their rice plants. As a result, they failed to harvest and lost tens of millions of rupiah. Erratic weather conditions are considered to be one of the triggers for the high number of rats. a number of rice plants appear tall and yellowish in color. At the edge of the rice field, the rice plants still have complete grains.Meanwhile, the rice planted in the center is shorter and has no grains. The rat infestation occurred when farmers were just entering the planting season, rats attacked the rice stems so that they grew imperfectlyand could not bear fruit, the rice plants that were actually ready to harvest were damaged by rats from the start of the planting season until the last 3 months when the farmers wanted to harvest (1). The pest attack has made farmers anxious, because rats do not only attack rice plants that have begun to bear fruit(2). Rice field rats (Ratus argentiventer) are relatively difficult pests to control. The rapid breeding of ratpests and the high destructive power of plants cause rat pests to always be a threat to every crop.

Damage to plants caused by rat attacks is very large, because it attacks plants from the time they are planted until just before harvest. In this regard, control efforts to reduce rat populations must be carried out continuously from pre-planting to harvest using various integrated techniques (3). Rat pests, attacking rice plants since the nursery process, can

damage plants with severe damage (4). The purposeof this Community Services Program is to provide solutions related to 2 problems, namely from the production aspect t o increase the quantity of products and the marketing aspect to increase the income turnover o f farmers.

2. LITERATURE REVIEW

Rats are one of the characteristic rodents detrimental both in the home and industry [1]. The events that cause the majority of people to be irritated are when lots of mice roam around the house, like kind rats Rattus rattus, Rattus tanezumi, and the like. In Besides being disgusting, the presence of mice can also be cause health problems for many people who did everything he could to drive away even Get rid of rat pests, both rat pests in the house or rat pests in the agricultural sector [2]. Based on these problems, there are various ways which incidentally is used to repel and eradicate mice. These methods include rat poison, rat traps, and electric rat repellent. Of these various ways you can alone has advantages and is effective in repelling mice,

but on the other hand there are functional weaknesses. Rat poison which has been mixed with food as a trap capable of causing a pungent odor where it is can be caused by dead mice (Wijanarko, 2017).

Apart from that, nowadays traps are often found electricity to eradicate rat pests where this tool is Simple technology that is effective in eradicating mice at a time. However, there is a weakness in this tool, namely: When this tool is used the level of security is less can harm other people. However, with the development of science and Current technology, especially in the field of electronics, exists one of the systems proclaimed as a rat repellent namely ultrasonic sound technology. The reason this technology was discovered is because Rats are one of the animals that have sensitivity high resistance to ultrasonic waves with a long range listen around 5-60 kHz. Under certain conditions even This range can be more than 100 kHz (Wijanarko, 2017).

However, with the development of science and Current technology, especially in the field of electronics, exists one of the systems proclaimed as a rat repellent namely ultrasonic sound technology. The reason this technology was discovered is because Rats are one of the animals that have sensitivity high resistance to ultrasonic waves with a long range listen around 5-60 kHz. Under certain conditions even This range can be more than 100 kHz (Wijanarko, 2017). Send feedback Side panels History Saved

3. RESEARCH METHOD

In the implementation of farmer school activities, it is based on higher education. Problems identified by academics are followed up through farmer schools with two-way interaction through synergy between the Trisakti University team with funding submitted to the government through the Ministry of Education and Culture-Ristek with target partners, namely the Karya Tani Group. The method of implementation stages can be seen in Figure 2.

The stages of implementing the PKM farmer school to the Karya Tani Farmer Group using ratmidges are as follows:

1. Socialization

   The implementation of initial socialization is needed to provide information to farmer

groups that there will be Community Service (PKM) activities. The target of this achievement is the understanding of the farmer work group to solve the problems that have been agreed upon.

2. Training

   This training is planned for the design of an environmentally friendly rat repellent device. (9) and to improve the marketing aspect, which currently uses conventional marketing. This requires training to farmer work groups to *transfer knowledge* to farmers. The target achievement of this activity is the completion of the design of an environmentally friendly rat repellent (10). Business management training was provided with business model canvas material (11).

3. Application of Technology

   With the completion of the rat repellent tool, the next step is to apply the technology in accordance with the tool specifications and tool performance. This is to solve problems related to rampant rat pests in the rice fields of farmer work groups. The target achievement of the application of technology is to reduce the number of rat pests in the rice fields. (12)

4. Mentoring and Evaluation

   Production and marketing aspects will be assisted and evaluated to improve the welfare and independence of the farmer work group.

5. Program Sustainability

   This community service activity will be planned for the sustainability of the program with a team of lecturers from Trisakti University either from campus funding or other funding sources.

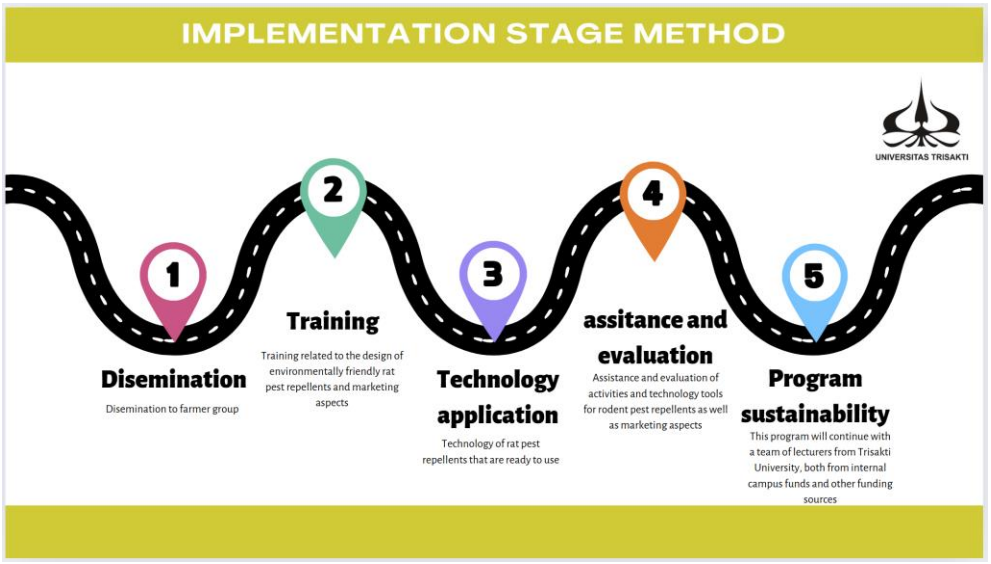


Figure 2. Method of stages of PKM Farmer School implementation

Target Achievement of Target Partners

In Figure 3, it is explained that the target achievement of target partners in terms of 2 aspects, namely the production aspect and the marketing aspect in the hope of increasing farmers' income.(13)

Partner Participation

In the implementation of this program, partners participated by providing a place for socialization, training and mentoring and donating land for the placement of environmentally friendly rat repellents. The farmer group is also willing to provide field assistance in this activity. **Evaluation of program implementation and program sustainability** in the field after the activity is completed is carried out by the PkM implementation team through a periodic monitoring and evaluation process by maintaining communication with participants in the WA group. The sustainability of the program will be followed up with the Internal PKM of Trisakti University in 2025.

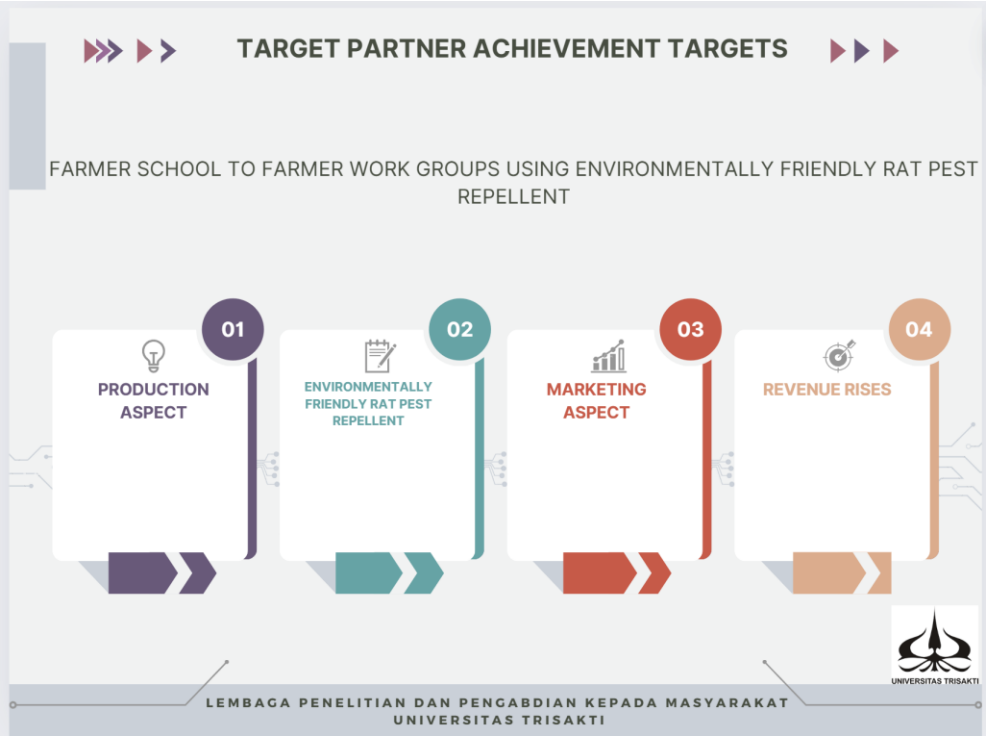


Figure 3. Target Achievement of Target Partners

4. RESULT AND DISCUSSION

This device uses ultrasonic waves with a frequency that can be adjusted between 25 kHz- 90 kHz.(14) This device will make rats leave the inhabited area or while in the area. It will also kill mice if the frequency of the ultrasonic waves is set very high and varied (70-90 kHz).(15)

Tool Specifications:

1. Effective coverage area 1 ha (10,000 m2)
2. Power required 50 Watts
3. Dimensions (main part): 100 cm x 40 cm x 40 cm
4. Monocrystalline solar panel 200 W

Solar charge controller:

1. MPPT 30A
2. 12V 50Ah Battery
3. 30W ultrasonic transmitter module

programmable)

Advantages:

1. 99% effective at repelling and killing mice
2. Wave frequency can be adjusted/programmed
3. Power source using solar energy (200 W solar power plant)
4. 24/7 uptime
5. Small appliance installation area (40 x 40 cm2)
6. Panel box and pole of stainless construction

The eco-friendly rat repellent system can be seen in Figure 4.

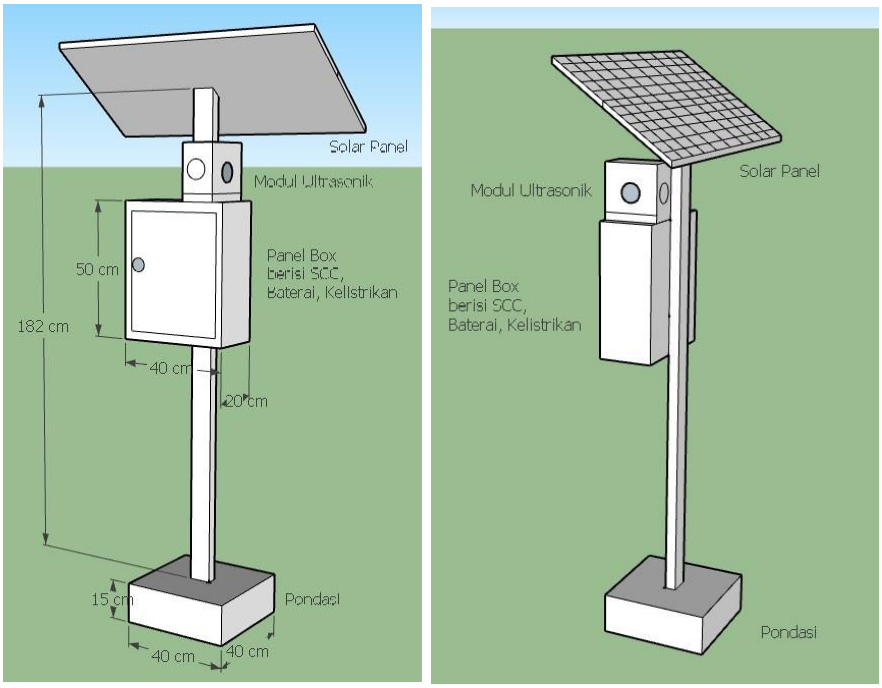


Figure 4. Schematic of the rat repellent system in rice fields & plantations

5. CONCLUSION AND RECOMMENDATIONS

This community services program produces an effective rodent pest repellent to increase rice crop production. Before the existence of rat pest repellents, one rice harvest produced 5 tons/hectare. After the existence of rat pest repellents, one harvest of rice can produce 6 tons/hectare. This means that there is an increase of 1 ton/hectare. So it can be concluded that this tool is sufficient to repel rat pests withultrasonic sound. However, the application of rat expulsion using ultrasonicsound does not have an impact on rat pests directly, because based on the testscarried out, it takes some time for rats to be affected or disturbed by ultrasonicsound. The design of a prototype mouse repellent device using ultrasonic waveshas been successfully carried out using a PIR sensor as a mouse movementdetector, a sensor as an input that is read by a microcontroller which is thenprocessed and sent to Blynk via internet connectivity. The results of theultrasonic sound generator test show that it is able to make mice disturbed witha few seconds of delay.

(3) (PDF) Rancang Bangun Prototype Alat Pengusir Tikus Dengan Pemanfaatan Gelombang Ultrasonik Berbasis Internet Of Things. Available from: https://www.researchgate.net/publication/363165735_Rancang_Bangun_Prototype_Alat_Pen

gusir_Tikus_Dengan_Pemanfaatan_Gelombang_Ultrasonik_Berbasis_Internet_Of_Things [accessed Jul 05 2024]..

REFERENCES

Firin Kalundra. Due to Rats, Some Farmers in Pagertoyo Failed to Harvest. [cited 2024 Mar 31]; Available from: http://pagertoyo.desa.id/kabardetail/UVN6V3V5MllEV3BnZndiSHFYSXhxQT09/akibat-hama- rats-some-farmers-in-pagertoyo-failed-harvest.html

Joshua Martin Sihotang. Rat Pests Attack Rice Plants Owned by Farmers in Sumbul - My Village - Dairi Journal - Present to Enlighten. [cited 2024 Mar 31]; Available from: https://jurnaldairi.com/berita/baca/2022/10/19/798/hama-tikus-serang-tanaman-padi-milik- farmers-in-sumbul/

Admin. Bojonegoro District Food Security and Agriculture Office. [cited 2024 Mar 31]; Available from: file:///C:/Users/wahyu/Downloads/Dinas%20Ketahanan%20Pangan%20and%20Pertanian%20Kabupaten%20Bojonegoro.html

Editorial. Hundreds of Rats Attack Agricultural Land. [cited 2024 Mar 31]; Available from: https://www.radarbanten.co.id/2020/07/06/ratusan-tikus-serang-lahan- pertanian/

Anggraini N, Fatih C, Zaini M, Humaidi E, Negeri Lampung P. DIGITAL MARKETING OF AGRICULTURAL PRODUCTS IN VILLAGE SUKAAWARINGIN KECAMATAN BANGUNREJO DISTRICT LAMPUNG

CENTRAL [Internet]. Vol. 1, National Service Journal. [cited 2024 Mar 31]. Available from: https://www.semanticscholar.org/paper/DIGITAL-MARKETING-PRODUK-PERTANIAN-DI- DESA-LAMPUNG-Anggraini-Sutarni/5936088dd08904d7c2169dd3a72cb52624f3cdd7

Asfani DA, Satriyadi Hernanda IGN, Yulistya Negara IM. Solar Cell Based Automatic Pest Exterminator in Pranggang Village, Kediri Regency. Sewagati. 2022 Mar 17;6(3):1-8.

Trymastuty B, Alfannisa HR, Dianastiti FE. MARKETING AGRICULTURAL PRODUCTS OFPASURUHAN VILLAGE, MERTOYUDAN SUB-DISTRICT, THROUGH SOCIAL MEDIA: STRATEGIES

structured mentoring Article History. 2020 [cited 2024 Mar 31];1(1). Available from: file:///C:/Users/wahyu/Downloads/3148-9869-1-PB.pdf

Ramdhani AR. Due to Long Drought, Rice Productivity in Serang Regency Declines. [cited 2024 Mar 31]; Available from: https://www.radarbanten.co.id/2023/10/12/akibat- kemarau-panjang-produktivity-padi-in-serang-district-declines/

Iqbal M, Rahayu AU. Arduino Uno and Ultrasonic Wave Based Rice Field Rat Repellent Device. Vol. 1, JOURNAL OF ENERGY AND ELECTRICAL ENGINEERING (JEEE). October;

Pratiwi DA, Yunus M, Utomo WP, Hanan IA. APPLICATION OF A RAT EXTERMINATOR UTILIZING SOLAR ENERGY SOURCES IN DELINGAN VILLAGE, DISTRICT KARANGANYAR. Kumawula: Journal of Community Service. 2023 Feb 8;6(1):91.

Aji DPB, Sukarnoto T, Astuti P. Implementation of Fish Feed Pellet Making Machine for Freshwater Fish Farming Groups in RW 04 Jatibening Baru Village, Bekasi City. Dinamisia: Journal of Community Service. 2023 Apr 30;7(2).

Juniansyah Arifandi R, Junus M, Kusumawardani M, Digital Telecommunication Network Studies P, Electrical Engineering J, State of Malang P. Bird and Rat Pest Repellent System onRice Plants Based on Raspberry pi.

Asmarantaka RW. Agribusiness Marketing Concepts: An Economic and Management Approach. [cited 2024 Mar 31]; Available from: file:///C:/Users/wahyu/Downloads/22140- Article%20Text-67856-1-10-20180717.pdf

Sandy MFR. Frequency-based Automatic Rat Repellent System_Muhammad Sandy. [cited 2024 Mar 31]; Available from: file:///C:/Users/wahyu/Downloads/JURNAL_Muhammad%20Sandy.pdf

Gelombang P, As U, Tikus PP, Wahyuni S, Ningsih S. Utilization of ULTRASONIC WAVES as a mice removal device [Internet]. [cited 2024 Mar 31]

CHAPTER 12

Digital-Driven Public Space Design and Creative Placemaking for Enhancing Urban Resilience and Community Well-Being in Indonesia

Nurhikmah Budi Hartanti
Departement of Doctor of Architecture Program, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
nurhikmah@trisakti.ac.id
Orcid: 0000-0002-6056-732X

Achmad Hadi Prabowo
Departement of Doctor of Architecture Program, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
hadi.prabowo@trisakti.ac.id
Orcid: 0009-0001-3163-6226

Purnama Sahrial Pradini
Departement of Doctor of Architecture Program, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
Orcid: 0009-0000-5546-0264

Albertus Prawata
Departement of Doctor of Architecture Program, Faculty of Civil Engineering and Planning,
Universitas Trisakti, Jakarta, Indonesia
Orcid: 0009-0001-5681-0841

ABSTRACT

Rapid urbanization in Indonesia brings challenges such as resource inefficiency and environmental degradation. Thoughtful designed public spaces, can serve as vital components of urban resilience by fostering social cohesion, economic vitality, and environmental sustainability. This chapter explores the transformative role of digital tools, and online platforms in the design and development of public spaces in Indonesia, focusing on enhancing urban resilience, community well-being and creative place making. By leveraging digital engagement for participatory planning and data-driven decision-making, the study integrates social, economic, environmental, and technological perspectives to address urban challenges. The chapter employs an integrative approach, including literature review, online data collection from social media, public forums, digital surveys, and case study analysis. Case studies from Indonesia show that these digital tools can help capture community input, leading to more inclusive and responsive urban planning processes. The results suggest that digital engagement and creative place making enhances both inclusivity and the effectiveness of public space design, to ensure that these spaces meet the diverse needs of urban populations. The chapter also discusses interdisciplinary solutions for sustainable public spaces, emphasizing the importance of collaboration between government, private sector, and communities. Challenges such as insufficient digital infrastructure, low public awareness, and policy gaps are discussed to present a broader picture. Exploring the intersections between community needs, digital technology, creative placemaking and sustainable design, this chapter presents a new view on how public spaces can contribute to urban resilience. It concludes with practical recommendations for policymakers, urban planners, and community organizations to foster sustainable urban environments resilient to socio-economic and environmental challenges. This integrated approach aims to pave the way for future research and practice in the region, ultimately contributing to the development of sustainable and resilient cities in Indonesia.

Keywords: Public space design, Digital engagement, Urban resilience, Community well-being, Creative place making, Participatory planning, Sustainable development.

1. INTRODUCTION

Rapid urbanization in Indonesia has caused various problems related to resource inefficiency and environmental degradation. The expansion of urban areas and population growth that is not balanced with environmental carrying capacity has caused a crisis of limited resources, such as air and energy, and contributed to increased pollution and waste production. The loss of green open space due to interstitial urban growth intensifies the urban heat island effect and reduces biodiversity. Moreover, rapid urbanization inevitably impacts urban resilience and the well-being of residents. Urban congestion and poor environmental quality significantly increase the prevalence of infectious diseases and mental health problems, especially in urban areas where access to health services and support may be uneven (Jackson 2003; Liyanto et al. 2022). This highlights the importance of designing urban environments to foster health and well-being of the inhabitants. The presence of public spaces in urban density can mitigate these problems by promoting sustainable resource use and improving environmental quality. Well-designed public spaces can incorporate green infrastructure and provide areas for water management and support local ecosystems. Therefore integrating nature into urban design including in the form of public space can improve psychological well-being, creating a healthier living environment for residents (Adiwena and Djuwita 2019; Giyasih 2017).

Public spaces refer to all places that are accessible to the public without any restrictions (Carmona 2010; Garau, Lancerin, and Sepe 2015; Hartanti et al. 2019). This definition is not limited to open spaces, it also includes closed spaces and even places owned by private but open for public. Urban resilience refers to a city's capacity to withstand, adapt, absorb, and recover from shocks and stresses of various challenges such as climate change, natural disasters, and socio-economic shifts, while maintaining essential functions and overall well-being as well (Ribeiro and Pena Jardim Gonçalves 2019). As the center of social interactions, public space plays a crucial role in enhancing urban resilience by providing adaptive spaces for communities and improves community well-being through accessible and inclusive spaces, which means promoting environmental sustainability, social inclusion, and community well-being. Research shows that public spaces play an important role in improving urban resilience and community well-being. Studies in Indonesia show that green and public open spaces not only improve environmental quality but also improve physical and mental health, including by providing sports facilities in green open spaces that have a positive impact on public health by encouraging physical activity and providing a healthy environment, as well as fostering environmental sustainability and social interaction (Megayanti and Fitria 2020; Sutanto and Junadi 2019). Even during the pandemic, people's preference for public open spaces has increased along with growing awareness of the need for exercise to boost immunity (Gehl 2020; Hartanti and Prabowo 2023). In addition, strategic public space planning can significantly improve community resilience to natural disasters (Dwirahmadi et al. 2019). These findings underline the multifaceted benefits of public spaces in urban environments, which contribute to environmental and human health.

The evolution of public space design reflects a growing focus on resilience policies, especially concerning to health (Battaglia, Cognigni, and Vettori 2023). The reactivation and enhancement of interstitial spaces within cities contribute to increased urban resilience, especially in response to the climate crisis and pandemic (Cognigni 2022). The existence of

public green spaces is essential for mitigating the impacts of climate change and maintaining human relationships with nature, thus the need to redefine these spaces for urban resilience (Egerer et al. 2024). In addition, integrating various functions into underground public spaces can maximize the utilization of urban space, but also requires comprehensive risk analysis and resilience enhancement strategies to ensure safety and disaster management. Overall, the design of public spaces serves as a key component in building resilient cities that can adapt to various challenges and promote sustainable development (Egerer et al. 2024).

In the design of public spaces, there is an important process called placemaking. It refers to the process that combines the needs and aspirations of the community into the creation and management of public spaces. This process emphasizes the involvement of local communities in the design process to ensure that the space reflects their social, cultural, and economic needs. It is the intentional creation of spaces that foster the connection between individuals with their physical and spiritual environment, promotes community engagement, and a sense of place identity (Fingerhut and Alfasi 2023). By implementation of place-making, communities can develop vibrant social interactions, and inclusive, livable settings that strengthen local identities and community cohesion (Rachev, Chan, and Pua 2020). Research shows that effective placemaking can significantly improve community well-being by fostering a sense of belonging, encouraging social interaction, and improving environmental quality (Frąckowiak 2023; Peinhardt 2021; Rachev, Chan, and Pua 2020). This strategy makes it possible to create places with unique identities.

In this era of digital technology, people can utilize the internet and the application of digital technology in the creative creation of public spaces. Digital media can also help stakeholders to collaborate, share information, and disseminate knowledge, which can encourage territorial-based innovation and organizational learning in society (Entezarinajafabadi and Roig 2023). Combining digital and physical environments in placemaking can empower local communities, and foster a sense of community ownership, while enabling distributed participatory design which is needed in times of constraint such as the COVID-19 pandemic (Gonsalves 2023). The integration of digital technology in public space design significantly impacts the user experience by enhancing the environment, shaping spatial identity, and creating dynamic elements. The integration of digital technology in public space design has a significant impact on user experience by enhancing the environment, shaping spatial identity, and creating dynamic elements. Digital technology has played a significant role in transforming public spaces, by enhancing the overall experience of users and thus influencing their aesthetic and psychological preferences. In addition, the role of the digital world in shaping spatial identity through urban screens, social media, and online interactions is crucial to planning and designing public spaces effectively (Costa, Artopoulos, and Djukic 2018). By using digital technology, public spaces can be transformed into engaging and interactive environments that meet the diverse needs and expectations of users, ultimately enhancing their overall experience.

Digital technology has become an important tool in the design of creative public spaces in Indonesia, by increasing local empowerment and fostering a sense of community. The design of digital public spaces has become more popular, particularly with the use of advanced technologies and community-based strategies. The integration of digital technology in the spatial planning process has been proven to improve the quality of urban spaces and

support arts and cultural activities. In addition, digital art technology has been widely adopted in Indonesia. The advantages of these digital tools enable innovative approaches to design and production, thereby supporting sustainable community development and cultural preservation. This paper explores how digital technology helps in public space design to promote urban resilience.

2. DIGITAL ENGAGEMENT IN PUBLIC SPACE DESIGN AND CREATIVE PLACEMAKING

The use of digital technology in public space design and creative placemaking has brought many changes to the landscape of public space design. By utilizing the Internet of Things (IoT), as well as digital platforms and devices, the public can participate more actively in the planning process, thereby promoting a sense of ownership, and increasing urban resilience and community well-being. Digital technology or platforms have become essential as innovative tools for interaction and collaboration between stakeholders in participatory planning and creative placemaking. They can facilitate communication, gather input, and ensure transparent decision-making processes by engaging communities in the planning and design of public spaces. This is essential in creative placemaking processes, where the integration of arts, culture, and community-based planning is needed to revitalize public spaces, promoting social cohesion and resilience. However, the use of these technologies to support social participation in the planning and design of public spaces requires technical capacity and literacy in Information and Communication Technology (ICT) and digital networks (Alvarado Vazquez et al. 2023).

By leveraging digital technologies such as participatory digital tools, social media reach and coverage, and multi-user digital environments, citizens can actively collaborate with local governments, to create design solutions, and influence decision-making processes. These tools not only empower citizens to be more engaged and collaborative in city development, but can also positively contribute to a community's sense of ownership of its environment, leading to more inclusive growth and sustainable urban development (Deniz 2023; Entezarinajafabadi and Roig 2023). Overall, digital technologies offer a path for inclusive design, community empowerment, and meaningful engagement with the urban environment. The integration of digital platforms and creative placemaking strategies enhances public participation, fosters a sense of ownership among community members, and ultimately leads to more equitable and resilient future cities. Digital tools can significantly increase stakeholder engagement by providing a platform for discussion and collaboration.

The role of digital technology as community engagement in the design process can take in several functions, including collaborative workspaces, social media platforms, virtual reality environments, and participatory mapping tools, each of which contributes to a more effective and inclusive planning process (Shantiko et al. 2021).

a. As Collaborative Workspace

Digital collaborative workspaces are designed to enhance stakeholder engagement by facilitating communication and collaboration that is not limited by space and distance. These digital environments integrate project management capabilities, video conferencing, and file-

sharing tools, allowing stakeholders to collaborate in real-time or asynchronously, without physical presence (Chowdhury and Lamacchia 2019). Although it has been known since the late 2000s, a dramatic increase in the use of digital collaborative workspaces due to the global shift to remote work triggered by the pandemic, making these tools essential for maintaining business continuity and team productivity. This approach has also been shown to increase multigenerational participation in digital transformation efforts and foster a culture of engagement and collaboration. Some examples of popular digital collaborative workspaces include Google Workspace, Microsoft Teams, Slack, Miro, Zoom, etc. Digital Collaborative Workspace has features that allow several parties to discuss and work on a project together without having to be physically in the same place. The advantages of these features include:

- As a real-time communication tool in the form of written chat or video conference.
- Working on a shared document, for shared document editing and file storage.
- As a Project Management tool in delivering scheduling, task assignments, and progress tracking.
- Can be integrated with each other or with various tools and other software (
- Easy accessibility via mobile and desktop access to ensure collaboration can happen anywhere.

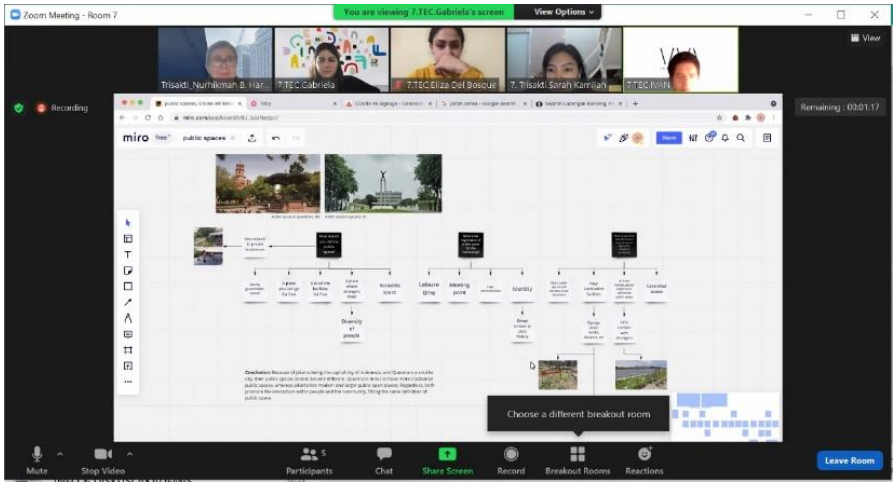


Figure 1. Example of Zoom and Miro integration for collaborative work between Architecture students in Universitas Trisakti Indonesia and TEC de Monterey Mexico in Public Space Design class.

b. Interactive Social Media and Digital Platforms

Social media and digital platforms have changed the concept of public space, where the notion of "space" is no longer limited by physical space. This is further strengthened by the pandemic conditions that actually limit physical interaction, so that for a while social media and digital platforms were considered a threat to the existence of urban public space (Languillon-Aussel 2022). However, in the end, urban designers can integrate social media into the process of public space design and creative spatial planning significantly by encouraging increased community involvement and collaborative design processes. Social media platforms such as Instagram, Tik-tok and collaborative platforms like Edmodo and GoodReader are effective tools for participatory planning and design. They enable broad

public participation, facilitate sharing of ideas, and enhance transparency in decision-making processes.

The integration of social media into architectural design has facilitated participatory spatial planning strategies. Urban designers, governments and communities can easily share ideas and provide direct feedback, thereby strengthening the relationship between people and places, and enhancing local identity through digital storytelling and cultural mediation. The use of location-based social networks also allows for collaborative use of public space that fosters a strong sense of community and ownership (Brunnberg and Frigo 2012; Maspoli 2014; Tsai and Dewancker 2022). Furthermore, digital platforms can also serve as a tool to combine technology and art to create flexible and dynamic public spaces that encourage public contribution and interaction (Mansilla & Perkis, 2016). These findings underscore the potential of digital tools in making public spaces more inclusive, interactive, and reflective of community needs and aspirations, thereby enhancing urban resilience and community well-being.

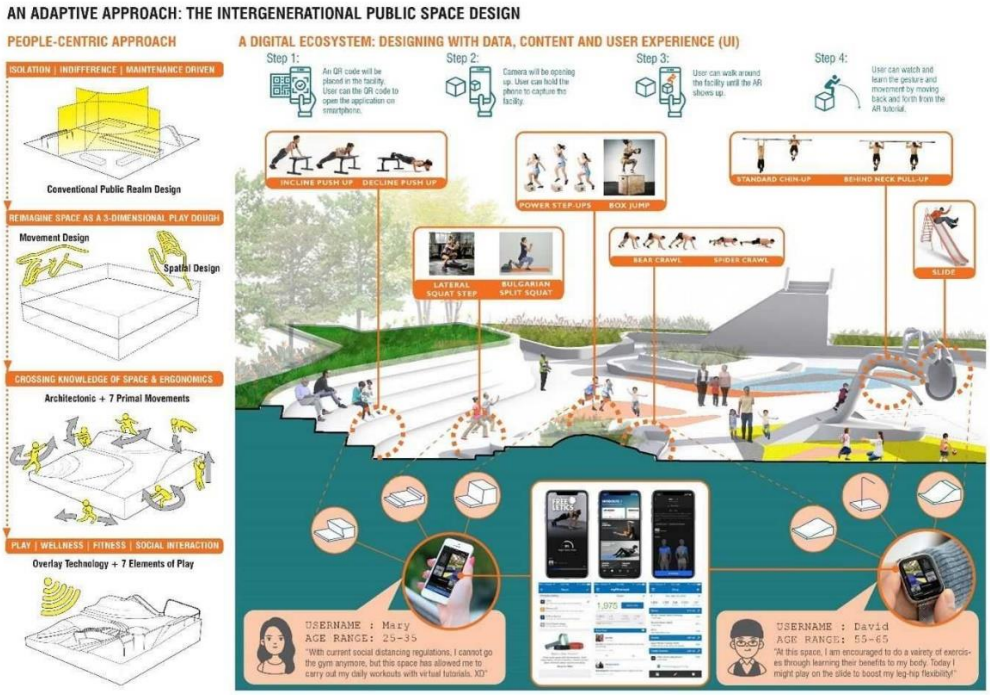


Figure 2. Example of an adaptive approach: The interrogational public space design (Gallacher, David; Suen 2024)

c. Participatory Mapping and Visualization Tools

Participatory digital mapping and visualization tools have become important instruments in urban planning processes, to enhance stakeholder understanding and participation. These tools have proven effective in visualizing complex data, engaging communities, and supporting collaborative planning efforts, ultimately leading to more transparent and democratic urban planning processes. An interactive mapping have proven to be quite effective in enhancing stakeholder understanding and participation in urban design processes, particularly in public space design and creative spatial planning. Such tools not only help in visualizing spatial data but also in gathering public knowledge, thereby encouraging a more

inclusive and collaborative urban design process. A combination of Geographic Information Systems (GIS), and computer photo manipulation are used to maximize public input in the planning process, and enhance the participatory planning process by providing a realistic representation of the proposed design (Chassin, Ingensand, and Joerin 2023; Kwon 2002). These digital tools vary widely in design and implementation, most of which use geographic information systems as the underlying platform and are referred to as participatory and volunteer GIS (Brown, Sanders, and Reed 2018; Pelly and Wiyono 2020). Interactive mental maps have been used to combine socio-economic data with geospatial information, improving the visualization and communication of results to policy makers and the public, thus encouraging participatory decision-making processes (Pfeiffer et al. 2008). The tools enable a collaborative approach where citizens and professionals can effectively visualize and analyze spatial data. Another example, the use of global positioning systems (GPS), geotagging techniques and participatory approaches to capture participants experiences such as which routes they have taken and how much time they have spent at certain locations (Dane et al. 2020).

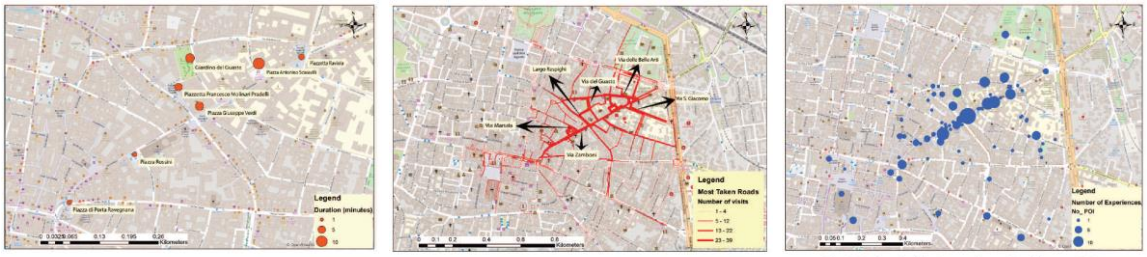


Fig. 2: Duration of participants' visits at area of interests (AOI). Fig. 4: The taken routes by participants. Fig. 5: Number of subjective experiences of participants at POIs.

Figure 3. Example of Participatory Mapping using geotagging techniques and participatory approaches
(Dane et al. 2020)

d. Participatory Design and Modelling

Participatory design and modeling frameworks allow for better decision-making by engaging stakeholders directly in the planning process. Examples of its application include the development of urban digital twins by integrating 3D models of the built environment, urban mobility simulations, and wind flow analysis, along with volunteered geographic information (VGI). With this technology, the public is involved in various participatory processes and provides input on design scenarios through a virtual reality platform. Designers present realistic and interactive models of proposed spaces, to provide stakeholders with virtual reality experiences through digital simulations with realistic visualization (VR) devices that allow stakeholders to better understand and influence design outcomes and provide feedback to create shared urban environments (Dembski et al. 2020). Integration of Digital Twins Environment with Virtual Reality (VR) technology creates a sense of presence and realism through visual, auditory, and sometimes tactile feedback using specialized devices. In urban design and public space design processes, VR environments are used as models to provide a realistic preview of the proposed design, facilitating better understanding and engagement. VR has also become a tool to increase public participation in urban design, where they engage with virtual representations of spaces to identify design problems and

propose improvements, demonstrating effectiveness (Ehab and Heath 2023; Sanchez-Sepulveda et al. 2019).

Figure 4. The use of VR as a simulation space in a circulation design experiment in a public space in London
(Ehab and Heath 2023)

3. CASE STUDIES OF DIGITAL ENGAGEMENT IN PUBLIC SPACE DESIGN AND CREATIVE PLACEMAKING IN INDONESIA

With its diverse cultural landscape, Indonesia provides a unique context to explore the application of digital tools in creative public space design and spatial planning. Coupled with rapid urbanization, expanding urban areas and increasing population, the need for innovative solutions in public space planning and design is increasingly urgent. Digital tools offer a way to bridge geographical and social maps, enabling more inclusive and participatory planning processes (Kurniawaty et al. 2022). Creative spatial planning, which integrates local culture and community input into urban design, helps foster social cohesion and resilience (Akbar and Edelenbos 2019). This section examines case studies in Indonesia, showing how these approaches are being used to address urban development challenges and opportunities in this dynamic country.

In Indonesia, several innovative public space projects have successfully integrated digital engagement and creative placemaking. Various studies have shown that digital intervention can make a significant contribution to creating dynamic and attractive spaces, as evidenced by the success of the increasingly popular application of digital placemaking, highlighting the importance of community involvement in driving the emergence of such spaces, emphasizing the significance of meeting community needs and aspirations for successful outcomes (Afiyah, Maulinda, and Umam 2023; Kurniawaty et al. 2022; Panjaitan, Pojani, and Darchen 2022). These examples showcase how Indonesia is leveraging digital technologies and creative approaches to enhance public spaces and promote sustainable development. Exploration of the case studies in Indonesia found six types of digital technology leveraging in public space design and creative placemaking.

a. Information and Communication Technologies (ICT)

The utilization of information and telecommunications technology has been applied to public spaces in Jakarta in the Smart City policy. One of the objectives of the Program is to

reduce traffic congestion by facilitating residents to be able to work at home or in public spaces without spending a lot of time on the road. The target of implementing the Jakarta Smart City concept policy regarding public space design is providing urban parks with ICT facilities such as Wi-Fi networks to meet the need for public access to the internet. Currently, many public parks in Jakarta are equipped with WiFi facilities, among others are Taman Suropati, Taman Menteng, and Lapangan Banteng which are located in Central Jakarta; and Taman Ayodya, Taman Tebet Ecopark, and Taman Langsat which are located in South Jakarta.

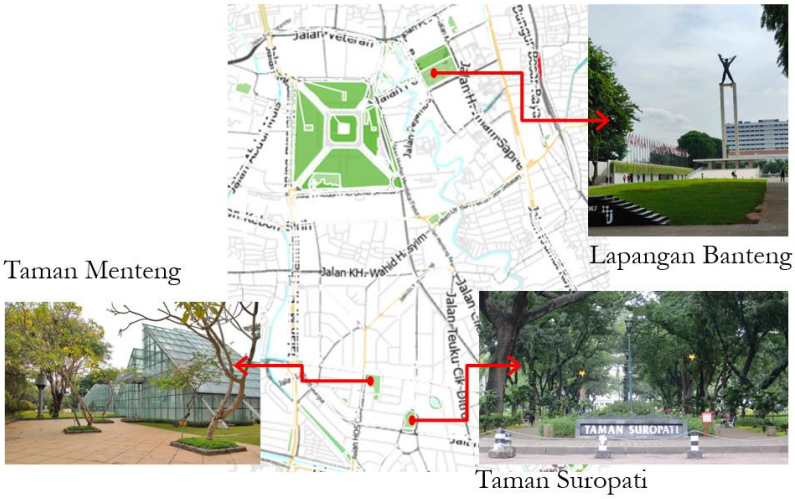


Figure 5. Public Parks with WiFi networks in Central Jakarta

Figure 6. Public Parks with WiFi networks in South Jakarta

Another case of ICT leveraging in Indonesia is Kampung Cyber Jogja is an internet-literate innovation movement for residential residents. This area in the city of Yogyakarta provides an internet network for all residents in the village to discuss various problems in the

village, disseminate or convey various kinds of information and run Small and Medium Enterprises (SMEs) in the village. In this village, all houses in 36 RTs have been connected to the Internet, so that residents can use the Internet to help the community in carrying out their daily lives. One of them is that the community uses the Internet as a medium for discussing the conditions of the Cyber village. The "RT36Kampoengcyber" site is used by residents to promote the business potential of Kampung Taman residents, such as batik businesses, online shops and education. All village residents are familiar with the internet, from children to the elderly have social networking accounts. Apart from that, the application of cyber city is also used by business people or business actors such as internet cafes, angkringan, cafes, shopping centers or other entertainment venues that provide hotspot facilities to attract the attention of consumers or the public. Other uses in the economic sector are also important, because this sector has a double effect and can move the economy at all levels of society, namely by providing information and interaction services, such as online reservations (hotels, packages, tours, transportation, etc.), online payment systems, management of regional tourism databases, interaction processes and other transactions. In the field of education, from elementary school to university level, the use of hotspots or the internet has become part of the lifestyle. The urgency of this use in the world of education needs to be realized by the school community as a supporter of achieving national education goals. The advantages of using the internet or hotspot facilities within the framework of teaching media by teachers will be seen from environmental integration (Ita Suryani 2017).

Figure 7. Kampung Cyber Yogyakarta (https://wargajogja.net/)

b. Digital Co-Design Platforms

Digital Co-Design Platform is a collaborative digital tool that facilitates multi-stakeholder engagement in the design process of public spaces and spatial planning initiatives. The platform enables direct collaboration, visualization, and feedback, allowing community members, designers, planners, and local governments to interactively co-create and refine public space designs. In Indonesia, an example of its application is the "Qlue" platform used in Jakarta. Qlue is a smart city platform that has been instrumental in Jakarta's transformation into a more resilient and responsive urban environment. Qlue integrates public feedback and participation in urban development, helping to improve public spaces and encourage creative spatial planning by allowing citizens to contribute ideas, report problems, and collaborate on solutions to improve their city environment. The platform includes a mobile app for citizen reporting and a GIS-dashboard for the city government to visualize and

analyze data. This system has significantly improved communication between the public and government, enhanced transparency, and streamlined problem resolution processes.

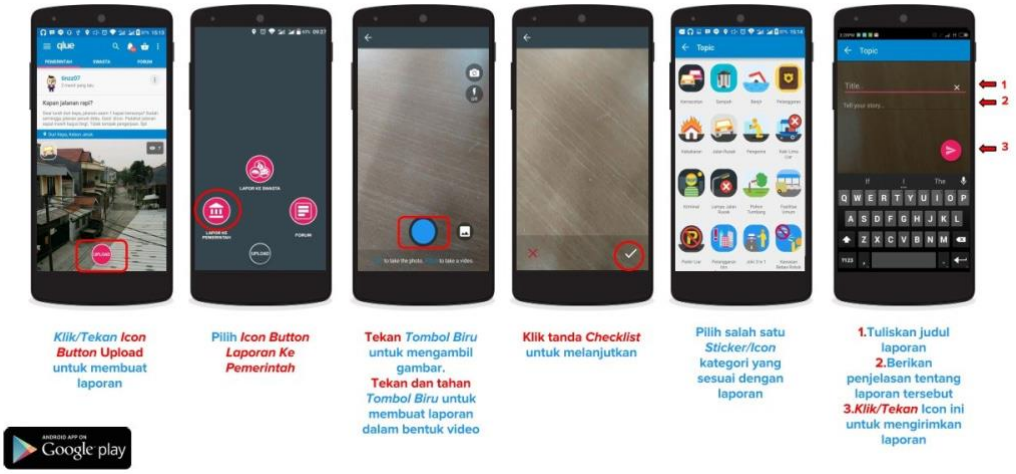


Figure 8. The interface of Qlue platform on citizen's mobile device (https://kumparan.com)

Another implementation of Digital Co-Design Platform is the Development of JAKI, a mobile application launched by the Jakarta Smart City Management, to provide a comprehensive digital platform for citizens to access various public services and information. JAKI can be use as (Rachmawati et al. 2021):

- Crowdsourcing Data: JAKI allows residents to report issues related to public spaces, such as damaged infrastructure, waste management problems, and traffic disruptions. This crowdsourced data is used by city authorities to identify and prioritize areas that need maintenance or improvement, ensuring responsive and efficient urban management.
- Engagement and Participation: The app encourages community participation by providing a platform for citizens to give feedback on public space projects and initiatives. This engagement helps incorporate public opinion into the planning and design process, making urban spaces more inclusive and responsive to community needs.
- Public Space Management, as a Real-Time Information, where JAKI provides real-time updates on the status of public spaces, including park accessibility, event schedules, and maintenance activities. This information helps residents make informed decisions about using these spaces and fosters a sense of ownership and responsibility toward maintaining them. It is also used as a Service Integration of various city services, such as public transportation schedules, weather forecasts, and emergency alerts, to enhance the overall experience of using public spaces. By consolidating these services, JAKI makes it easier for citizens to navigate and utilize urban areas effectively.
- Digital Mapping and Navigation: JAKI includes features like digital mapping and navigation tools that help residents find and access public spaces easily. These tools also provide information on amenities and facilities available in different areas, promoting better use and enjoyment of urban environments.
- Environmental Monitoring: The app supports environmental monitoring by providing data on air quality, noise levels, and other environmental factors. This information is

crucial for designing public spaces that promote health and well-being, ensuring they are safe and comfortable for residents, , especially in the pandemic time.

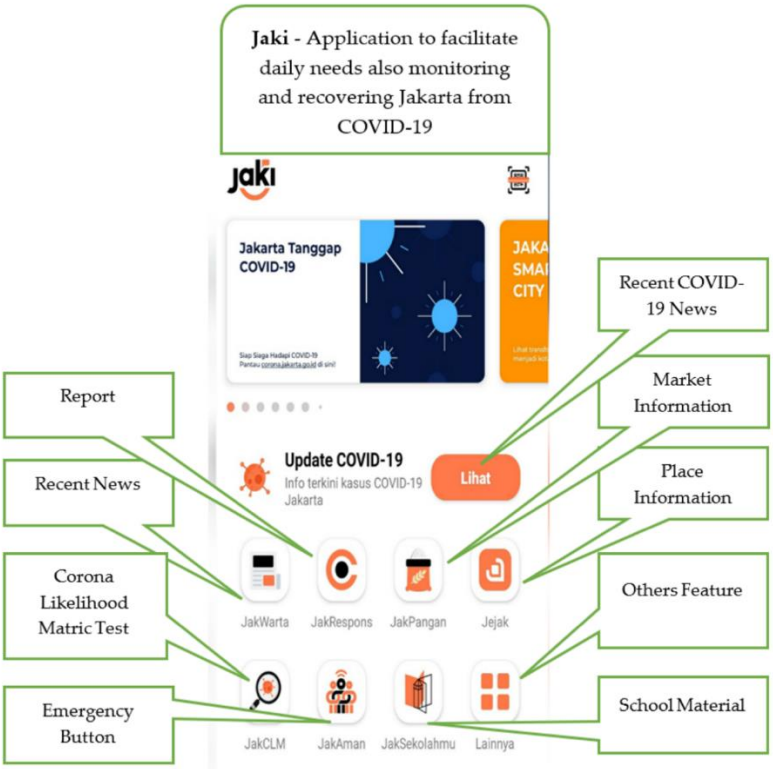


Figure 9. The interface of JAKI platform
(Rachmawati et al. 2021)

c. Geographic Information Systems (GIS) and Data Sharing

GIS are tools that allow us to visualize, analyze, and interpret data related to locations on the Earth's surface. Data sharing refers to making information available to different people and organizations so they can work together more effectively. In the urban design process, it means giving access to data about the city to all stakeholders involved in the process. GIS technology provides a holistic understanding of the urban environment by enabling visualization, analysis, and interpretation of spatial data that can be leveraged to promote transparency and public participation in the planning process. Data sharing ensures that relevant stakeholders have access to the necessary information, which fosters collaboration and integrated planning efforts (Golicnik and Marusic 2012; Monokrousou and Giannopoulou 2016). These systems improve urban operational efficiency and facilitate the integration of public data with urban environments. In Indonesia, the application of GIS in public space design and creative spatial planning is exemplified by various projects. One notable example is Jakarta Satu (https://jakartasatu.jakarta.go.id/), a GIS-based urban information system developed by the Jakarta Provincial Government, which integrates spatial data to improve urban planning and management. The system provides detailed, real-time geographic data for planners and the public. This application demonstrates how GIS and data sharing not only support efficient and sustainable urban development but also empower communities by making spatial information accessible and actionable.

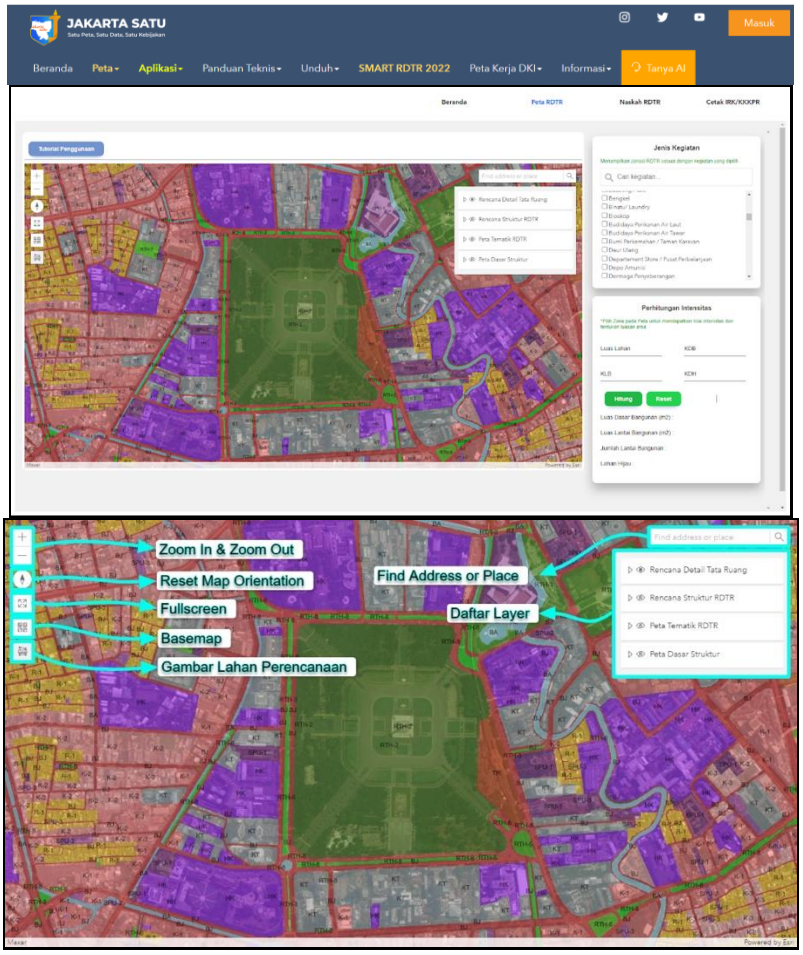


Figure 10. The interface of Jakarta Satu (https://jakartasatu.jakarta.go.id/)

d. Interactive Storytelling and Cultural Mediation

Interactive storytelling and cultural mediation are ways of conveying messages through interactive and participatory narratives, often using digital media to enhance the experience. By involving the community, interactive storytelling becomes an important component in the process of designing public spaces and planning places. It is widely used to facilitate understanding and dialogue between stakeholders to foster the integration of cultural heritage into the design of public spaces. This approach not only makes public spaces more interesting and meaningful, but also fosters social cohesion, increases cultural awareness, and promotes community well-being. Examples of the implementation in Indonesia are the implementation of interactive storytelling and cultural mediation is the project involving the regeneration of peripheral historical neighborhoods through collaborative placemaking. This project integrates local cultural narratives and interactive media to create public spaces that reflect the community's identity and heritage. For instance in Jakarta, Tebet Eco Park revitalization incorporated interactive elements and cultural mediation to engage the local community. The project focused on ecological restoration and community involvement, using digital storytelling to highlight the park's history and ecological significance, thereby fostering a deeper connection between residents and the public space.

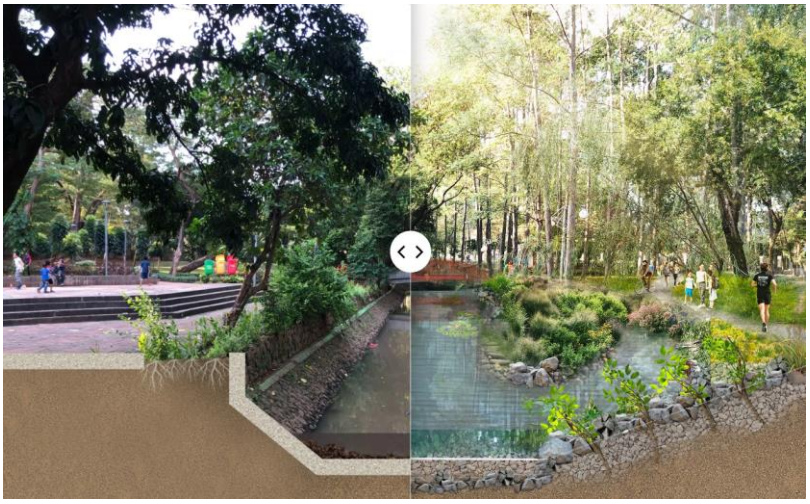


Figure 11. Interactive storytelling in the design process of Taman Tebet Jakarta (https://www.siurastudio.com/tebet-eco-park)

e. Digital art installations in public spaces

Art installations are an important element in public spaces that function not only to beautify the environment but also to create or strengthen identity and character. Digital art installations are innovative uses of technology to create interactive, engaging, and aesthetically pleasing environments. These installations can include elements such as digital screens, augmented reality (AR), virtual reality (VR), and interactive sculptures. These installations utilize digital technology to enhance the aesthetic appeal of public spaces, encourage community engagement, and reflect cultural narratives. Digital art installations can transform ordinary spaces into vibrant and dynamic areas that encourage public interaction and foster a sense of community. Unlike conventional art installations that are static and primarily visual, digital art installations offer an interactive and multisensory experience that can be continuously updated and customized. These installations can be part of creative placemaking strategies that integrate art and technology to foster community well-being and urban resilience. It is a kind of interactive storytelling with interactive multimedia art installations using sensors that respond to movement or even digital augmented reality technology to provide an immersive experience for visitors.

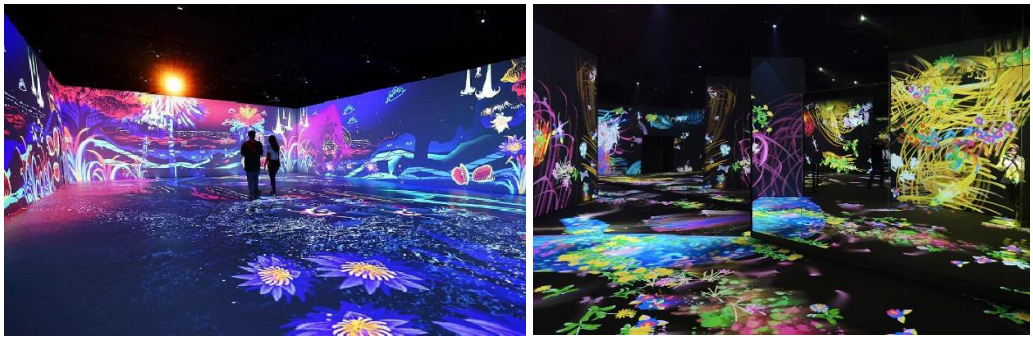


Figure 12. Interactive storytelling at National Museum of Indonesia and Pondok Indah Mall (https://travel.tempo.com; https://www.indonesia.travel/)

The implementation of Digital art installation in Indonesia is quite extensive. One of them is "Metaverse Tourism at the Immersive Space Exhibition in the National Museum of Indonesia". Metaverse Tourism is an emerging concept that combines virtual reality (VR) and augmented reality (AR) technologies to create immersive and interactive tourism experiences. The implementation of Metaverse Tourism at the National Museum of Indonesia successfully enhances tourist attraction by providing immersive and interactive experiences. This approach not only draws more visitors but also contributes to sustainable tourism development. Another example is the use of video mapping performances at Museum Fatahillah public spaces, which combine modern digital technology to create immersive cultural experiences that are accepted by local and wider audiences. The concept of "immersion" is also applied in the form of narrative video mapping. In video mapping, image is projected on a three-act structure such as a building façade in an integrative method. The integration with the 3D structural screen and other visual elements, such as recognizable objects and characters alongside the narrative, helps the audiences to follow and engage with the story, and become immersed in the narrative.

Figure 13. Video mapping at Bank Indonesia Yogyakarta and at Museum Fatahillah Jakarta (https://jogjavideomapping.com; https://travel.tempo.co/; https://www.merdeka.com/)

f. Social Media Platforms

Indonesians are social media savvy, with Facebook and Instagram as the top 2 social media platforms (Leksono and Wisesa 2020). Social media platforms, such as Facebook, Instagram, and Twitter, are online tools that enable users to create, share, and engage with content. These platforms can be leveraged in public space design and placemaking by facilitating communication, gathering public input, and promoting community engagement. Social media allows for broader and inclusive participation in the planning process, enabling real-time feedback and fostering a sense of community ownership and involvement. Social media platforms facilitate public participation in urban design processes. The use of social media in the process of urban design and management in Indonesia is quite extensive. Among others is the Indonesia Berkebun Movement, which utilizes social media to promote urban farming and community building. The Indonesia Berkebun movement is an excellent example of how social media can be leveraged for public space design and creative placemaking. By utilizing platforms like Facebook and Instagram, the movement promotes urban farming and engages citizens in discussions about urban sustainability. This initiative has successfully created public spaces for community gardening, fostering a sense of

community and promoting sustainable urban living. The movement engages citizens by Social Media utilization, for:

- Raising Awareness: Regular posts on social media platforms educate the public about the benefits of urban farming and sustainable living.
- Engaging Community: Social media is used to organize events, coordinate volunteer efforts, and share success stories, which helps build a supportive community network.
- Sharing Knowledge: Through tutorials, live sessions, and interactive content, the movement disseminates practical knowledge about urban farming techniques and best practices.

Other example is the utilization of Instagram for participatory design tools in Indonesia. Given the country's vast geography and infrastructure challenges, Instagram has been used to bridge communication gaps and involve the public in the design and planning processes. This approach has proven effective in gathering public input and fostering a collaborative design environment (Leksono & Wisesa, 2020). These examples demonstrate the potential of social media platforms to enhance public participation and engagement in public space design and creative placemaking.

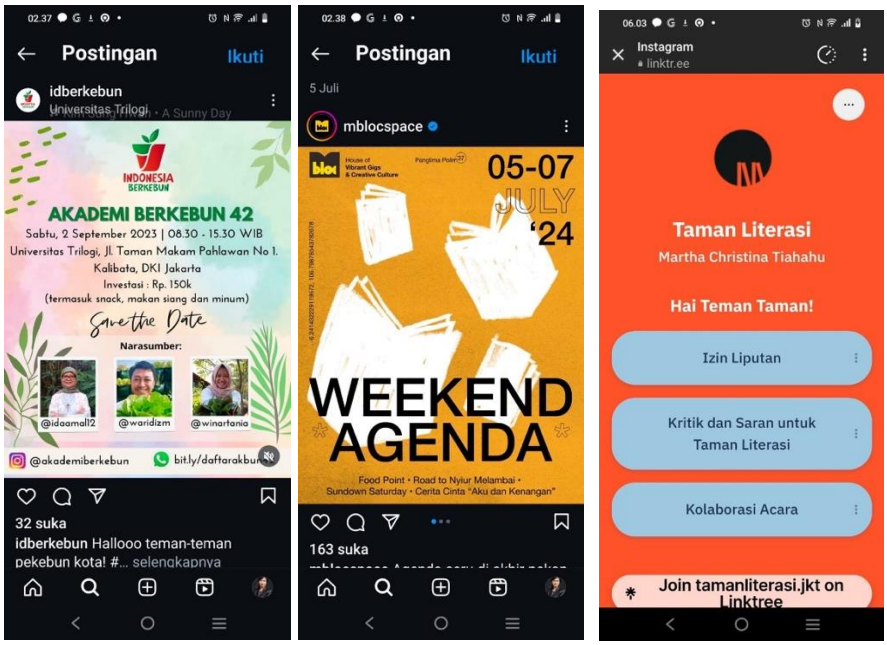


Figure 14. The use of Instagram application as public engagement

4. CHALLENGES AND OPPORTUNITIES

The implementation of digital engagement in public space design in Indonesia, faces some challenges, including digital literacy and technical capacity, infrastructure and connectivity, resource constraints, and opportunity of the increase of public participation, inclusivity, transparency, and collaboration. The bigest challenge is the issues of digital literacy and technical capacity, A key challenge is the varying levels of digital literacy and technical capacity among stakeholders. Effective social participation in the planning and design of public spaces requires substantial ICT literacy and technical skills, which are currently uneven across demographics and regions. Rural communities, in particular, lack the

skills necessary to effectively use digital tools and platforms. This gap can hinder the inclusive participation required for successful public space design. The other challenges is infrastructure and connectivity issues. Where inadequate digital infrastructure and limited internet connectivity pose significant barriers to the implementation of digital engagement strategies. While urban areas may have better access to high-speed internet and digital devices, rural and less developed areas often struggle with poor connectivity. This gap can lead to unequal participation and limit the benefits of digital engagement in public space design. Resource constraints also make such a challenge. The implementation of digital tools and platforms requires significant financial and human resources. Digital collaborative workspaces require investment in software, training, and ongoing support to ensure their effective use and sustainability. Developing, maintaining, and updating these technologies can be costly, and local governments or community organizations may lack the necessary funding and expertise.

However, these challenges can be overcome by optimizing existing opportunities, including increased public participation and inclusivity, transparency, and collaboration. Digital engagement tools can significantly increase public participation by providing an accessible platform for community members to provide ideas and feedback. Social media, participatory mapping, and co-design platforms such as Qlue in Jakarta have shown that digital tools can facilitate broad community engagement, making planning processes more democratic and inclusive. This results in designs that better reflect the needs and aspirations of diverse community members. Digital technologies promote transparency in decision-making processes by making information readily available and allowing for real-time updates and feedback. Tools such as GIS and digital co-design platforms enable stakeholders to visualize and understand spatial data, fostering collaborative and informed planning efforts. The GIS-based urban information system Jakarta Satu is a prime example of how data sharing can improve urban planning and management by integrating detailed geographic data that is accessible to planners and the public. nThe integration of digital art installations, interactive storytelling, and virtual reality can transform public spaces into dynamic and engaging environments. These technologies can enhance the cultural relevance and aesthetic appeal of public spaces, encourage community interaction, and foster a sense of belonging. Projects such as the revitalization of Tebet Eco Park and Metaverse Tourism at the National Museum of Indonesia illustrate the potential of digital tools to create immersive and culturally meaningful public spaces.

5. CONCLUSION AND RECOMMENDATION

Digital technologies have significantly transformed public space design and creative spatial planning in Indonesia by enabling more active public participation and fostering a sense of ownership among community members. Internet of Things (IoT)-based devices, platforms and digital tools have facilitated interaction and collaboration among stakeholders, making planning processes more inclusive and transparent. By leveraging participatory digital tools, social media and multi-user digital environments, citizens can effectively engage with local governments, influence decision-making processes and contribute to design solutions. This shift towards digital engagement not only empowers communities but also promotes urban resilience and well-being, leading to more sustainable and equitable urban

development. Despite promising progress, successful implementation of digital technologies in public space design requires technical capacity and literacy in Information and Communication Technology (ICT). Case studies from Indonesia highlight innovative applications, such as the Jakarta Smart City initiative, Kampung Cyber in Yogyakarta, and platforms such as Qlue and JAKI, that have facilitated community engagement and improved urban management. In addition, the integration of digital art installations, interactive storytelling, and GIS-based systems have enhanced the aesthetic appeal, cultural relevance, and functionality of public spaces. These examples underscore the potential of digital tools in making public spaces more dynamic, inclusive, and reflective of community needs.

For future research and development, it is recommended to focus on improving digital literacy and technical capacity among all stakeholders to ensure widespread adoption and effective use of digital tools in public space design. Further exploration of the integration of emerging technologies, such as augmented reality (AR), virtual reality (VR), and digital twins, can provide more immersive and interactive experiences for community engagement. In addition, continuous assessment and refinement of digital platforms and tools based on user feedback will help optimize their effectiveness and accessibility. Emphasizing the role of digital technologies in promoting social cohesion and cultural integration will be critical to creating resilient and dynamic public spaces in Indonesia's rapidly urbanizing landscape. It requires strong commitments from all stakeholders, including policymakers, urban planners, and designers, as well as the community. Policymakers are recommend to do strategic actions, to promote digital inclusion, encourage participatory planning, and support public-private partnerships. Urban planners and designers are recommended for practical approaches, where they should adopt data-driven planning, integrate creative placemaking, and focus on sustainability. Community organizations are recommended for community actions, where they should engage in digital literacy programs, advocate for inclusive public spaces, collaborate with stakeholders.

REFERENCES

Adiwena, Bartolomeus Yofana, and Ratna Djuwita. 2019. "Nature Relatedness as a Predictor of Psychological Well-Being: A Study of Indonesian Urban Society." *ANIMA Indonesian Psychological Journal* 34(4): 175–87.

Afiyah, Salamatul, Vika Maulinda, and Khaerul Umam. 2023. "Innovations in Utilizing Public Open Space in Sustainable Development." *KnE Social Sciences* 2023(4): 236–49.

Akbar, P N G, and J Edelenbos. 2019. "Place-Making in Indonesian Kampung: A Case Study of Bustaman, Semarang." In *Proceedings of the 55th ISOCARP World Planning Congress.*, https://isocarp.org/app/uploads/2021/06/ISOCARP_2019_Akbar_861.pdf.

Alvarado Vazquez, Sergio, Ana Mafalda Madureira, Frank O. Ostermann, and Karin Pfeffer. 2023. "The Use of ICTs to Support Social Participation in the Planning, Design and Maintenance of Public Spaces in Latin America." *ISPRS International Journal of Geo-Information* 12(6).

Battaglia, Silvia, Marta Cognigni, and Maria Pilar Vettori. 2023. Part F813 Urban Book Series *Resilient Design for Outdoor Sports Infrastructure*. Springer International Publishing. http://dx.doi.org/10.1007/978-3-031-29515-7_59.

Brunnberg, Liselott, and Alberto Frigo. 2012. "Placemaking in the 21st-Century City: Introducing the Funfair Metaphor for Mobile Media in the Future Urban Space." *Digital Creativity* 23(2): 113–25.

Carmona, Matthew. 2010. "Contemporary Public Space: Critique and Classification, Part One: Critique." *Journal of Urban Design* 15(1): 123–48.

Chassin, Thibaud, Jens Ingensand, and Florent Joerin. 2023. "Media Coverage of 3D Visual Tools Used in Urban Participatory Planning." *International Journal of E-Planning Research* 12(1): 1–32.

Chowdhury, Khairul, and Diego Lamacchia. 2019. "Collaborative Workspace for Employee Engagement

Leveraging Social Media Architecture." *Society of Petroleum Engineers - Abu Dhabi International Petroleum Exhibition and Conference 2019, ADIP 2019*.

Cognigni, Marta. 2022. "CITY, UNEXPRESSED SPACES, SPORT. RESILIENCE IN THE DESIGN OF NEW PUBLIC SPACES." In *3rd Valencia International Biennial of Research in Architecture, VIBRArch, ,* 98–107.

Costa, C S, G Artopoulos, and A Djukic. 2018. "Reframing Digital Practices in Mediated Public Open Spaces Associated with Cultural Heritage." *Journal of Communication and …*. http://www.fcsh.unl.pt/rcl/index.php/rcl/article/view/110%0Ahttp://www.fcsh.unl.pt/rcl/index.php/rcl/article/download/110/115.

Dane, Gamze et al. 2020. "Reviewed Paper Participatory Mapping of Citizens' Experiences at Public Open Spaces: A Case Study at Bologna Living Lab Gamze Dane, Soheil Derakhshan, Tahsin Ettefagh, Martina Massari, Valentina Gianfrate, Mauro Bigi." 8(September): 645–54. https://repository.corp.at/697/1/CORP2020_91.pdf.

Dembski, Fabian et al. 2020. "Urban Digital Twins for Smart Cities and Citizens: The Case Study of Herrenberg, Germany." *Sustainability (Switzerland)* 12(6): 1–17.

Deniz, Deniz. 2023. "The Importance of Digitalization for Sustaining Cultural Environments in Resilient Cities." *Environmental Science & Sustainable Development* 8(1): 01–09.

Dwirahmadi, Febi, Shannon Rutherford, Dung Phung, and Cordia Chu. 2019. "Understanding the Operational Concept of a Flood-Resilient Urban Community in Jakarta, Indonesia, from the Perspectives of Disaster Risk Reduction, Climate Change Adaptation and Development Agencies." *International Journal of Environmental Research and Public Health* 16(20).

Egerer, Monika et al. 2024. "Urban Oases: The Social-Ecological Importance of Small Urban Green Spaces." *Ecosystems and People* 20(1): 1–12. https://doi.org/10.1080/26395916.2024.2315991.

Ehab, Ahmed, and Tim Heath. 2023. "Exploring Immersive Co-Design: Comparing Human Interaction in Real and Virtual Elevated Urban Spaces in London." *Sustainability (Switzerland)* 15(12).

Entezarinajafabadi, Ali, and Eduardo Roig. 2023. "Beyond Physical Boundaries: The Impact of Digital Rendering on Spatial Identity." *Journal of Architecture and Urbanism* 47(1): 87–94.

Fingerhut, Zohar, and Nurit Alfasi. 2023. "Operationalizing Community Placemaking: A Critical Relationship-Based Typology." *Sustainability (Switzerland)* 15(8).

Frąckowiak, Maciej. 2023. "Place-Making as an Attentive Urban Presence." *Society Register* 7(2): 21–32.

Gallacher, David; Suen, Stephen. 2024. "Designing Public Spaces through People and Data." *Insight*. https://digital.aecom.com/article/designing_public_spaces_through_people_and_data/ (July 8, 2024).

Garau, P., L. Lancerin, and M. Sepe. 2015. "The Charter of Public Space." *II Biennial of Public Space*.

Gehl, Jan. 2020. *Public Space & Public Life Study during COVID19*. http://gehlarchitects.com/blog/moscow-2/.

Giyasih, Sri Rum. 2017. "Regional Management of Areas with Indications of Urban Sprawl in the Surrounding Areas of Universitas Muhammadiyah, Yogyakarta, Indonesia." *Indonesian Journal of Geography* 49(1): 35–41.

Golicnik, Barbara, and Damjan Marusic. 2012. "Behavioural Maps and GIS in Place Evaluation and Design." In *Application of Geographic Information Systems, ,* 113–38.

Gonsalves, Kavita. 2023. "Radical Placemaking."

Hartanti, Nurhikmah Budi, and Achmad Hadi Prabowo. 2023. "Redefining Public Space as a Public Life Adaptation to the Covid-19 Pandemic Based on People Preferences in Jakarta." *AIP Conference Proceedings* 2646(March).

Hartanti, Nurhikmah Budi, Achmad Hadi Prabowo, Arief Fadhilah, and Dwi Rosnarti. 2019. "Public Space as Development Control Element in Coastal Settlements: Comparison of Urban Design Guidelines Concepts." *International Journal of Scientific and Technology Research* 8(10): 3417–23.

Ita Suryani. 2017. "'REPUBLIK HOT NGELESOT' SEBAGAI WUJUD PENERAPAN PROGRAM CYBER CITY PEMERINTAH DAERAH ISTIMEWA YOGYAKARTA (Studi Kasus Pada Program Cyber City Pemerintah Daerah Istimewa Yogyakarta)." *Journal Communication* VIII(1): 1–7.

Jackson, Laura E. 2003. "The Relationship of Urban Design to Human Health and Condition." *Landscape and Urban Planning* 64(4): 191–200.

Kurniawaty, G., V. Horlanso, M. Y. Aditama, and D. Larasati. 2022. "Digital Placemaking and Its Effect to the Architectural Development (Case Study: City of Dreams, Macau)." *IOP Conference Series: Earth and Environmental Science* 1058(1).

Kwon, Miwon. 2002. *One Place After Another (Frag. Książki): Sitings of Public Art: Integration versus Intervention*.

Languillon-Aussel, Raphaël. 2022. "Digitalization of Public Spaces. The Great Urban Change?" *Articulo, Journal of Urban Research* (22). https://doi.org/10.4000/articulo.4859.

Leksono, Fitorio Bowo, and Toufiq Panji Wisesa. 2020. "Utilization of Social Media Platform Instagram as Participatory Design Tools in Indonesia." *Idealogy Journal* 5(2): 41.

Liyanto, Elvira et al. 2022. "How Well Are Indonesia's Urban Poor Being Provided Access to Quality Reproductive Health Services?" *PLoS ONE* 17(4 April): 1–18. http://dx.doi.org/10.1371/journal.pone.0265843.

Maspoli, Rossella. 2014. "Outdoor Collaborative and Creative Space Renewal in a Smart City." *Advanced Engineering Forum* 11: 27–34.

Megayanti, Trias, and Dian Fitria. 2020. "Participatory Rural Appraisal Implementation in Identifying Public Open Space." *Journal of Architectural Research and Education* 2(1): 19.

Monokrousou, Klio, and Maria Giannopoulou. 2016. "Interpreting and Predicting Pedestrian Movement in Public Space through Space Syntax Analysis." *Procedia - Social and Behavioral Sciences* 223: 509–14.

Panjaitan, Tigor Wilfritz Soaduon, Dorina Pojani, and Sébastien Darchen. 2022. "Alternative Public Space: Experiences and Lessons from Indonesian Cities." *Proceedings of the Institution of Civil Engineers: Urban Design and Planning* 175(2): 56–66.

Peinhardt, Katherine. 2021. *Resilience through Placemaking: Public Spaces in Rotterdam's Climate Adaptation Approach*.

Pfeiffer, Constanze et al. 2008. "Facilitating Participatory Multilevel Decision-Making by Using Interactive Mental Maps." *Geospatial Health* 3(1): 103–12.

Rachev, Rumen, Yvonne Chan, and Talia Pua. 2020. "Building a Sense of Identity Belonging and Culture Through Place-Making and Creative Co-Design: Practices within New Zealand's Educational Context." *DRS2020: Synergy* 1: 11–14.

Rachmawati, Rini et al. 2021. "The Use of Ict-Based Applications to Support the Implementation of Smart Cities during the Covid-19 Pandemic in Indonesia." *Infrastructures* 6(9): 1–24.

Ribeiro, Paulo Jorge Gomes, and Luís António Pena Jardim Gonçalves. 2019. "Urban Resilience: A Conceptual Framework." *Sustainable Cities and Society* 50.

Sanchez-Sepulveda, Mónica, David Fonseca, Jordi Franquesa, and Ernesto Redondo. 2019. "Virtual Interactive Innovations Applied for Digital Urban Transformations. Mixed Approach." *Future Generation Computer Systems* 91: 371–81.

Shantiko, Bayuni, Nining Liswanti, Robin Bourgeois, and Yves Laumonier. 2021. "Land-Use Decisions in Complex Commons: Engaging Multiple Stakeholders through Foresight and Scenario Building in Indonesia." *Environmental Management* 68(5): 642–64. http://dx.doi.org/10.1007/s00267-021-01470-1.

Sutanto, E., and P. Junadi. 2019. "The Role of Environmental Quality in Kalijodo Green Open Space for Society in Jakarta City, Indonesia." *IOP Conference Series: Earth and Environmental Science* 264(1).

Tsai, Yuling, and Bart Dewancker. 2022. "Architectural Design Process Combined with Social Media Technology A Case Study on Urban Creativity and Placemaking Strategy in Taiwan." *Proceedings of the ARTEPOLIS 8 - the 8th Biannual International Conference (ARTEPOLIS 2020)* 602(Artepolis 2020): 48–54.

CHAPTER 13

Compatibility Testing for Tween 20 Surfactant At 8000 ppm Salinity Against Light Crude Oil At 60˚c

Alvino Malva Wibowo
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
Orcid: 0009-0002-7969-8685

Havidh Pramadika*
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
havidh@trisakti.ac.id
Orcid: 0000-0002-2934-3678

Pauhesti Pauhesti
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
Pauhesti@trisakti.ac.id
Orcid: 0000-0002-9305-1610

Rini Setiati
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
rinisetiati@trisakti.ac.id
Orcid 0000-0001-9243-062X

Dina Asmaul Chusniyah
Departement of Geodynamics, Institute of Geology and Geophysics, Chinese Academy of Science
dinachusniyah@mail.iggcas.ac.cn
Orcid: 0000-0002-1024-029X

ABSTRACT

Enhanced Oil Recovery (EOR) is classified as a tertiary oil recovery method, aiming to improve displacement and volumetric sweep efficiency. EOR approaches are designed to enhance oil recovery by utilizing external energy sources. The characteristics of oil, rock, and formation water play a crucial role in determining the effectiveness of EOR methods. Surfactant injection is one of the techniques within Enhanced Oil Recovery, particularly suitable for reservoirs with high-viscosity fluids, as its application can reduce interfacial tension and yield relatively high recovery during the sweeping of heavy oil compared to conventional water injection. Tween 20, as a synthetic surfactant, remains stable at low salinity and temperature. This study aims to determine the compatibility of Tween 20 surfactant with light oil at a salinity of 8000 ppm and a temperature of 60˚C. Compatibility testing includes two tests: aqueous stability and phase behavior. The results of the aqueous stability test indicate that all concentrations of Tween 20 surfactant solution exhibit a homogeneous phase, showing that all concentrations of the solution are compatible. Subsequently, phase behavior testing was conducted, and the results showed that a Tween 20 surfactant solution at a concentration of 1% formed a middle phase emulsion of 22.5%. The conclusion drawn from this study is that a Tween 20 surfactant solution at a concentration of 1% is considered compatible with light crude oil (39˚ API). The Tween 20 surfactant solution at a concentration of 1% exhibits the best emulsion stability, making it highly potential for reducing interfacial tension to enhance oil recovery.

Keywords: Enhanced oil recovery, Surfactant injection, Tween 20, Aqueous stability test, Phase behavior test

1. INTRODUCTION

Enhanced Oil Recovery is included in the tertiary oil extraction method, which aims to improve the efficiency of the extraction and volumetric drainage. The EOR approach itself aims to encourage oil acquisition using energy from outside the reservoir. Oil, rock, and water characteristics of the formation play an important role in determining the effectiveness of the EOR method. One of these processes is the formation of microemulsions as an indication of a compatible solution in reducing the voltage of the interface (Mustamina Maulani & Rini Setiati, 2018). Surfactant injection belongs to one of the techniques in Enhanced Oil Recovery on reservoirs with fluid content with high viscosity because its application is capable of reducing interfacial tension and recovery which is produced relatively large when leaking on heavy oil compared to conventional water injections. Surfactants play a role in reducing the interface tension so that oil and water are soluble in the oil water contact zone and improve the sweep efficiency (Prisiela Utami et al., 2019). Tween 20 as one of the synthetic surfactants is able to remain stable at salinity and low temperatures. Tween 20 has the characteristics of having good solubility in water and has a low viscosity that can facilitate the injection process of the surfactant agent. Similar to the primary purpose of injection of surfactants, Tween 20 is used to lower the tension between the oil phase and the water phase in the reservoir (Zhang R, 2015). The use of ethanol as a co-surfactant can help in stabilizing the physical characteristics of microemulsions (Fadila et al., 2018).Surfactant solution screening is carried out through two stages of compatibility testing, namely aqueous stability test and phase behavior test (Juita et al., 2016). The phase behavior test was carried out with the aim of obtaining a stable microemulsion indicating a solution that is compatible to lower IFT (Nusaly et al., 2020).

2. LITERATURE REVIEW

The compatibility test consists of two tests, the solution stability test and the phase behavior test. Compatibility test is a test between brine, surfacing solution and also crude oil. This series of tests is aimed at determining the stability of a solution in the face of a reservoir with temperatures and salinities (Suparwoto et al., 2024). The solvent stability test, or commonly called aqueous stability, is commonly used to measure the ability of a surfactant-acting solution to maintain its stability in water at a certain temperature. This test aims to identify the physical or chemical changes that occur on the surfactant agent when dissolved in water. This test helps determine to what extent the surfactant remains effective without experiencing separation or sedimentation at a certain temperature, which in turn affects the performance of the surfactant agent solution or other solution used (Juita et al., 2016). While heterogeneous solutions tend to have unstable physical properties and may undergo significant phase changes, the use in enhanced oil recovery is less effective (Yulia et al., 2020).

Phase Behavior Testing, also known as phase behavior, is a method of studying how components in a system, especially surfactant acts or other surfactants with additives, interact and change under certain conditions that affect it such as temperature, pressure, or other composition. This test involves observing phase or composition changes when these variables are modified (M. Farid Hermiza, 2022). Understanding this phase behavioral change is important to predict fluid movement inside the reservoir and optimize the design of the

surfactant agent injection process. The brine-oil-surfactant mixture in the phase behavior test produces three types of phases, namely the lower phase (water-soluble surfactant), the middle phase or commonly referred to as micromemulsion (soluble oil-water-phase surfactant), and the upper phases (solute oil-solute surfactant) (Andriyan et al., 2018). In the surfactant-active solution phase testing, what is expected to occur is the formation of microemulsions. A stable microemulsification can help in improving the ability of the surfactant agent to reduce the interfacial tension between oil and water so that it can increase oil production (Yulia et al., 2017).

3. RESEARCH METHOD

The research began with the process of making brine and Tween 20 surfactants at different concentrations. The desired salinity of brine is 8000 ppm, while the desired surfactant agent concentration variation is 0.5; 0.7; 0.9; 1 and 1.3%. Aqueous Stability test is carried out at 60℃. This test is conducted for 3 days with 1 hour, 24 hours, 48 hours and 72 hours checking intervals to see the stability of the surfactant agent at a certain temperature, after a solution stability test, then a Phase Behavior Test is performed with the addition of oil into the tube containing the surfactant solution and then inserted into the oven at 60 °C at a temperature and with a checking time interval of 0, 1/2, 1, 2, 48, 168 and 336 hours. Since the expected emulsion is not formed, then the solution is added with co-surfactant namely Ethanol 98% according to the concentration of the solution.

The indicator of success when performing the durability test of a solution is that it does not form a heterogeneous solution. Since the homogeneum solution allows the surfactant agent to work optimally in reducing the interfacial tension so it is more effective in the use of the Enhanced Oil Recovery method. Whereas if it forms a heterogenic solution, it tends to have unstable physical properties and can undergo significant phase changes, so the use in enhanced oil recovery is less effective (Liu et al., 2022). While the indicator of success of phase behavior testing is the formation of a mid-phase emulsion (microemulsion) indicating that the surfactant agent solution, brine and oil have a balanced interaction (Bera & Mandal, 2015). The larger value of the microemulsion produced, the greater the concentration of the solution used for the core flooding process.

4. RESULT AND DISCUSSION

Aqueous stability test or solution balance test is one of the important parameters in determining a solution that is stable in the influence of salinity and temperature. The purpose of this test is to know the behavior of the surfactant agent in the reservoir, to ensure that the surfactant agents can work optimally under various influences of the reserve conditions such as temperature and salinity. The trials were conducted for three days with checking intervals of 1 hour, 24 hours, 48 hours and 72 hours, placing the surfactant agent solution in the oven. The results of aqueous stability testing of Tween 20 surfactants at a temperature of 60℃ at a salinity of 8000 ppm can be seen from table 1 below.

Table 1. Result of aqueous stability test

No	Concentrations (%)	Time of Observation			
		1 Jam	1 Hari	2 Hari	3 Hari

1	Tween 20 0,5% + Co-surfactant	homogen	homogen	homogen	homogen
2	Tween 20 0,7% + Co-surfactant	homogen	homogen	homogen	homogen
3	Tween 20 0,9% + Co-surfactant	homogen	homogen	homogen	homogen
4	Tween 20 1% + Co-surfactant	homogen	homogen	homogen	homogen
5	Tween 20 1,3% + Co-surfactant	homogen	homogen	homogen	homogen

The results of aqueous stability tests with concentrations of 0.5; 0.7; 0.9; 1 and 1.3% are presented. The results of the observations of the equilibrium test, each surfactant agent solution forms a solution that tends to be stable by the influence of salinity and temperature. Aqueous Stability tests showed that the surfactant agent Tween 20 solution is compatible with the salinities of the used brine, i.e. brine with a saltity of 8000 ppm.

Because the aqueous stability test did not find any deposits or particles that could cause problems when injected, then the subsequent test conducted a phase behavior test. In the phase behavior testing, the observed factor was concentration on the surfactant agent solution. The mechanism of this test is to put a surfactant agent solution of different concentrations together with the oil in a tube, and then put a tube containing the oil and the surfactant agent in a oven at 60℃. The tests were conducted for two weeks with visual observation to see the emulsion formed in accordance with the specified time interval. The results of the phase behavior test can be seen in table 2 below.

Table 2. Result of phase behavior test

Sample Oil	**Surfactant Composition**	**Phase**	**Volume at Observation Time(hours)**		**Total Emulsion (%)**	**Types of mulsions Phase**
			0	336		
Light Crude Oil 39◦ API	Salinity 8000 ppm 0.5 % Surfactant + 0.5% cosurfactant	Oil	1,6	1,75	6,25%	Upper
		Emulsion	1,7	0,25		
		Surfactant	0,7	2		
	Salinity 8000 ppm 0.7 % Surfactant + 0.7% cosurfactant	Oil	1,05	1,4	13,75%	Upper
		Emulsion	0,9	0,55		
		Surfactant	2,05	2,05		
	Salinity 8000 ppm 0,9 % Surfactant + 0,9% cosurfactant	Oil	1,1	1,9	1,25%	Upper
		Emulsion	1,3	0,05		
		Surfactant	1,6	2,05		
	Salinity 8000 ppm 1 % surfactant + 1% cosurfactant	Oil	1,1	1,4	22,50%	Middle
		Emulsion	2,4	0,9		
		Surfactant	0,5	1,7		
	Salinity 8000 ppm 1.3% surfactant + 1.3 % cosurfactant	Oil	1,4	1,8	5,00%	Upper
		Emulsion	2,1	0,2		
		Surfactant	0,5	2		

The phase behavior test results in table 2 showing emulsion changes over 0 hours and 336 hours (2 weeks). The mixture of a surfactant agent solution, brine and oil produces three types of emulsion phases, namely lower phase emulsions (water soluble surfactants), middle phase or microemulsion (water-soluble surfactant and oil soluble) and upper phase (surfaktan larut dalam minyak). Surfactants with concentrations that escaped in this test are surfactants that picked the middle-phase emulsion type. Surfactant substances with 1% concentrations showed the best microemulsion stability compared to the concentrations of other surfactant agent solutions. With the formation of a middle-phase emulsion with a total emulsifying value of 22.5% indicates that a surfactant agent with a concentration of 1% is considered compatible to lower interfacial tension and increase oil mobilization.

5. CONCLUSION AND RECOMMENDATIONS

The results of a solution compatibility test included aqueous stability test and phase behavior test as characteristics of a surfactant agent screening with concentration variations as well as brine with salinity 8000 ppm and temperature 60℃. Aqueous Stability test results showing a homogeneous solution at the overall surfactant agent concentration, then indicated a leakage solution for subsequently conducted Phase Behavior Test. Then the results of the behaviour phase test obtained microemulsion results or the formation of a middle phase only at a solution with a concentration of 1%. So it was concluded, surfing Tween 20 with 1% concentration is compatible with light oil (39˚API). Surfactant solvent with concentrations has the best 1% emulsion stability so that there is a potential to greatly reduce interfacial tension so that the oil can be improved.

REFERENCES

Andriyan, R., Setiati, R., Kasmungin, S., Pratiwi, R., Teknik, J., Fakultas, P., Kebumian, T., & Trisakti, E. (2018). PENGARUH TES UJI FASA DAN INTERFACIAL TENSION (IFT) TERHADAP KINERJA SURFAKTAN DALAM PROSES EOR. *PROSIDING SEMINAR NASIONAL CENDEKIAWAN*, *0*(0).

Bera, A., & Mandal, A. (2015). Microemulsions: a novel approach to enhanced oil recovery: a review. In *Journal of Petroleum Exploration and Production Technology* (Vol. 5, Issue 3, pp. 255–268). Springer Verlag. https://doi.org/10.1007/s13202-014-0139-5

Juita, R., Arnelli, A., & Yusniati, Y. (2016). Telaah Surfaktan untuk Proses Enhanced Oil Recovery (EOR) dan Profil Adsorpsi Surfaktan A-Olefin Sulfonates (AOS). *Jurnal Kimia Sains Dan Aplikasi*, *19*(1). https://doi.org/10.14710/jksa.19.1.27-31

Liu, W., He, H., Yuan, F., Liu, H., Zhao, F., Liu, H., & Luo, G. (2022). Influence of the Injection Scheme on the Enhanced Oil Recovery Ability of Heterogeneous Phase Combination Flooding in Mature Waterflooded Reservoirs. *ACS Omega*, *7*(27), 23511–23520. https://doi.org/10.1021/acsomega.2c02007

M. Farid Hermiza. (2022). *UJI LABORATORIUM PEMILIHAN SURFAKTAN POLIMER TAHAP EOR UNTUK MENINGKATKAN PEROLEHAN MINYAK LAPANGAN X*. Universitas Islam Riau.

Mustamina Maulani, & Rini Setiati. (2018). Korelasi Konsentrasi Surfaktan NaLS Ampas Tebu Pada Beberapa Salinitas Terhadap Pengukuran IFT. *Jurnal Petro 2017*, *VI*(No 2).

Nusaly, P., Kasmungin, S., Rakhmanto, A., Teknik, J. M., Fakultas, P., Kebumian, T., Energi, D., & Trisakti, U. (2020). Webinar Nasional Cendekiawan Ke 6 Tahun 2020. In *KOCENIN Serial Konferensi* (Issue 1).

Prisiela Utami, Sugiatmo Kasmungin, Puri Pauhesti, Havidh Pramadika, Aziz Ibrahim, & Abdalim Fadlu. (2019). *PENGARUH KONSENTRASI SURFAKTAN TERHADAP PADA LAPANGAN DI SUMATERA SELATAN*. Universitas Trisakti.

Suparwoto, S., Setiati, R., Rahkmanto, P. A., Fathaddin, Muh. T., Prakoso, S., & Mardiana, D. A. (2024). UJI KESTABILAN LARUTAN DAN PERUBAHAN FASA SEBAGAI KARAKTERISTIK DARI SCREENING SURFAKTAN METIL ESTER SULFONATE KELAPA SAWIT TERHADAP MINYAK RINGAN LAPANGAN "X". *JURNAL PENELITIAN DAN KARYA ILMIAH LEMBAGA PENELITIAN UNIVERSITAS TRISAKTI*, 268–275. https://doi.org/10.25105/pdk.v9i1.18790

Yulia, P. S., Kasmungin, S., & Fathaddin, M. T. (2017). Kajian Laboratorium Mengenai Pengaruh Salinitas, Jenis Surfaktan Dan Konsentrasi Surfaktan Terhadap Recovery Factor Dalam Sistem Injeksi Surfaktan Untuk Batuan Karbonat. *Prosiding Seminar Nasional Cendekiawan*, *3*.

Yulia, P. S., Kasmungin, S., & Fathaddin, M. T. (2020). ANALISIS SALINITAS DAN KONSENTRASI SURFAKTAN AOS DAN TWEEN 20 TERHADAP RECOVERY FACTOR PADA PROSES IMBIBISI DAN CORE-FLOODING. *PETRO:Jurnal Ilmiah Teknik Perminyakan*, *9*(4). https://doi.org/10.25105/petro.v9i4.8227

Zhang R. (2015). Surfactant Enhanced Oil Recovery in Carbonate Reservoirs: Influence of the Surfactant Structure on Interfacial Tension Reduction and Oil Recovery. *Energy & Fuels*, *29*(8), 5145–5145.

CHAPTER 14

Effectiveness of Microbes on Oil Recovery Enhancement and Sludge Oil Management in Crude Oil Tanks

Chanaya Annisa Kalila
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
Chanaya071002000045@std.trisakti.ac.id
Orcid: 0009-0004-2671-0526

Samsol*
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
samsol@trisakti.ac.id
Orcid: 0000-0002-5386-8546

Havidh Pramadika
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
havidh@trisakti.ac.id
Orcid :0009-0005-4183-5447

Rini Setiati
Departement of Petroleum Engineering, Faculty of Earth Technology and Energy,
Universitas Trisakti, Jakarta, Indonesia
rinisetiati@trisakti.ac.id
Orcid :0009-0005-4183-5447

Widia Yanti
Environment, Development, and Sustainability - Faculty of Graduate School,
Chulalongkorn University, Thailand

ABSTRACT

Sludge oil is a byproduct of crude oil processing that poses a serious concern in the oil and gas industry 197uet o its negative impact on the environment and oil production efficiency. This study aims to evaluate the effectiveness of using microbes to address sludge oil, focusing on enhancing oil recovery in the experiments conducted. The research was conducted through experimental and laboratory analysis approaches. Bioremediation was implemented to clean sludge oil from crude oil tanks, while factors such as the type of microorganisms, environmental conditions, and handling time were evaluated to understand their impact on oil recovery effectiveness. The results showed that the use of microbes was effective in reducing sludge oil and increasing sludge oil recovery by up to 17.1%. However, factors such as the composition of sludge oil and environmental conditions influenced the success rate of the method. This study contributes to the development of more effective solutions for addressing sludge oil and enhancing oil recovery in the oil and gas industry. The results of this experiment can serve as a foundation for further research on the use of bioremediation to optimize oil recovery and maintain environmental sustainability.

Keywords: Sludge Oil, Bioremediation, Recovery, Tank, Microorganisms.

1. INTRODUCTION

The oil and gas industry plays a crucial role in meeting global energy demands, with crude oil extraction processes forming the backbone of much of this activity. However, a persistent challenge within the industry is the formation of sludge oil, a byproduct of crude oil refining processes within storage tanks. Sludge oil, a complex mixture of organic and inorganic compounds that settles at the bottom of crude oil tanks, poses significant environmental pollution risks if not properly managed. Effective handling of sludge oil is critical not only for environmental sustainability but also for maintaining production efficiency. Accumulated sludge oil in crude oil tanks can lead to reduced storage capacity, degradation of oil quality, and potential damage to pipeline infrastructure. Addressing the problem of sludge oil necessitates the development of effective methods to mitigate its impact. Among the promising approaches are bioremediation and biodegradation. Bioremediation employs microorganisms to decompose the compounds in sludge oil into safer and non-hazardous forms, while biodegradation breaks down complex hydrocarbons into simpler compounds. These methods have shown potential in enhancing hydrocarbon recovery from sludge oil. Despite their promise, several challenges remain in the effective application of bioremediation and biodegradation, such as the chemical composition of sludge oil, environmental conditions within crude oil tanks, and the adaptation of microorganisms to extreme environments. This study aims to evaluate the effectiveness of microbial use in addressing sludge oil in crude oil tanks, with the goal of improving oil recovery. By understanding the mechanisms of bioremediation and biodegradation, as well as the factors influencing their successful implementation, it is hoped that more efficient strategies can be developed for sludge oil management and oil recovery enhancement. This research seeks to make significant contributions to optimizing the use of bioremediation and biodegradation in the oil and gas industry, thereby improving production efficiency and minimizing negative environmental impacts.

2. LITERATURE REVIEW

Sludge oil is a thick, viscous hydrocarbon mixture consisting of sediment, water, oil, and high concentrations of hydrocarbons (Ubani et al., 2013). It forms during crude oil refining, tank cleaning, and wastewater treatment in refineries, resulting from the sedimentation of particles in storage tanks driven by gravity and thermodynamic conditions, leading to the accumulation of heavier hydrocarbons at the bottom. This can reduce storage capacity, degrade oil quality, and damage pipelines (Jiang et al., 2020). Sludge oil contains around 60% oil, 25% moisture, and 15% solids, including sulfides, phenols, heavy metals, aliphatic hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs), with paraffins, asphaltenes, and aromatic hydrocarbons making up over 90% of its composition. It is a stable emulsion of water, solids, petroleum hydrocarbons (PHCs), and metals, categorized into saturates, aromatics, resins, and asphaltenes, originating from various refinery sources. Sludge oil's stability depends on natural emulsifiers like fine solids, PHCs, oil-soluble organic acids, and other segregated products. Its environmental impact is significant due to its flammable and toxic properties, containing PAHs, heavy metals, anthracene, pyrene, and phenols, which pose risks to soil, groundwater, and air, affecting plant, animal, and human health (Alfutaisi et al., 2007; Chen et al., 2020; Hu et al., 2013; Li et al., 1995; Thong et al., 2021; Ubani et al.,

2013). Effective removal and reduction are essential to mitigate these impacts. Given its high oil concentration, recovering oil from sludge is a viable environmental option, allowing the oil and gas industry to reuse valuable oil, reducing pollution and hazardous waste. Various physical and chemical methods, such as centrifugation, froth flotation, solvent extraction, thermochemical methods, pyrolysis, microwave irradiation, and ultrasonic treatment, have been explored, but they often face challenges like secondary pollution, high costs, and low processing capacity (Hu et al., 2013; Huang et al., 2014; Jing et al., 2011; Thong et al., 2021). Bioremediation has gained interest as a promising alternative, using living organisms like microbes or plants to degrade, transform, or capture pollutants in an environmentally friendly manner. Bioremediation methods include biodegradation, where organisms break down chemical compounds into less harmful products, and enhanced bioremediation, which optimizes conditions for microbial activity. This technology is considered more environmentally friendly and often more economical than chemical or physical methods, effectively mitigating pollution and environmental damage caused by petroleum waste, as increased populations of specific microorganisms reduce contaminant concentrations. Enhanced bioremediation improves efficiency through techniques like biostimulation, enhancing the natural microbial population and accelerating biodegradation by improving nutrient availability and contaminant bioavailability, and biosurfactants, which increase hydrocarbon bioavailability by reducing surface tension between oil and water and enhancing emulsification, facilitating microbial biodegradation. These methods, combining degrading bacteria, nutrients, and biosurfactants, provide effective and environmentally friendly strategies for oil pollution remediation. (Fidiastuti et al., n.d.; Gomathi et al., 2020).

3. RESEARCH METHOD

This research begins with two samples, each containing 500 grams of sludge and 300 ml of demineralized water. In Sample 1, the following materials are added: Crude Oil, Demineralized Water, Microbes M & S, Liquid Hydrocarbon, Microbial Nutrient, Biosolvent, and Biosurfactant. For Sample 2, only Crude Oil, Demineralized Water, and Liquid Hydrocarbon are added, excluding the microbes. The purpose of this setup is to determine the effectiveness of the bacteria in degrading the sludge oil. By comparing the results from the two samples, we can assess whether the presence of the bacteria significantly enhances the degradation process.

Once the materials are added to both samples, the treatment process begins. Sample 1, with its full complement of additives including the microbes, is expected to undergo a more rapid and effective degradation process compared to Sample 2, which lacks the microbial component. This comparison will provide insights into the role of bacteria in the bioremediation process and whether their inclusion is crucial for efficient sludge oil degradation. The duration of the treatment will be carefully monitored to determine the time required for effective degradation in each sample. The ultimate goal is to evaluate and confirm the efficacy of bacterial action in breaking down the complex hydrocarbons present in sludge oil. This study is conducted over a period of 4 weeks.

4. RESULT AND DISCUSSION

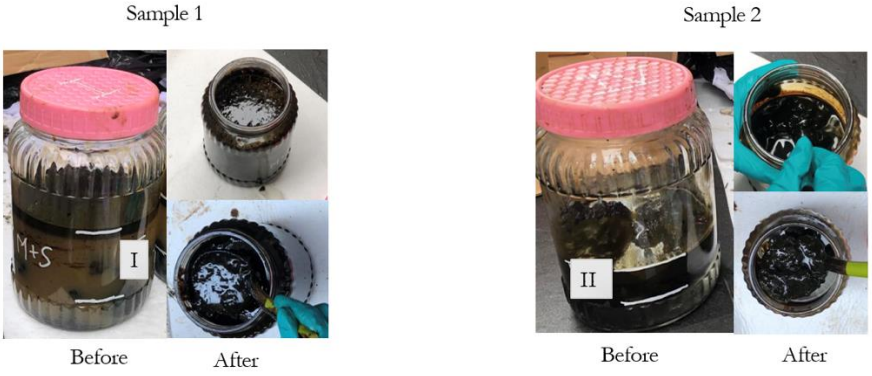


Figure 1. Before and after degradartion oil

On the seventh day, Sample 1 showed thickening and bubble formation, indicating intense microbial activity. The microbes began degrading the sludge oil, producing gases like carbon dioxide (CO2) or methane (CH4) as byproducts of their metabolism. They used enzymes such as lipase, protease, and amylase to break down complex hydrocarbon chains into simpler compounds. The bubbles resulted from enzymatic activity, with gases escaping as bubbles. However, large clumps of sludge oil remained, indicating ongoing microbial activity.By the fourteenth day, significant degradation of sludge oil was observed. The large clumps had softened, showing effective microbial breakdown of the sludge oil's complex structure. Medium-sized clumps persisted, indicating that degradation was still in progress.On the twenty-first day, the medium-sized clumps had further reduced to small clumps, indicating that the microbes continued to break down the sludge oil.

The reduction in viscosity further indicated the breakdown of long hydrocarbon chains into shorter, simpler compounds.ln Sample 2, liquid hydrocarbon was used without microbes, biosurfactants, biosolvents, or nutrients. There was no significant change, except that the outer surface of the sludge oil softened slightly. While liquid hydrocarbon helped to soften the sludge oil by dissolving some components, it was not enough to cause significant structural changes. This shows that microbes, along with additives like biosurfactants and biosolvents, are essential for effective bioremediation. In the sludge oil recovery experiment, a 3-liter jar was used, containing 500 grams of sludge oil and 300 ml of demineralized water to achieve a total 200olüme of 800 ml. From the first to the third day, 100 ml of Microbes M&S, 50 ml of biosurfactant, 50 ml of biosolvent, 100 ml of light hydrocarbon, and 50 ml of nutrients were added 200olüm, repeated three times for a total of 1,050 ml. On days seven, fourteen, twenty-one, and twenty-seven, an additional 50 ml of Microbes M&S, 25 ml of light hydrocarbon, and 25 ml of nutrients were added, repeated four times, totaling 400 ml. The treatment process resulted in a 17.1% increase in the jar’s total 200olüme, or 22.8% of the total treatment 200olüme, demonstrating that the applied method effectively enhanced crude oil recovery from sludge oil, with a significant increase in the treatment outcome percentage.

5. CONCLUSION AND RECOMMENDATIONS

The use of microbial consortia has proven effective in degrading sludge oil, breaking down complex hydrocarbons into simpler compounds and increasing recoverable oil volume. Large container surfaces allow optimal microbe distribution, and environmental conditions like temperature and nutrients affect biodegradation effectiveness. Stirred samples showed better results than poked ones, highlighting the importance of proper treatment. Biosurfactants and biosolvents improve hydrocarbon solubility and microbial degradation, leading to a 17.1% recovery of oil, demonstrating significant industrial potential. Further research can detail the specific microbes used, the composition of the sludge, field reservoir conditions, production processes, surface tension, microbial growth, and economic aspects.

REFERENCES

Alfutaisi, A., Jamrah, A., Yaghi, B., and Taha, R. (2007): Assessment of alternative management techniques of tank bottom petroleum sludge in Oman, *Journal of Hazardous Materials*, **141**(3), 557–564. https://doi.org/10.1016/j.jhazmat.2006.07.023

Chen, H.-S., Zhang, Q.-M., Yang, Z.-J., and Liu, Y.-S. (2020): Research on Treatment of Oily Sludge from the Tank Bottom by Ball Milling Combined with Ozone-Catalyzed Oxidation, *ACS Omega*, **5**(21), 12259–12269. https://doi.org/10.1021/acsomega.0c00958

Fidiastuti, H. R., Si, S., Pd, S., Pd, M., Lathifah, A. S., Pd, S., and Pd, M. (n.d.): BIOREMEDIASI LIMBAH INDUSTRI.

Gomathi, T., Saranya, M., Radha, E., Vijayalakshmi, K., Prasad, P. S., and Sudha, P. N. (2020): Bioremediation: A Promising Xenobiotics Cleanup Technique (1st ed.), 3139–3172 *in* S. Kim, ed., *Encyclopedia of Marine Biotechnology*, Wiley. https://doi.org/10.1002/9781119143802.ch140

Hu, G., Li, J., and Zeng, G. (2013): Recent development in the treatment of oily sludge from petroleum industry: A review, *Journal of Hazardous Materials*, **261**, 470–490. https://doi.org/10.1016/j.jhazmat.2013.07.069

Huang, Q., Han, X., Mao, F., Chi, Y., and Yan, J. (2014): Effect of the Particle Surface on Oil Recovery from Petroleum Sludge, *Energy & Fuels*, **28**(7), 4480–4485. https://doi.org/10.1021/ef500808x

Jiang, H., Wang, Y., Nie, C., Yan, F., Ouyang, X., and Gong, J. (2020): Oil Sludge Deposition in Storage Tanks: A Case Study for Russian Crude Oil in Mo-he Station, *Applied Sciences*, **11**(1), 321. https://doi.org/10.3390/app11010321

Jing, G., Luan, M., and Chen, T. (2011): Prospects for development of oily sludge treatment, *Chemistry and Technology of Fuels and Oils*, **47**(4), 312–326. https://doi.org/10.1007/s10553-011-0301-4

Li, C.-T., Lee, W.-J., Mi, H.-H., and Su, C.-C. (1995): PAH emission from the incineration of waste oily sludge and PE plastic mixtures, *Science of The Total Environment*, **170**(3), 171–183. https://doi.org/10.1016/0048-9697(95)04705-X

Thong, O., Ibrahim, A., Abdul Rahim, H., Yong, W. J., and Ismail, N. (2021): Review of Crude Oil Extraction Methods from Petroleum Sludge, *International Journal of Engineering Technology and Sciences*, **8**(1), 40–50. https://doi.org/10.15282/ijets.8.1.2021.1006

Ubani, O., Atagana, I. H., and Thantsha, S. M. (2013): Biological degradation of oil sludge: A review of the current state of development, *African Journal of Biotechnology*, **12**(47), 6544–6567. https://doi.org/10.5897/AJB11.1139

Zhang, J., Li, J., Thring, R. W., Hu, X., and Song, X. (2012): Oil recovery from refinery oily sludge via ultrasound and freeze/thaw, *Journal of Hazardous Materials*, **203–204**, 195–203. https://doi.org/10.1016/j.jhazmat.2011.12.016.

CHAPTER 15

Effect of Emulsion Formation on AOS and ALS Surfactants at 80 ℃ With 39 ºAPI

Kesit Bayu Kumoro Aji
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
kesit071002000058@std.trisakti.ac.id
Orcid: 0009-0008-1571-1602

Pauhesti
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
pauhesti@trisakti.ac.id
Orcid: 0000-0002-9305-1610

Ridha Husla
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
ridha.husla@trisakti.ac.id

Samsol*
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
samsol@trisakti.ac.id
Orcid : 0000-0002-5386-8546

Rini Setiati
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
rinisetiati@trisakti.ac.id
Orcid: 0000-0001-9243-062X

Widia Yanti
Environment, Development, and Sustainability - Faculty of Graduate School,
Chulalongkorn University, Thailand

ABSTRACT

Along with the increasing demand for petroleum energy, decreasing oil recovery in oil and gas fields must be a current and future problem. One of the enhanced oil recovery (EOR) methods is surfactants. In this study, two surfactant solutions were used: AOS (alpha olefin sulfonate) surfactant and ALS (ammonium lauriel sulfonate) surfactant. The AOS and ALS surfactants each have a salinity of 9000 ppm. Both surfactants have characteristics that allow them to reduce interfacial tension. Phase behavior tests were conducted to measure the stability of the foam in this study. This test was conducted for fourteen days at 80 degrees Celsius. The phase behavior test involved mixing the surfactant solution with the oil before placing it in the oven for fourteen days at 80 degrees Celsius to produce an emulsion closer to the midpoint for optimal emulsion stability. The interfacial tension test, conducted at 80 degrees Celsius, was conducted to measure the interfacial tension of the surfactant to improve the fluid sweeping efficiency. Finally, a core flooding test was conducted to determine how much oil was obtained in the sandstone when the surfactant was injected. In this research, it is expected that a middle phase emulsion will be found.

Keywords: Enhanced oil recovery (EOR) technology, Chemical Flooding, Surfactants, Alpha olifien sulfonate, ammonium lauriel sulfonate, Core flooding, Recovery factor (RF).

1. INTRODUCTION

In the oil industry, oil production from reservoirs will gradually decline or even stop, even when primary and secondary methods have been used. However, this does not mean that the crude oil reserves in the reservoir are depleted. Therefore, advanced methods such as Enhanced Oil Recovery (EOR) are needed to maximize the production of crude oil still present in the reservoir. Enhanced Oil Recovery (EOR) methods include CO2 injection, chemical injection, miscible injection, and immiscible injection [1]. In this experiment, the EOR method used is chemical injection using plant-based surfactants. One example of a plant-based surfactant is the anionic surfactant AOS and ALS [2].

Alpha Olefin Sulfonate (AOS) is a type of anionic surfactant derived from alpha olefins. These olefins are hydrocarbon compounds with a special structure that provides excellent surfactant properties [3]. The chemical structure of AOS consists of a hydrophilic sulfonate group (which attracts water) attached to a lipophilic alkyl chain. Among these surfactants, Alpha Olefin Sulfonates (AOS) stand out as versatile workhorses contributing to the efficacy and performance of various consumer and industrial products. One of the main advantages of AOS is its biodegradability [4]. This means that after use, AOS molecules can break down into harmless substances in the environment through natural processes. Ammonium Lauryl Sulfate (ALS) is a type of anionic surfactant that is a main component in anionic detergents and acts as a surface active agent (Enhanced Oil Recovery surface active agent), which reduces surface tension[5].

Surfactant injection is used to lift the remaining oil in the reservoir to the surface by reducing the interfacial tension between the oil and water [6]. By lowering the interfacial tension (IFT), the capillary number will increase, thereby increasing the production of the remaining oil [7].

The main goal of surfactant injection is to determine the recovery factor that can be achieved and to understand the oil recovery results [8]. By conducting core flooding, the recovery factor results can be obtained, and analysis can be performed to find the best results from the various types of light oil that have been tested [9].

2. RESEARCH METHOD

The research design used in this study is analytical and experimental, aimed at understanding the cause-and-effect relationship between two variables operationally, including differences, relationships, and researcher interventions within them[10]. Analysis was conducted on data such as the type of surfactant, surfactant concentration, and salinity levels used [11]. Thus, the relationship between these three floodingvariables and their differences can be used to determine the Recovery Factor (RF) in sandstone formations[11].

In the process of preparing surfactant solutions using AOS and ALS, the first step involves preparing solutions with various concentrations[12]. In this process, surfactant solutions are initially prepared with the highest concentration and then diluted to the lowest concentration.

Phase behavior measurements were conducted at 80°C using 39 °API oil and surfactant at varying concentrations [7]. During the phase behavior test of crude oil with AOS or ALS surfactants, the procedure involves mixing 2 ml of crude oil with 2 ml of AOS or ALS surfactant in a tube, then shaking the tube for 2 minutes until an emulsion forms. This phase

behavior test can be conducted for up to 14 days[13] . The Core Flooding test uses a core holder where the core will be injected with brine and surfactant that have reached the Critical Micelle Concentration (CMC) point, and this will be tested on the available sandstone core[14].In the Core Flooding test using a core holder, the core will be injected with brine, AOS surfactant, and ALS surfactant at a concentration of 1.3% and a salinity of 9,000 ppm. At this stage, the core rock is already saturated with oil. Since a 5 tube will be used, OOIP (original oil in place) data is needed as a reference to measure the volume of fluid that will exit the core[15].

3. RESULT AND DISCUSSION

The results of injecting AOS and ALS surfactants into 39 °API oil at 80 °C using a concentration of 1.3% showed that AOS produced a 1.50% emulsion in the middle phase, while no emulsion was observed with ALS. Subsequently, an interfacial tension test using a spinning drop apparatus yielded a value of 0.8212077 dyne/cm for 1.3% AOS surfactant. After completing the interfacial tension test, the study proceeded with core flooding using only 1.3% AOS surfactant in the middle phase. The results of the core flooding showed that the recovery factor from water flooding was 44.44% and from surfactant flooding was 30.83%, resulting in a total RF of 75.27%.

This surfactant injection process demonstrates that AOS performed the best with 39 °API oil, achieving a total RF of 75.27%.

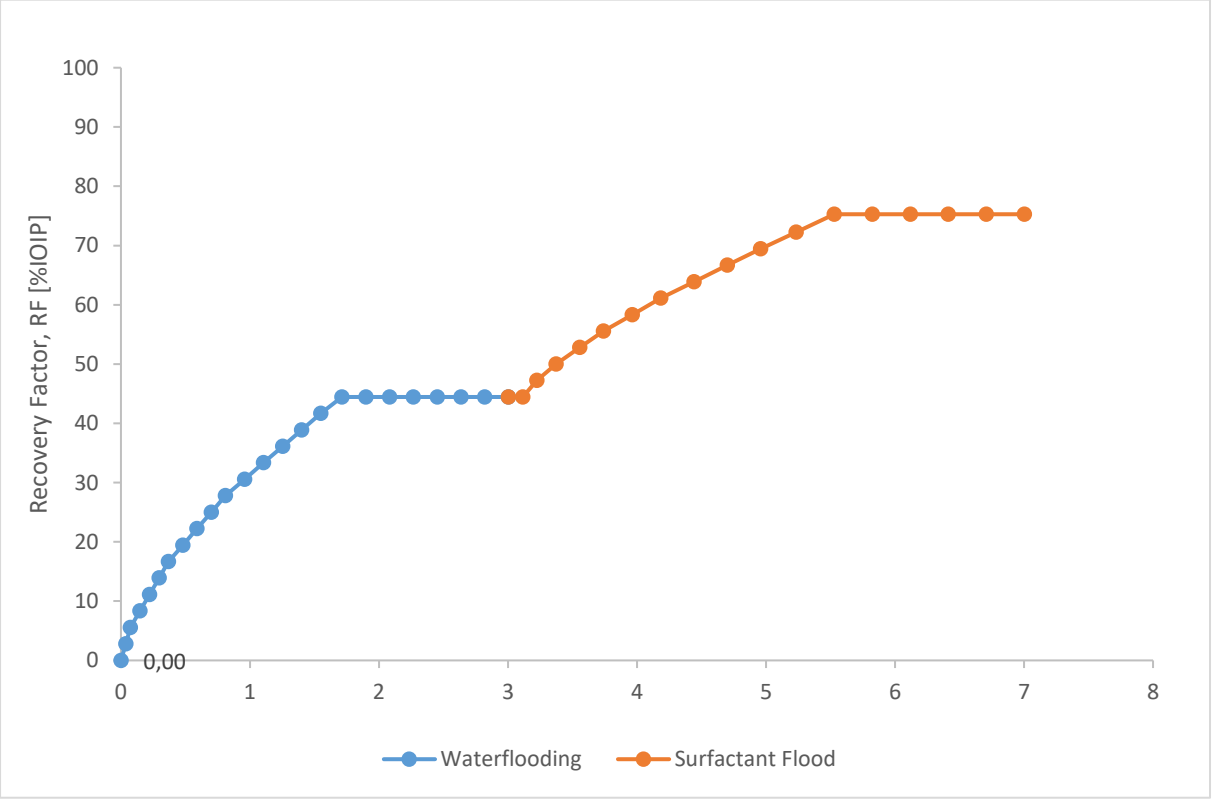


Figure 1. Surfaktan AOS 1,3% 80 °C pada konsentrasi 1,3%
AOS Surfactant Injection into 39 °API Oil

Based on the graph, the 39 °API oil after the flooding process achieved a total recovery factor of 75.27%. Core flooding method was employed to simulate chemical oil displacement in the oil reservoir, using the slug method where the injected volumes were predetermined at the beginning of the study [16]. Two PV (Pore Volumes) of water flooding and two PV of surfactant flooding were injected, making a total of four PV injected in the core flooding method.

4. CONCLUSION AND RECOMMENDATIONS

From this study, based on phase behavior tests and core flooding experiments with AOS and ALS surfactants on 39 °API oil, it was found that the total Recovery value is 75.27%. The research also indicates that at 80 °C temperature and with 39 °API oil, the most effective surfactant is AOS at a concentration of 1.3%. These findings suggest that emulsion formation can impact the Recovery factor value.

REFERENCES

[1] B. A. Suleimanov, F. S. Ismayilov, O. A. Dyshin, and E. F. Veliyev, "Selection methodology for screening evaluation of EOR methods," *Pet Sci Technol*, vol. 34, no. 10, pp. 961–970, May 2016, doi: 10.1080/10916466.2015.1107849.

[2] R. Juita, Arnelli, and Yusniati, "Telaah Surfaktan untuk Proses Enhanced Oil Recovery (EOR) dan Profil Adsorpsi Surfaktan A-Olefin Sulfonates (AOS)," *Jurnal Kimia Sains dan Aplikasi*, pp. 27–31, 2016.

[3] P. Pauhesti, S. Kasmungin, and K. F. Hartono, "UJI LABORATORIUM UNTUK MENINGKATKAN PEROLEHAN MINYAK MENGGUNAKAN INJEKSI SURFAKTAN AOS KONSENTRASI RENDAH," *PETRO:Jurnal Ilmiah Teknik Perminyakan*, vol. 6, no. 2, pp. 66–70, Aug. 2018, doi: 10.25105/petro.v6i2.3107.

[4] R. A. Nugraha, W. Yanti, P. S. Yulia, A. Fattahanisa, A. Ristawati, and Fadliah, "Analisis Pengaruh Peningkatan Konsentrasi dan Salinitas Pada Injeksi Surfaktan AOS Terhadap Recovery Factor," *PETRO:Jurnal Ilmiah Teknik Perminyakan*, vol. 11, no. 1, pp. 1–5, Jun. 2022, doi: 10.25105/petro.v11i1.13300.

[5] D. Kurniawan, B. Laboratorium Teknologi Bahan Alam dan Mineral Jurusan Teknik Kimia, F. Teknik, U. Riau Kampus Binawidya Km, and S. Baru Panam, "EPOKSIDASI KARET ALAM DENGAN MENGGUNAKAN SURFAKTAN AMONIUM LAURIL SULFAT SEBAGAI WETTING AGENT," 2015.

[6] R. Aditya, R. Setiati, S. S. Riswati, I. Sumirat, and Bharoto, "Correlation of middle phase behavior to IFT: Literature review," 2023, p. 020147. doi: 10.1063/5.0120301.

[7] R. Andriyan, R. Setiati, S. Kasmungin, and R. Pratiwi, "PENGARUH TES UJI FASA DAN INTERFACIAL TENSION (IFT) TERHADAP KINERJA SURFAKTAN DALAM PROSES EOR," *PROSIDING SEMINAR NASIONAL CENDEKIAWAN 2018*, Oct. 2018.

[8] M. A. L. I. Masrur, "PERANCANGAN SISTEM EOR (ENHANCED OIL RECOVERY) TERMAL DENGAN ENERGI NUKLIR KAPASITAS 20.000," pp. 69–71, 2017.

[9] E. M. Tobing, "UJI SENSITIVITAS VOLUME SLUG PADA INJEKSI ALKALI MELALUI MODEL SIMULASI CORE FLOODING EOR," *Lembaran publikasi minyak dan gas bumi*, vol. 53, no. 1, pp. 15–27, Apr. 2019, doi: 10.29017/LPMGB.53.1.360.

[10] R. A. Nugraha, W. Yanti, P. S. Yulia, A. Fattahanisa, A. Ristawati, and D. Fadliah, "Analisis Pengaruh Peningkatan Konsentrasi dan Salinitas Pada Injeksi Surfaktan AOS Terhadap Recovery Factor", [Online]. Available: https://trijurnal.lemlit.trisakti.ac.id/index.php/petro

[11] R. Setiati, M. Taufiq Fathaddin, and A. Fatahanissa, "The Importance of Microemulsion for the Surfactant Injection Process in Enhanced Oil Recovery," in *Surfactants and Detergents - Updates and New Insights*, IntechOpen, 2022. doi: 10.5772/intechopen.101273.

[12] S. Kalam *et al.*, "Static and dynamic adsorption of a gemini surfactant on a carbonate rock in the presence of low salinity water," *Sci Rep*, vol. 13, no. 1, p. 11936, Jul. 2023, doi: 10.1038/s41598-023-38930-z.

[13] Anggie Suci Meilanie, "ANALISIS KINERJA SURFAKTAN AOS (ALPHA OLEFIN SULFONAT) DAN KO-SURFAKTAN NP-10 (NONYL PHENOL ETHOXYLATE) TERHADAP KELAKUAN FASA FLUIDA (PHASE BEHAVIOR) DAN UJI BUSA (FOAMY TEST)(LABORATORIUM STUDY)," Pekanbaru, Jan. 2021. Accessed: Jul. 21, 2023. [Online]. Available: https://repository.uir.ac.id/12560/1/193210835.pdf

[14] P. H. Krumrine, J. S. Falcone, and T. C. Campbell, "Surfactant Flooding 1: The Effect of Alkaline Additives on IFT, Surfactant Adsorption, and Recovery Efficiency," *Society of Petroleum Engineers Journal*, vol. 22, no. 04, pp. 503–513, Aug. 1982, doi: 10.2118/8998-PA.

[15] A. K. Suparmanto, L. Satiawati, H. Pramadika, Pauhesti, and Samsol, "STUDY LABORATORIUM INJEKSI SURFAKTAN ABS DENGAN KONSENTRASI RENDAH PADA BATUAN BAREA SANDSTONE," *PETRO: JURNAL ILMIAH TEKNIK PERMINYAKAN*, vol. 12, pp. 183–190, 2023, doi: 10.25105/petro.v12i3.17300.

[16] D. Aditya Rachman and H. Pramadika, "Laboratory Study of the Effect of Salinity on the Demulsification Process in High Temperature Crude Oil (Kajian Laboratorium Pengaruh Salinitas pada Proses Demulsifikasi dalam Minyak Mentah Bersuhu Tinggi)," *Journal of Earth Energy Science, Engineering, and Technology*, vol. 3, no. 2, 2020.

CHAPTER 16

Petrophysical Analysis and Causes of The Lower Zone Well X Resistivity

M Hanif Fadhlurrahman Ramadhan
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
m071002000025@std.trisakti.ac.id
Orcid: 0009-0003-4856-7401

Suryo Prakoso
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
suryo_prakoso@trisakti.ac.id

Djunaedi Agus Wibowo
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
djunaedi.agus@trisakti.ac.id

Sigit Rahmawan*
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
sigit_rachmawan@trisakti.ac.id
Orcid :0009-0005-4183-5447

Puri Wijayanti
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
puri.wijayanti@trisakti.ac.id
Orcid: 0000-0003-1953-0610

Widia Yanti
Environment, Development, and Sustainability - Faculty of Graduate School, Chulalongkorn University, Thailand

ABSTRACT

Hydrocarbon reserves are one of the main points that are very important in the sustainability of the productivity of an oil and gas field. The data used in the formation evaluation process is in the form of well logging, petrophysical, geological and geophysical data. This process is used to determine the physical properties of rocks such as rock lithology, porosity, permeability, water saturation and initial hydrocarbon reserves. However, there are several reservoirs or zones that experience low resistivity effects which will give an initial indication that the zone or reservoir is not attractive or has no effect for development. In field X, there are zones that experience low resistivity effects, making these zones unattractive for production. So that in order to make this zone attractive for production, identification analysis is carried out in the X field to determine the type or type of fluid from the two zones. Fluid type identification analysis was carried out using the fluid identification factor cross plot method with the results obtained that in Zones A and B there were 2 types of fluid types, namely hydrocarbon and water with a depth limit of 5450 ft in Zone a and 5500 ft in zone b. By knowing the type of hydrocarbon fluid contained in these two zones, it should be able to increase interest in producing these zones as potential production zones, however, it is necessary to carry out perforations at the depth range indicated by the hydrocarbon fluid and carry out initial production tests to prove the results of the analysis. this research.
Keywords: Fluid, Hydrocarbon, Low Resistivity, Potential, Zone.

1. INTRODUCTION

The well logging method is a technique for obtaining information about geological formations and fluid properties in drilled holes, which involves measuring parameters, such as resistivity, density, porosity and fluid saturation (Aprilia et al., n.d.). This is done by recording the response of the log tool inserted into the well due to differences in the physical and fluid properties of the rock. The response is recorded continuously in a curve. This curve contains information about the condition of the rock formation beneath the formation, both lithology and fluid type. Well logging results in the form of curves require interpretation techniques to interpret subsurface conditions, determine layers containing hydrocarbons, determine the type of rock formation, and optimize well production strategies.

Subsurface rock layers have varying resistivity values. This can be influenced by differences in water saturation levels. A rock formation has the ability to accommodate and flow the fluids contained within it. The presence of clay minerals and, also the mineral content of pyrite in sandstone as a reservoir greatly influences the results of log analysis (firman herdiansyah1, 2016). There is a condition in rock resistivity which is called low resistivity, namely the value of electrical resistance to fluids is low due to the presence of conductive minerals, shaly sand reservoir rocks, and fresh water formation. High formation water salinity can also cause resistivity measurements to be inaccurate, because the formation water salinity is high, the resistivity reading becomes low due to the conductive nature of the water. The problem with this formation is that the rock is shaly sand and contains pyrite minerals, so it can affect resistivity readings, because pyrite minerals have high electrical conductivity. Previously this research had been carried out using the double apparent resistivity method, but there was no clear comparison between the types of fluids in the low resistivity zone. So the author feels it is necessary to carry out research to be able to identify the type of fluid contained in reservoirs that experience low resistivity conditions

2. LITERATURE REVIEW

Drilling operations are an important part of the oil and gas industry. Drilling operations include the discovery and demonstration that the drilling operation contains reserves within the reservoir. The goal of a drilling operation is to drill, evaluate and complete a well that will produce oil and gas efficiently and safely. Therefore, proper planning of drilling operations is necessary. Drilling is the operation of making a hole from the surface to the target to be achieved to prove whether or not there are hydrocarbons in the reservoir. Drilling mud consists of fluids that are used in the drilling process by cleaning the bottom of the drill hole and lifting the powder to the surface so that the drilling process can run smoothly. The circulation system aims to circulate drilling mud throughout the drilling system so that it can be optimized. This mud is circulated from above the surface to the drill hole. This circulation begins with drilling mud which flows from the suction tank to the pump, then the mud flows through the pipe connection to the stand pipe and into the drill pipe series to the drill bit. The circulation process is carried out repeatedly so that the mud mixed with the cuttings can be cleaned

3. RESEARCH METHOD

This research methodology adopts a case study approach with quantitative data analysis. The initial steps in the research stages carried out start from collecting articles or journal articles that have been previously published, especially in low resistivity zone areas, then collecting data that will be researched, such as the data analysis stage, which starts from determining the permeable zone in the low resistivity area, reading data logging spontaneous potential log (sp), determining sp sand and sp shale boundaries, reading resistivity logs, determining effective porosity using weld data, determining permeability, determining fx and fy values, and determining fluid type division categories. The Interactive Petrophysics program was used as a qualitative analysis and evaluation tool for rock lithology formations.

Fluid identification factor cross plot method is a method used to identify the type of fluid in a reservoir by utilizing the distribution and pattern of data points from two or more types of log data on a flat graph or crossplot (Bai et al., 2019). This method helps understand fluid characteristics and differentiate between different zones based on the response of each device

The data collected includes information about well logging, core data, and weld data. For logging data, the parameters collected include low resistivity zone depth values, SP log values, AT 10, AT20, AT30, AT60, AT90, SP delta, delta t, shale and sand limit values in the SP log.

1. Logging reading of the triple combo log
2. Logging readings in the low resistivity zone on track 2
3. Reading the sp log on track 1 with low resistivity depth, and determining the limit values for sp sand and sp shale
4. Reading AT10, AT20, AT30, AT60, AT90 values on the resistivity log
5. Calculation of Delta SP and Delta T values using resistivity and sp data
6. Determine the porosity value using interactive petrophysics software
7. Calculate the permeability value based on the Eastern equation method
8. SWIRR calculation to determine the eastern permeability equatio n value using the buckle method
9. Calculation of fx and fy values involving the previous parameters to determine the crossplot value
10. Making crossplot graphs and categorizing the type of fluid contained according to resistivity reading.

4. RESULT AND DISCUSSION

4.1. Qualitative Analysis

The research area is in Well With the aim of increasing production interest after the fluid type is known as a potential zone for production, it is necessary to perforate at a depth identified as a hydrocarbon zone and carry out initial production tests to prove the analysis results. Low resistivity zone is one of the problem conditions, namely the condition of the rock layer has a low electrical resistance value, meaning that it easily transmits electricity so it can be expected to have high water saturation.

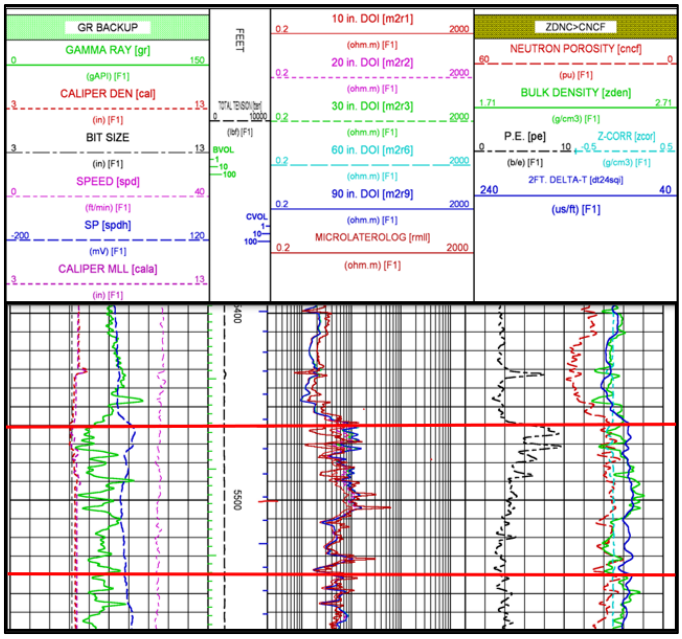


Figure 1. Triple combo log

This research uses interactive petrophysics v3.5 software in data processing. For track one, it displays the gamma ray log, caliper, and sp log. Track 2 displays the M2R1, M2R2, M2R3, M2R6, M2R9 logs as resistivity logs as in table 1, then track 3 displays the NPHI and RHOB logs as porosity logs and neutron logs. Log reading is focused on track 2, namely logs M2R1, M2R2, M2R3, M2R6, M2R9 as resistivity logs and log reading results are obtained. Next, divide the depth into 3 layers, namely oil layer, transition layer, oil water layer as in table 2. After that, determine the interval, sp shale and sp sand as the boundaries of the shale and sand zones for all depths used in the calculation.

4.2. Fluid Identification Factor Cross Plot Method

From the results of the quick looking reading indications using qualitative analysis, quantitative analysis is then carried out, namely calculating the fluid identification factor cross plot method in the low resistivity zone so that it can determine the type of fluid that has a low resistivity value but is interesting to produce in the depth range of 5450 - 5528.95 ft. The following calculations are used in the fluid identification factor cross plot method (Bai et al., 2019)

$$Fx = \Delta SP * (\frac{K}{\emptyset})^{1/2}$$

$$Fy = D_R \times AT90$$

Fx and fy in the crossplot method can identify oil layers, oil and water layers, and water layers in oil pay areas. The fx and fy plot in the low resistivity zone area can magnify the differences between the oil layer, oil water layer, and water layer. The results of the research identified low resistivity zones using the fluid identification factor cross plot method. The results of the research can be seen in the graph, namely in the green oil layer zone there is still

a blue low resistivity zone. So, in zones that are considered to have low resistivity, there are hydrocarbon fluids. Apart from that, the transition zone is clearly visible, namely the transition zone between the oil layer and the water layer as in Figure 1

Table 1. Resistivity log

Depth	AT10	AT20	AT30	AT60	AT90
5450	1,74	1,84	1,86	1,83	1,79
5453,95	1,96	2,13	2,2	2,19	2,13
5457,89	3,92	5,01	5,69	6,07	5,7
5461,84	5,29	7,58	9,4	10,2	9,45
5465,79	5,58	7,83	9,78	11,1	11
5469,74	2,87	4,19	5,45	6,2	6,29
5473,68	4,77	6,92	8,42	9,34	9,6
5477,63	4,83	5,5	5,83	5,88	5,9
5481,58	4,59	6,2	7,12	7,52	7,44
5485,53	5,18	8,32	10,6	11,4	11,3
5489,47	3,56	5,27	6,21	6,38	6,37
5493,42	6,3	8,66	10,1	10,5	10,3
5497,37	8,86	12,5	14,5	15	14,6
5501,32	7,19	9,42	10,4	10,7	10,5
5505,26	7,75	10,3	11,3	11,6	11,5
5506	6,9	9,12	9,81	9,92	9,91
5507	6,1	7,82	8,23	8,23	8,3
5508	5,72	7,08	7,39	7,39	7,52
5509,21	4,53	5,38	5,69	5,7	5,86
5513,16	3,13	3,43	3,47	3,42	3,44
5517,11	4,21	4,36	4,51	4,54	4,53
5521,05	4,3	4,99	5,12	5,09	5,09
5525,00	2,8	3,11	3,19	3,1	3,08
5528,95	3,08	3,39	3,48	3,44	3,38

Table 2 Division of fluid types

Depth	Layer
5450	Oil Layer
5453,95	Oil Layer
5457,89	Oil Layer
5461,84	Oil Layer
5465,79	Oil Layer
5469,74	Oil Layer
5473,68	Oil Layer
5477,63	Oil Layer
5481,58	Oil Layer
5485,53	Oil Layer
5489,47	Oil Layer
5493,42	Oil Layer
5497,37	Oil Layer
5501,32	Oil Layer
5505,26	Transition Layer

Depth	Layer
5506	Transition Layer
5507	Transition Layer
5508	Transition Layer
5509,21	Transition Layer
5513,16	Water Layer
5517,11	Water Layer
5521,05	Water Layer
5525,00	Water Layer
5528,95	Water Layer

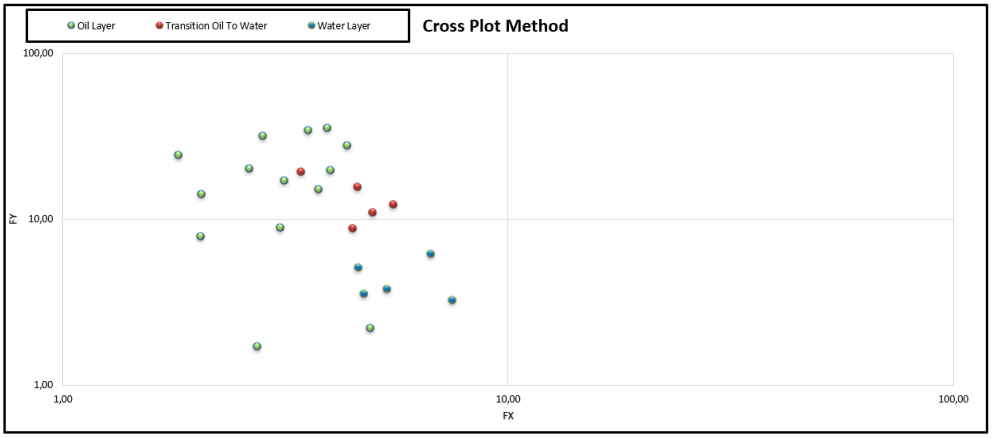


Figure 2. Cross plot method

5. CONCLUSION AND RECOMMENDATIONS

This x formation is formed by shaly sand rock which consists of the clay mineral, namely illite, cementation in this rock is dominated by the clay mineral, namely pyrite. Because the presence of pyrite and illite minerals in the formation can influence logging readings, the presence of pyrite and illite can affect resistivity readings, which should have high resistivity, becoming low resistivity because there is conductivity mineral content.

It was found that the depth of the low resistivity zone with quick looking readings was in the depth range of 5540 -5528.95 feet. The division of fluid types found in the low resistivity zone with a depth range of 5540 – 5528.95 feet is oil layer, transition layer and water layer. Based on the results of the fluid type identification analysis using the fluid identification factor cross plot method, it can be concluded that this method can identify the type hydrocarbon fluid in the low resistivity zone due to the division of oil layer, transition and water layer is clearly visible on the cross plot graph. And also the location of the transition zone is in the depth range of 10 in the fy value.

REFERENCES

Aprilia, R., Dewanto, O., dan Ramadhan, A. (t.t.): *ANALISIS PETROFISIKA DAN PENYEBAB LOW RESISTIVITY RESERVOIR ZONE BERDASARKAN DATA LOG, SEM, XRD DAN PETROGRAFI PADA LAPANGAN X SUMATERA SELATAN*.

Bai, Z., Tan, M., Li, G., dan Shi, Y. (2019): Analysis of low-resistivity oil pay and fluid typing method of Chang 81 Member, Yanchang Formation in Huanxian area, Ordos Basin, China, *Journal of Petroleum Science and Engineering*, **175**, 1099–1111. https://doi.org/10.1016/j.petrol.2019.01.015

Boakye, A. A., Adeigbe, C. O., Bempong, F. K., dan Prempeh, M. K. (2022): *Article Open Access A Comparative Permeability Modelling Study of the Enyenra Turonian Reservoirs, Tano Basin-Ghana*, Petroleum and Coal Pet Coal.

Buckles, R. S. (1965): *POOR IMAGE DUE TO ORIGINAL DOCUMENT QUALITY Correlating and Averaging Connate Water Saturation Data*, diperoleh melalui situs internet: http://onepetro.org/JCPT/article-pdf/4/01/42/2166303/petsoc-65-01-07.pdf/1.

Buryakovsky Leonid, V. C. G. H. R. H. S. S. (t.t.): *Fundamentals of the Petrophysics of Oil and Gas Reservoirs*.

FIRMAN HERDIANSYAH[1], A. I. S. (2016): LOW RESISTIVITY ZONE PADA RESERVOIR BATUPASIR FORMASI CIBULAKAN ATAS, CEKUNGAN JAWA BARAT UTARA LOW RESISTIVITY ZONE IN SANDSTONE RESERVOIR UPPER CIBULAKAN FORMATION, NORTH WEST JAVA BASIN, *Bulletin of Scientific Contribution*.

Genter, A., Castaing, C., Dezayes, C., Tenzer, H., Traineau, H., dan Villemin, T. (1997): Comparative analysis of direct (core) and indirect (borehole imaging tools) collection of fracture data in the Hot Dry Rock Soultz reservoir (France), *Journal of Geophysical Research: Solid Earth*, **102**(B7), 15419–15431. https://doi.org/10.1029/97jb00626

Hamada, G. M., Al-Blehed, M. S., dan Al-Awad, M. N. J. (2000): Nuclear Magnetic Resonance Log Evaluation of Low-Resistivity Sandstone Reservoirs By-Passed by Conventional Logging Analysis, *All Days*, SPE. https://doi.org/10.2118/64406-MS

Holmes, M., Holmes, A., dan Holmes, D. (t.t.): *Relationship between Porosity and Water Saturation: Methodology to Distinguish Mobile from Capillary Bound Water*.

Klinmanee, P., dan Dürrast, H. (t.t.): *Geophysical logging for groundwater investigations in Southern Thailand*, J. Sci. Technol, diperoleh melalui situs internet: http://www.sjst.psu.ac.th, **34**, 433–444.

Maulana iqbal (2016): *PETROPHYSICAL ANALYSIS AND RESERVE ESTIMATION "KAPRASIDA" FIELD BATURAJA FORMATION SOUTH SUMATERA BASIN*, 1–49.

Rahmawan, S., Herdiansyah, F., Prakoso, S., Burhannudinnur, M., Irham, S., Samsol, Himawan Prakoso, M., dan Fakhriyatul Ummah, H. (2023): Identification Analysis of Fluid Type in the Low Resistivity Zone of Well Z-2 Field "Z", South Sumatera, *Journal of Earth Energy Science, Engineering, and Technology*, **6**(2). https://doi.org/10.25105/jeeset.v6i2.17522

Saputro, O. D., Maulana, Z. L., dan Latief, F. D. E. (2016): Porosity Log Prediction Using Artificial Neural Network, *Journal of Physics: Conference Series*, Institute of Physics Publishing, **739**. https://doi.org/10.1088/1742-6596/739/1/012092

Serra, Oberto. (1984): *Fundamentals of well-log interpretation*, Elsevier.

Wahl, J. S., Tittman, J., dan Johnstone, C. W. (1964): The Dual Spacing Formation Density Log, *Journal of Petroleum Technology*, **16**(12), 1411–1416. https://doi.org/10.2118/989-PA

Yang, Y., Li, K., Wang, Y., Deng, H., He, J., Xiang, Z., dan Li, D. (2021): Using the modified resistivity–porosity cross plot method to identify formation fluid types in tight sandstone with variable water salinity, *Energies*, **14**(19). https://doi.org/10.3390/en14196335,

CHAPTER 17

Sukuh Temple as a Cultural and Arts Education Tourism in Central Java

Menul Teguh Riyanti
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
menulteguh@trisakti.ac.id
Orcid 0009-0005-6631-2140

Suhaila Binti Basar
Politeknik Ibrahim Sultan, Malaysia
Orcid 0009-0006-0296-7727

Bambang Triwardoyo
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
bambangtri@trisakti.ac.id
Orcid 0000-0002-6336-6574

Ekananda Haryadi
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
ekananda@trisakti.ac.id
Orcid 0009-000702463-0153

Virginia Suryani*
Departement of Visual Communication Design, Faculty of Art and Design,
Universitas Trisakti, Jakarta, Indonesia
Virginia@trisakti.ac.id
Orcid 0009-005-555-1218

ABSTRACT

Sukuh Temple is a very unique temple, different from existing temples, as a historical heritage site. In developing it as a tourist destination, there are many problems that must be resolved. Some of these problems include lack of infrastructure, authenticity/damage to the site, lack of tourist attractions displayed and promoted on social media, human resource problems and a lack of management synergy between the management and the Karanganyar district government. By looking at this, the aim of this research is to analyze factors from an internal perspective in the form of strengths and weaknesses of the potential that an object has, as well as from an external perspective in the form of threats and opportunities that an object has. Aims to explain the direction of synergistic development of tourism objects as a zone for developing art and cultural education tourism in Central Java while maintaining the important value of an area. This research uses naturalistic qualitative methods. The data used is mostly the result of interviews, where the number of informants varies from local government, managers, tourists and also the surrounding community. The results of the interviews were SWOT analyzed to determine directions for developing the synergy of these tourist attractions for the continuity of cultural tourism in Karanganyar district. The results of this research showed that internal and external factors at Sukuh Temple included weaknesses, strengths, opportunities and threats. Through the results of the existing analysis, these tourist attractions can be explained from the analysis of tourism products, marketing and institutional development through SWOT analysis. The results of the SWOT analysis produce basic principles for developing tourist destinations, in each supporting zone of the core zone.
Keywords: Sukuh temple, Indonesian cultural and arts tourism, Synergy.

INTRODUCTION

Sukuh Temple is a Hindu temple from the Majapahit era located in Central Java, located in Sukuh Hamlet, Berjo Village, Ngargoyoso District, Karanganyar Regency, Central Java Province. This temple was discovered by archaeologists during the reign of Governor Raffles in 1815. Efforts to preserve this temple complex have been carried out by the Antiquities Service since 1917. Sukuh Temple is a Hindu temple from the Majapahit era located in Central Java, located in Sukuh Hamlet, Berjo Village, Ngargoyoso District, Regency Karanganyar, Central Java Province. This temple was discovered by archaeologists during the reign of Governor Raffles in 1815. Efforts to preserve this temple complex have been carried out by the Antiquities Service since 1917. This temple was founded in the 15th century AD during the reign of Suhita, Queen of Majapahit who ruled from 1429-1446, earning the nickname "The Last Temple" is the last remaining Hindu temple from the Majapahit era. However, the uniqueness and uniqueness of Sukuh Temple, which is not found in other temples, does not make its existence as popular as other temples, namely as an object of research and so on for historical tourism for the community, especially among young people or millennials. Indonesia is a country that has diverse cultures because it consists of many islands inhabited by different tribes. Cultural diversity is what makes the Indonesian nation unique in the eyes of the world. This is in line with the opinion of Julia (2013, p. 65) who explains that: In a cultural context, a good human being is a human being who knows and understands his own culture. This means that without knowing their own culture, humans will not be cultured according to the customs, rules or norms that apply in their own environment. As a result, they will become strangers in their area.

Anticipate this, the Indonesian state must have a strong foundation in order to maintain the original culture characteristic of each region. Because culture must be preserved. Sukuh Temple can be used as an educational tourism for Indonesian arts and culture. Karanganyar is one of the districts in Central Java Province, Indonesia. Located on the western slopes of Mount Lawu, the mountain which is the border with East Java province. The natural potential, diversity of arts and culture, the friendliness of the people and the historical heritage values provide the attraction and charm of Karanganyar Regency as a tourist destination.

2. LITERATURE REVIEW

The results of the analysis highlight the existence of the Sukuh temple, which until now has been little known by the public, regarding the meaning of the reliefs and the philosophy of life, so there is a need for the role of promotional media from government agencies to work with the private sector in synergy.

In determining the direction of tourism development, there are several tourism destination development models as proposed by Davidson and Mitland (in Buhalis, 2000). The description put forward by Davidson is seen as a place that offers a portfolio of tourism products that must always be updated in line with changes in market demand (tourist demand). This is because existing products are very dependent on existing resources in the destination and these resources are not owned or controlled by the tourism industry, so there is no guarantee from the tourism industry that these resources can be protected unless there is strong enough intervention from the parties. authorized to protect it. For this reason, planning

and management at the destination level is very necessary so that the development that occurs can have a positive impact on the destination. Several destination development models obtained from the literature are as follows; Miossec model, Butler model, Plog approach, Reime and Hawkins approach and Buhalis approach. Some of these approaches will later be used as direction for developing synergy between the two tourist attractions. Tourist destinations are interactions between various elements. There are components that must be managed well by a tourist destination, namely tourists, the region and information about the region. Attractions are also a vital component that can attract tourists as well as supporting facilities. These tourist attractions must have unique qualities that can attract tourists.

Cultural Heritage Tourism Management. In explaining this approach, one of the most important aspects is conservation management, where preservation contains important values such as science, important historical values and also important cultural values (Widiyanto, 1994).

Promotion is the activity of informing about products or services that will be offered to potential consumers/tourists who are the target market. Promotional activities should ideally be carried out continuously through several media that can effectively reach the market, both print and electronic. Promotions or also sales promotions provided by several marketing experts (Introduction to Tourism, Herman Bahar, 2002: 103): Sales promotion is any non-face-to-face activity related to sales promotion, but includes advertising

Visualisations that are memorable "at-a-glance" have memorable content. The visualisations that are most memorable "at-a-glance" are those that can be quickly retrieved from memory. (Murwonugroho W, 2019

Promotion is any marketing effort whose function is to provide information or convince potential consumers regarding the usefulness of a product or service with the aim of encouraging consumers to either continue or start purchasing at a certain price.

Judging from the type of data, the research approach used in this research is a qualitative approach. What is meant by qualitative research is research that intends to understand the phenomena experienced by research subjects holistically, and by means of descriptions in the form of words and language, in a special natural context and by utilizing various scientific methods (Moleong, 2007:6).

According to Sugiyono, 2006: 6 descriptive research is research conducted on variables and independently without comparison or connecting with other variables. Then according to Suharsimi Arikunto, 2003: 31 descriptive research is not intended to test certain hypotheses, but only describes what is about the variables

3. RESEARCH METHOD

This type of research approach is descriptive. Descriptive research is research that attempts to describe solutions to current problems based on data. The type of qualitative descriptive research used in this research is intended to obtain in-depth and comprehensive information about the Sukuh temple as an arts and cultural educational tourism destination in Central Java. Apart from that, with a qualitative approach it is hoped that the situation and situation can be revealed problems faced in community participation activities and the younger generation or Millennial generation is a generation with a fast-paced character.

4. RESULT AND DISCUSSION

Based on its geographical location, Sukuh Temple is located on the slopes of Mount Lawu which has beautiful natural views and cool air. Sukuh Temple is located in Berjo Village, Ngargoyoso District, Karanganyar Regency, Central Java Province. The location of Sukuh Temple is at an altitude of + 910 m above sea level.

Sukuh Temple was rediscovered in a collapsed state in 1815 by Johnson, Resident of Surakarta during Raffles' reign. Furthermore, Sukuh Temple was examined by Van der Vlis in 1842.

Candi Sukuh is respected as a service to the ancestors of the legacy of the Kingdom's glory. Religion animates all life, including culture. The religion adopted is Hinduism, the people around Sukuh temple still embrace the ancestral religion of Hinduism (Menul Teguh Riyanti, 2018)

The Sukuh Temple tourist attraction has the potential to be a very unique tourist attraction because it is different from Hindu temples in general. The shape of this temple is trapezoidal and is similar to Mayan temples. Because of its uniqueness, this temple is a very interesting temple in Southeast Asia.

Analysis of internal and external factors from the Sukuh Temple and Astana Mangadeg which is projected into three things, namely tourism product analysis, marketing and institutional development through SWOT analysis, can be described as follows:

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The input for this variable analysis is the factors that are the strengths and weaknesses of the area that occur more often or originate from within the environment. Below are the points regarding the existing condition of the Sukuh Temple object area based on the strengths and weaknesses of the primary and secondary survey results.

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Tourists must walk along a path surrounded by shady trees. Tourists will not feel bored walking long distances to the burial location because the surrounding natural atmosphere is shady and beautiful. Analysis of internal and external factors from the Sukuh Temple and Astana Mangadeg which is projected into three things, namely tourism product analysis, marketing and institutional development through SWOT analysis, can be described as follows:

The input for this variable analysis are factors that are the strengths and weaknesses of the area that occur more frequently or originate from within the environment. Below are points regarding the existing conditions of the Sukuh Temple and Astana Mangadeg object areas based on the strengths and weaknesses of the primary and secondary survey results. The results of the strengths/strengths from the Internal variable analysis include: Nature Reserve which is a historical heritage in Central Java, Potential for natural beauty, culture, society and the environment that can be relied upon, transportation accessibility that is easy to reach both conventionally and online, tourism costs that are still cheap and Good supervision/security

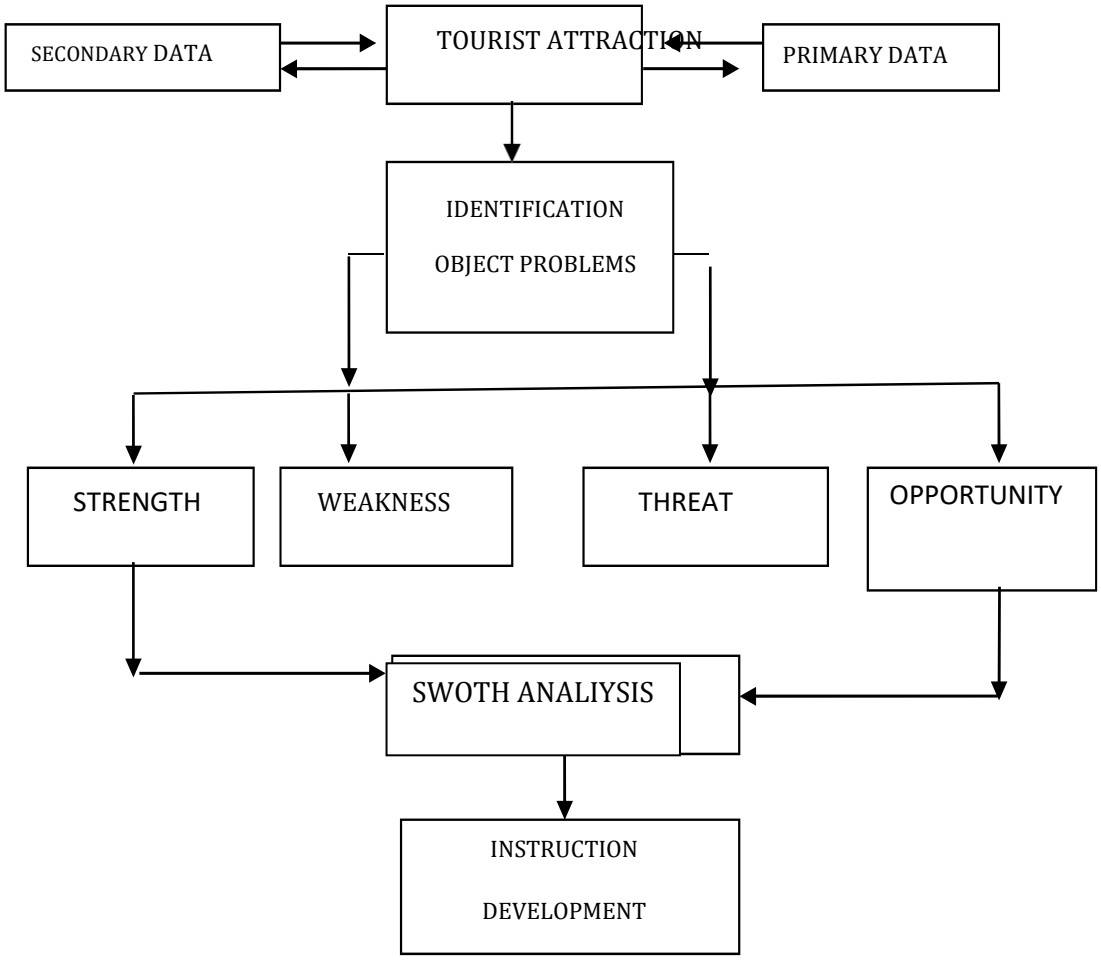


Figure 1. Analysis techniques data

Meanwhile, the results of weaknesses include: Not yet managed well, due to a lack of coordination and cooperation between the central government, district government and the private sector and the community, governance management.

Insufficient area space, inadequate facilities/accommodation such as lodging, low quality of human resources and small population growth rates, tourism promotion which is considered inadequate, lack of tourist attractions and also lack of marketing of tourism packages that involve all tourism potential in the region. Karanganyar

The input for this external variable analysis is factors which are opportunities and threats that exist and occur or originate from outside the environment. Below are points regarding the existing conditions of the Sukuh Temple and Astana Mangadeg object areas based on the

opportunities and threats from the results of primary and secondary surveys. Identification of existing opportunities include: Ease of accessibility, Located in the middle of economic growth (Central Java and East Java), The rise of research conducted in the Karanganyar area (Tourism Department, educational institutions, NGOs, etc.), The existence of policies from the Regional Government Central Java Province for the development of educational cultural tourism areas, the existence of surrounding villages that have the potential to become tourist villages that support regional growth, increasing community needs for recreation. Meanwhile, the identification of threats that arise include: Threats of environmental conservation and the impact of mass tourism which will threaten conservation at Sukuh Temple and Astana Mangadeg, Low interest in investment, Conflicts of interest both personal and group in carrying out cooperation between tourism institutions, Widespread theft of objects antiquity, the emergence of competition between tourist areas in other areas, both nationally and internationally, negative impacts that give rise to foreign cultural influences that are not in accordance with local culture.

Directions for developing the Sukuh Temple and Astana Mangadeg sites as tourism development zones. Zoning for the development of Sukuh Temple and Astana Mangadeg consists of 3 types of zoning, namely core zoning, buffer zoning and developer zoning. Core zoning is directed at the core or main area of regional development. This area is home to cultural heritage buildings which are historical heritage as a tourist attraction and regional identity. With the existence of cultural heritage buildings, preservation is carried out in terms of the development of Sukuh Temple even though it is located in the middle of a residential area. For the buffer zone, it can be directed into macro-spatial and macro-non-spatial development analysis. Development of macro-spatial analysis includes: designing and arranging the Sukuh Temple area, improving maintenance through cultural heritage care, communicating with the management to carry out maintenance and care properly, considering accommodation including hotels and homestays as well as restaurants around the Sukuh Temple area, building new parking lots. accommodation facilities in accordance with policy. Meanwhile, non-spatial directions include highlighting information about the history of Sukuh Temple, needing arts and cultural attractions around the Ngargoyoso and Matesih areas, consolidating cultural communities in the area, promoting regular events for cultural attractions, providing English language training to temple managers. Sukuh. For development zones, it is also directed at macro-spatial and micro-spatial development analysis. Macro-spatial directions include: Updating road access to the Sukuh Temple, improving the quality of transportation in the area, both conventional and online, creating an integrated parking area, adding road signs to the Sukuh Temple access. Meanwhile, non-spatial development analysis includes

Table 1. Internal factors

Strenght	Weakness

1. The existence of Sukuh Temple provides a cultural feel in Karanganyar as a cultural tourism destination 2. The artistic and cultural potential that exists, especially in the Karanganyar area which is rich in historical heritage, is an important asset for the development of cultural tourism that can be offered to tourists	1. In terms of construction, many of the buildings are no longer intact, such as statues and reliefs that are no longer suitable because some are missing so they cannot describe the history of Sukuh Temple. 2. The lack of tourist attractions at Sukuh Temple is a theme that is not strong enough for the development of other heritage tourist attractions in the Karanganyar area 3. It is rare to find tourist service packages, especially for historical tourism, throughout the country Karanganyar region

Table 2. Eksternal factors

Opportunites	**S-O Strategy** support aggressive growth policies	**O-W Strategy** Minimize internal problems
1. Easy accessibility, close to the Solo-Tawangmangu transportation route, is an opportunity to connect Greater Solo tourism 2. Various tourist objects and attractions in Karanganyar can be developed together and can also be distributed in tourism activities to objects that have not yet been more development	1. Develop a synergy of natural tourism objects and cultural tourism throughout the Karanganyar area 2. Developing the Sukuh Temple tourist attraction as part of the tourism package in the Karanganyar area 3. Creating interesting events around the Sukuh Temple object 4. Improving human resources, especially providing professional guidesprovide direction strong enough for the brand historical theme become a characteristic of Sukuh Temple object	1. Develop cross-regional cooperation in Central Java in the form of creating tour packages to encourage the development of the Sukuh Temple object, especially in the Karanganyar area in general Formulate new concepts and themes through local tourism packages, for example by developing creative industries in the villages of Ngargoyoso and Matesih

Threath	**Strategi S-T** (Product diversification strategy by paying attention to sustainable and environmentally sound development)	**Strategi W-T** (strategi defensif)
1. The widespread theft of ancient objects must be handled as early as possible. 2. Seeing the weakness of overlapping management between the government and the private sector, there is no coordination. 3. Negative impacts, namely the emergence of foreign cultural influences that are not in accordance with local culture and threats to natural and environmental sustainability.	1. Integrated development of the Sukuh Temple tourist attraction by paying attention to aspects of environmental sustainability and sustainability as well as preservation of local culture 2. Formulate tour packages involving the Sukuh Temple tourist attraction through regional tourism cooperation	1. Formulate concepts and directions for comprehensive tourism development that pay attention to environmental, cultural and sustainable development. 2. Create a development strategy that is able to minimize existing weaknesses and optimize existing strengths to overcome sharp competition between regions in attracting tourist visits.

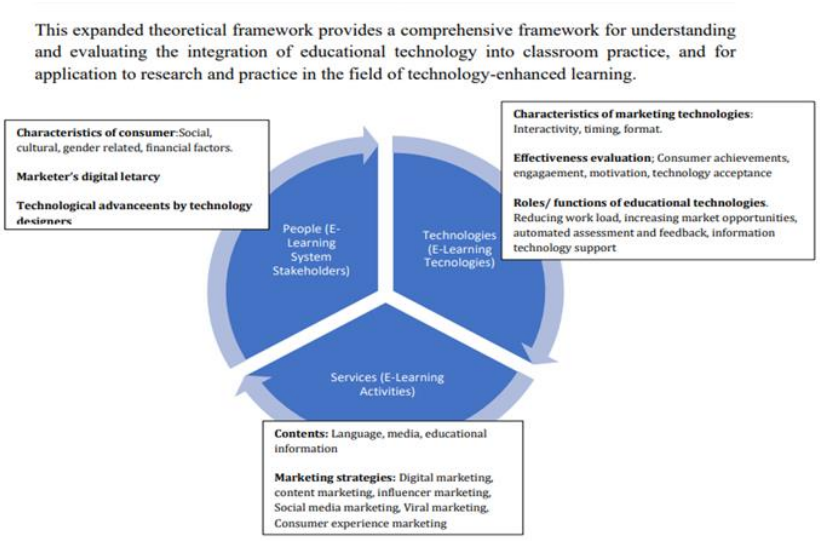


Figure 2. A proposed theoretical framework of aı in marketing

The use of AI in marketing through the TAM theory approach involves several elements. Figure 2 proposes a theoretical framework for building relationships between people, technology, and services. These three components are like a triple helix. The synergy concept

of trilateral cooperation. The concept aims to promote innovation and development and strengthen the relationship between the three organizations. This concept has been applied in various fields, including the development of AI in marketing, particularly in the beauty industry. The use of AI in technology-based marketing differs from the theoretical framework of Aparicio et al. (2016). This framework consists of several components related to technology-based learning and educational technology. These components include: 1. Characteristics of Marketing Technology: Here are aspects such as interactivity, timing, format, and other technical features that affect the marketing process. 2. Effectiveness Evaluation:This component focuses on evaluating the impact of marketing technology on marketing performance, including: Customer loyalty, customer complaint rate, and technology adoption. 3. Role/Function of Marketing Technology: This component examines the various roles and functions of marketing technology. Such as reducing workload, increasing innovation opportunities, providing automated assessment and feedback, and providing information technology support. 4. Customer characteristics: This includes consideration of social, cultural, gender and financial factors that may influence interactions with technology and marketing processes. 5. Marketing Digital Literacy: This component emphasizes the importance of marketing digital competencies to use technology effectively. 6. Technology Advancement by Technology Designers: This component focuses on the role of technological advancements and designer innovation in shaping marketing technology. The framework also includes specific content and strategies related to the three main elements of a technology-based marketing system: stakeholders, technology, services, and technologybased marketin

Figure 3. Geogologi karang anyar dan 4.2 district tourism karanganyar (https://www.google.com/search?q=promosi+candi+sukuh&safe=strict&sxsrf=ALeKk00aPYm9F0HDaUrEWk63Cxpu0IG1Q:1586478930024&source=lnms&tbm=isch&sa=X&ved=2ahUKE-wiz)

Techniques in supporting interviews to analyze and the percentage of adult, female and male domestic tourists as well as young people can be seen from their interest in Sukuh Temple by using social media to make links/websites easier to fill out questionnaires.

https://forms.gle/iqEVAcVF5zjYoAVN7

Figure 4. Sukuh temple and turtle statue
(Menul T.R dan Young Sandra, 2020

Tourism Development Approach

In determining the direction of tourism development, there are several tourism destination development models as proposed by Davidson and Mitland (in Buhalis, 2000). The description put forward by Davidson is seen as a place that offers a portfolio of tourism products that must always be updated in line with changes in market demand (tourist demand). Tourist destinations are interactions between various elements. There are components that must be managed well by a tourist destination, namely tourists, the region and information about the region.

Attractions are also a vital component that can attract tourist interest as well as supporting facilities. These tourist attractions must have unique qualities that can attract tourists.

Cultural Heritage Tourism Management. In explaining this approach, one of the most important aspects is conservation management, where preservation contains important values such as science, important historical values and also important cultural values (Widiyanto, 1994). Promotion is any marketing effort whose function is to provide information or convince potential consumers regarding the usefulness of a product or service with the aim of encouraging consumers to either continue or start purchasing at a certain price.

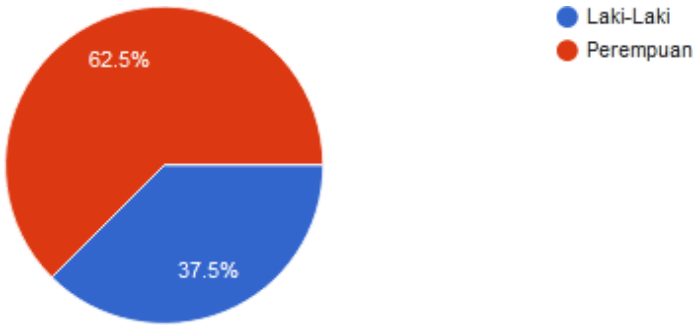
The steps for developing effective promotions as proposed by Kotler (1995) are:

1. Identify the target market
2. Determine the purpose of communication
3. Design the message
4. Finalize communication channels.
5. Determine the amount of the promotional budget
6. Determine Promotional Tools.
7. Measuring Promotion Results
8. Manage and Coordinate the Communication Process

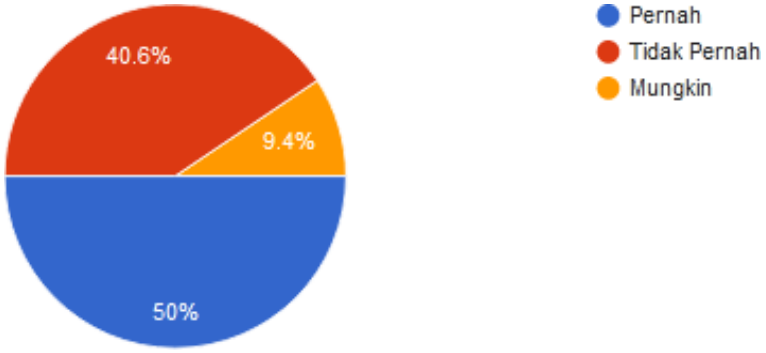
The results of the questionnaire can be seen on the next page with social media making it easier to get the opinions of tourists, plus researchers and informants who visited the Sukuh Temple location in Karang Anyar, Central Java, saw firsthand what the condition of the environment was, and the researchers were from Solo so it was easier to get access to the temple.

Respondent Identity

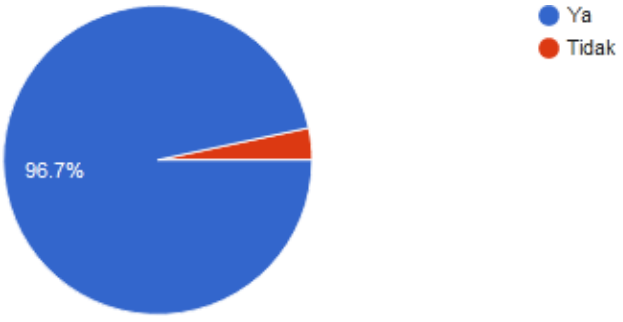
Gender



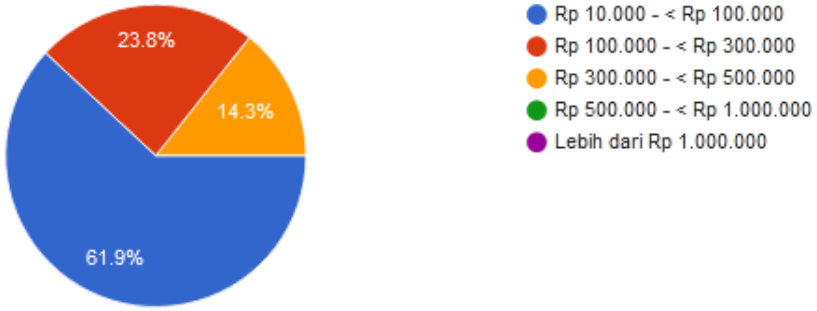
Visitor Characteristics



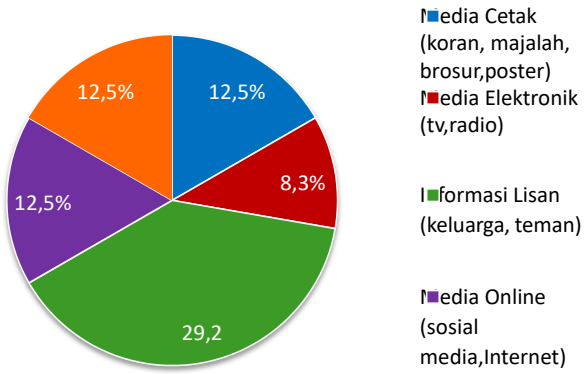
If you haven't, are you interested in finding out more about Sukuh Temple? (30 responses



How much will it cost you to visit the Sukuh Temple tourist attraction? (21 responses)



If so, how did you learn about the Sukuh Temple tourist attraction in Karang Anyar, Central Java? (24 responses)



Design Plan

The logogram with a gestalt consisting of an S shape and a sukuh temple icon is intended to be easily attached visually by visitors and tourists

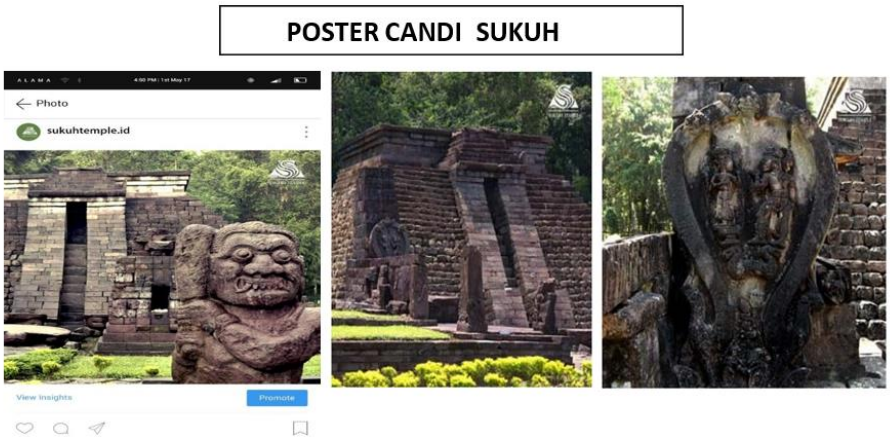


Figure 5. Instagram
(Adinda Geraldine & Menul Teguh Riyanti)

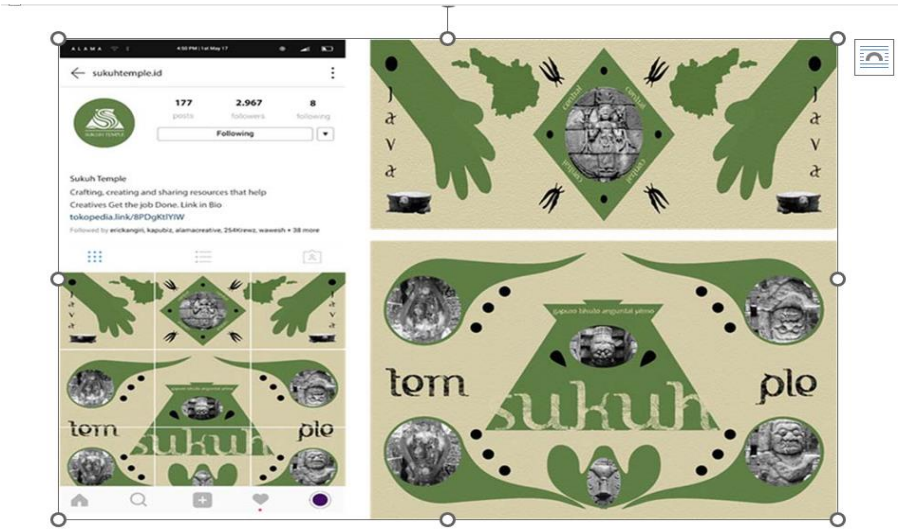


Figure 6. Instagram
(Adinda Geraldine & Menul Teguh Riyanti)

Figure 7. Web design
(Adinda Geraldine & Menul Teguh Riyanti)

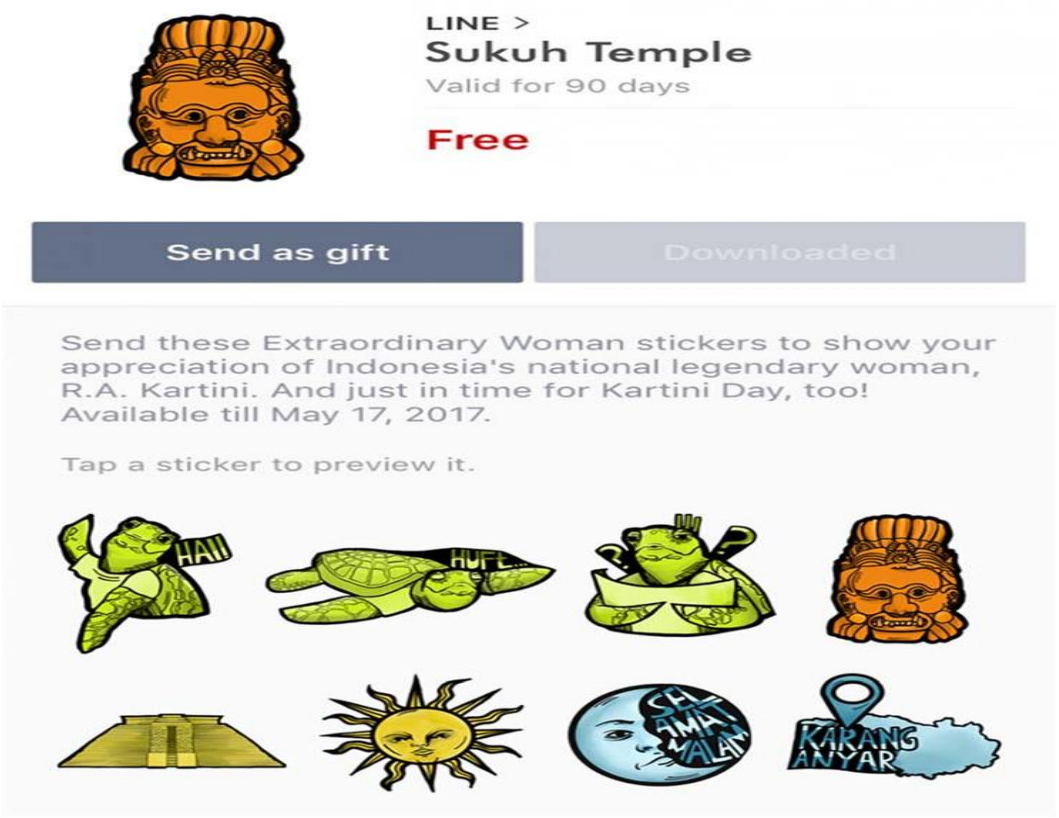


Figure 8. Line sukuh temple
(Adinda Geraldine & Menul Teguh Riyanti)

5. CONCLUSION

Analysis of internal and external factors in the Sukuh temple area. Internal and external factors at Sukuh Temple are seen from weaknesses, strengths, opportunities and threats. Through the results of the existing analysis, these two heritages can be explained from the analysis of tourism products, marketing and institutional development through SWOT analysis.

The concept of developing cultural tourism at Sukuh Temple in the regional tourism synergy of Karanganyar district. You can see several results from the SWOT analysis, so through this a basic conception (principle) of preserving the Sukuh Temple site will be produced, development through macro development analysis in collaboration with private agencies, massive promotion with social media and souvenirs so that tourists get memories. once visited the Sukuh temple tourist attraction in Central Java, Indonesia.

REFERENCE

Ariani. 2017. "Potensi Padung-Padung sebagai Alternatif Elemen Estetik pada Pengembangan Desain Produk Kontemporer". Penelitian Program Studi Desain Produk Fakultas Seni Rupa dan Desain Universitas Trisakti

Akhadiah, Sabarti dan Winda Dewi Lestari. 2011. *Filsafat Ilmu Lanjutan*. Jakarta: Predana Media Group.

Arikunto, Suharsini. 1989. *Prosedur Penelitian Suatu Pendekatan Praktek.* Jakarta: Rineka Cipta.

Arifin, M. 1985. *Menguak Misteri Ajaran Agama-Agama Besar*. Jakarta: PT. Golden Terayon press.

Asmadi, Suwarno dan Soemadi Haryono. 2004. *Candi Sukuh: Antara Situs Pemujaan dan Pendidikan Seks.* Surakarta: CV Masa Baru.

Berkson, William and John Wettesten. 2003. *Psikologi Belajar dan Filsafat Ilmu*.
Yogyakarta: Qalam.

Bobin, AB dan Husna. 1998. *Candi Sukuh dan Kidung Sudamala.* Jakarta: Proyek Pengembangan Media Kebudayaan, Ditjen Kebudayaan Departemen Pendidikan dan Kebudayaan RI.

Eco Umberto. 2009. *Teori Semiotika.* Yogyakarta: Kreasi Wacana.

Furuta. 1998. *Komunikasi Antar Budaya, Sebuah Perbandingan antara Jepang- Amerika*. Jakarta; Cv. Antara.

Yolanda Masnita, Aura Auliya Ramadina, *Mastering The World Of Artificial Intelligence: Strategies In The Beauty Industry,* Social Green Behaviour, Artificial Intelligence and Business Strategies & Perspectives in Global Digital Society, NCM Publishing House 2024

L. Tubs, Sylvia. 2001. *Prinsip-prinsip Dasar Human Communication*, Bandung: PT Remaja Rosdakarya.

Menul Teguh Riyanti. (2018). "*SUKUH TEMPLE IN KARANG ANYAR CENTRAL JAVA*." International Journal of Engineering Technologies and Management Research, 5(10), 75-93. DOI: 10.5281/zenodo.1491888.

Nasrullah, Rulli. 2012. *Komunikasi Antarbudaya*, *di Era Budaya Siber*, Jakarta: Kencana Prenada Media Group.

Rakhmat, Jalaludin. 2004. *Psikologi Komunikasi*, Edisi Revisi. Bandung: PT Remaja Rosdakarya.

Sugiharto, Bambang. 2015. *Untuk Apa Seni*. Seri Buku Humaniora UNPAR. Bandung: Matahari, cetakan ke III.

Sumartono. 2017. *Metodologi Peneliti Kualitatif Seni Rupa dan Desain*. Jakarta: Pusat Studi Reka rancang Ruang Universitas Trisakti.

Murwonugroho, W (2019). Mediating role of social media in the memorability of street sculpture art: Jogja Street sculpture Project 2017 as case study. Wacana Seni Journal of Arts Discourse

CHAPTER 18

Effect of Temperature on Palm Oil Mes Surfactant on Oil Recovery Improvement

Nuraini
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
aini09593@gmail.com
Orcid: 0009-0003-0122-9843

Aqlyna Fattahanisa
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
aqlina@trisakti.ac.id
Orcid: 0000-0002-8063-3179

Muhammad Taufq Fathaddin
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
muh.taufiq@trisakti.ac.id
Orcid : 0000-0003-2351-0292

Rini Setiati
Department of Petroleum Engineering, Faculty of Earth and Energy Technology,
Universitas Trisakti, Jakarta, Indonesia
rinisetiati@trisakti.ac.id
Orcid: 0000-0001-9243-062X

Dina Asmaul Chusniyah
Geodynamics,Institute of Geology and Geophysics,Chinese Academy of Science
Orcid: 0000-0002-1024-029X

ABSTRACT

Surfactant-based chemical injection is one of the EOR techniques used. Anionic surfactants such as methyl ester sulfonate (MES) are made from palm oil. Surfactants serve to lower interfacial tension. Sweeping of oil from the pores of the reservoir rock becomes possible when the interfacial tension drops. To maximize the efficiency of oil dewatering, it is recommended to use surfactants that are compatible with reservoir conditions and formation water. The use of this surfactant has several disadvantages, including poor resistance to hard conditions and its detergency decreases very sharply at high salinity levels, high cost and still has to be imported. The disadvantages of petroleum sulfonate surfactants have triggered the search for alternative surfactant substitutes. One of the alternative surfactants is MES (methyl ester sulfonate) surfactant. The last test conducted to determine how much oil is obtained when injected on a laboratory scale is the coreflooding test. To produce a formula in accordance with the characteristics required by the petroleum industry, the formulation of surfactants was carried out.
Keywords: Chemical injection, Surfactant, Interfacial tension, Salinity, Mes.

1. INTRODUCTION

In the production process with natural driving force (primary recovery) and secondary recovery, the remaining petroleum in the reservoir ranges from 60 to 70 percent of the initial oil volume. Once the reservoir can no longer push oil to the surface, an advanced oil recovery method known as Enhanced Oil Recovery is used to produce the remaining oil. One method to reduce residual oil in the reservoir is to inject surface active substances into the reservoir (Sheng, 2015). To meet Indonesia's oil and gas energy needs, one of the Enhanced Oil Recovery (EOR) methods is surfactant injection. Lowering the oil-water interfacial tension indicates the performance of the surfactant as an injection fluid. The suitability of the surfactant to the type of crude oil being injected determines its performance as an injection fluid (Wicaksono et al., 2015). Therefore, surfactant screening must be carried out when it is used as an injection fluid in the EOR process (Eni et al., 2017)

2. MATERIAL AND METHOD

2.1. Enhanced Oil Recovery and Chemical Injection

Enhanced oil recovery (EOR) is a method to increase oil production by injecting energy sources and external materials to obtain oil that cannot be recovered economically using primary recovery and secondary recovery (SKK Migas, 2015). EOR can be carried out via the chemical injection method by adding chemicals to the injection water to increase oil recovery, increase sweeping efficiency, and/or reduce residual oil saturation remaining in the reservoir. This chemical injection method has the potential to be successful if applied to reservoirs where water injection has been carried out, but there is still a lot of oil that cannot be extracted (Ansyori, 2018).

Chemical injection is an EOR method that has been used for a long time, especially in China, this method has not been widely used in Indonesian oil fields due to high costs and lack of technology. Along with increasing surfactant research in Indonesia, this chemical injection is starting to be considered as a suitable method for industry in Indonesia. One promising option for EOR is chemical injection, which is supported by research into the synthesis of surfactants from various material sources and methods. This is based on the fact that chemical injection is not limited by reservoir pressure to react the oil with an EOR agent as is the case with gas injection (Widyaningsih, 2017)

2.2. Surfaktan Metil Ester Sulfonat (MES)

Currently, palm oil methyl ester (CPO) and palm kernel oil (PKO) are the raw materials most widely developed in Indonesia for making MES surfactants. This is because CPO and PKO are easy to obtain, cheap and environmentally friendly (Hidayati, 2009)

Surfactant performance is able to reduce interfacial tension (IFT). With a low IFT value, the capillary number will increase, thereby increasing oil recovery. Before a surfactant is deemed suitable for injection in an oil field, a number of screening tests need to be carried out in addition to IFT (Eni et al., 2010) Compatibility and phase behavior tests are included in checking the suitability of surfactants for use in EOR. Compatibility tests are carried out to determine the level of compatibility between surfactants and formation water in a reservoir. The core flooding test is the final test carried out to find out how much oil is recovered when injected on a laboratory scale. Formulation of surfactants is carried out to produce formulas that meet the characteristics required by the petroleum industry (Tobing, 2016)

3. RESEARCH METODOLOGY

This research is experimental and analytical, and involves calculations after experimental data and measurements in the laboratory have been collected. Primary data collected directly from research subjects is the main source of information. The research method used was

experimental, where data was obtained from surfactant pre-screening, namely compatibility testing, phase behavior testing and coreflooding testing.

Surfactant compatibility with the appropriate formation water in a particular reservoir is an important factor when selecting a surfactant for an EOR application. Meanwhile, the appropriate surfactant is then subjected to phase behavior testing which aims to determine the solubility of the surfactant in the oil sample. The phase behavior test can be used to determine whether an emulsion forms between the surfactant solution and the oil (Setiati et al., 2018). Next, the coreflooding test is to determine the effectiveness of the surfactant solution injected into the reservoir rock in increasing oil depletion.

3.1. Test Aqueos Stability

Compatibility test, the surfactant solution was dissolved in formation water for 168 hours of observation in an oven at 60 °C. If the solution remains clear, the surfactant is compatible with the formation water; if conditions change to suspension or colloid, the surfactant is incompatible with the reservoir, and subsequent testing is not necessary. To carry out the test, the mixture of the surfactant solution in the formation water is adjusted and then heated for a certain time at the reservoir temperature. If the surfactant solution tested is more compatible, the surfactant will be more effective in reducing interfacial tension. The absence of precipitate formation in the surfactant solution indicates the suitability of this surfactant. The purpose of this compatibility test is to determine how soluble the surfactant is in the formation water. Solutions that meet the compatibility test must be completely soluble, clear (clear solution), or not cloudy (non-turbid solution) (Cheng et al., 2018)

3.2. Test Phase Behaviour

The Phase Behavior test is then carried out on the appropriate surfactant. This Phase Behavior test determines whether an emulsion is formed between the surfactant solution and the oil. Emulsions can form as lower phase emulsions, middle phase emulsions, or upper phase emulsions. The formation of an intermediate emulsion, also known as a microemulsion, indicates that the interfacial tension between the solution and the oil has decreased (Setiati et al., 2018).

3.3. Test Uji Coreflooding

To calculate the recovery factor (RF), coreflooding experiments were carried out. The brine solution is added to the rock core sample to ensure the brine fluid is contained within it. Before core saturation can be performed, the weight and volume of the sample are measured. Then, after the brine saturation process is complete, the rock sample must be soaked in a 5,000 ppm brine solution for at least 24 hours until there are no more air bubbles coming out of the sample core. Once this process is complete, the dry weight of the sample is measured and calculated to determine the amount of brine that entered the rock sample (Jihan et al., 2020)

Once brine saturation and calculations are complete, oil saturation of the core sample is a process intended to fill the core with liquid oil. At this point, the amount of brine released can be used to calculate the initial OOIP (Original Oil in Place). After saturation is complete, the test will proceed to the coreflooding stage using the slug method using a volume of 2 PV (Pore Volume). After the airflooding stage is complete, the test will proceed to the surfactant injection process.

4. RESULT AND DISCUSSION

4. 1. Test Compatibility

The compatibility test is a preliminary test before other tests are carried out to find out how compatible the surfactant is with the reservoir formation water. If the surfactant in this test does not pass or is not compatible, the surfactant is considered unsuitable for the reservoir in question. Compatibility tests expect a perfect mixture or colloid to form (Fattahanisa et al., 2018). On the other hand, suspension is not desirable due to concerns that blockages will occur when the surfactant solution is introduced into the rock. The compatibility test involves dissolving the MES surfactant with formation water at a salinity of 5,000 ppm. The surfactant was tested at a concentration of 0.5% at 60 °C and 1.75% at 90 °C. The table below shows the results of the MES surfactant compatibility test.

Table 1. MES surfactant compatibility test results

No.	MES Surfactant Concentration (%wt)	Tempeature °C	Observation result
1	0,5	60	Clear
2	1,75	90	Clear

Compatibility results for concentrations of 0.5% and 1.75% did not occur in precipitation or phase separation. So this concentration can be continued to the next experimental stage. The aim of the compatibility test is to evaluate the suitability of the surfactant to the tested formation water conducting a study of surfactant compatibility with controlled interfacial tension for Enhanced Oil Recovery (EOR) procedures) (Kesuma and Kasmungin et al., 2015). One measure of the performance of a surfactant is its ability to reduce the interfacial tension between oil and water in the reservoir system. The preferred interfacial tension is the lower interfacial tension.

4.2. Uji Phase Behaviour dan Uji Coreflooding

Phase behavior testing is to measure optimal salinity values and surfactant solubility in oil samples. Some people say that this behavioral test is a faster and easier test stage to measure the IFT value and effectiveness of the performance of the surfactant solution being tested (Suparwoto et al., 2024). When the surfactant forms a microemulsion, this behavioral test collects optimal salinity data. The IFT value produced by this microemulsion will be greater than the IFT value. However, lower phase emulsions (soluble in water), middle phase emulsions (soluble in oil and water phases), and upper phase emulsions (soluble in oil) can be made from a mixture of surfactants, water, and oil (Widyaningsih, 2017).

The phase behavior test is used to select the chemicals needed to produce a microemulsion between the oil and chemical phases. These laboratory test results show how much oil can be extracted from the core with the selected chemical. In order for the oil phase in the reservoir to flow easily, the chemical chosen to wet the reservoir must have the ability to reduce the wettability of the oil (Rachman et al., 2020).

To calculate the recovery factor (RF), coreflooding experiments were carried out. The brine solution is added to the rock core sample to ensure the brine fluid is contained within it. Before core saturation can be performed, the weight and volume of the sample are measured (Kumar et al., 2019). Once brine saturation is complete, the rock sample should be soaked in a 5,000 ppm brine solution for a minimum of 24 hours to ensure that no air bubbles escape from the sample core.

Table.2 Surfactant injection test results (core flood)

No.	Temperature (°C)	MES Surfactant Concentration (%wt)	Middle Phase Emulsion (stable) (%)	RF WF (%)	RF SF (%)	RF Total (%)
1	60	0,5	7,50	60,00	32,50	92,50
2	90	1,75	6,25	60,00	32,50	92,50

The purpose of the phase behavior test is to measure changes in the type and volume of the emulsion phase over time over a certain period of time. This test was carried out for 504 hours, or three weeks. The result is expected to be a stable emulsion phase with a fairly large and stable volume.

At a temperature of 60 °C using a surfactant concentration of 0.5%, the middle phase emulsion yield was 7.50%. After that, a core flooding test was carried out where the results obtained for water flooding were 60% surfactant flooding of 32.50%. Total RF of 92.50%.

At a temperature of 90 °C using a surfactant concentration of 0.5%, the middle phase emulsion yield was 6.25%. After that, a core flooding test was carried out where the results obtained for water flooding were 60% surfactant flooding of 32.50%. Total RF of 92.50%.

The core flooding method was used to simulate the chemical transfer of oil in an oil reservoir. The slug method used was where the injected volume was determined at the beginning of the research. The volume of water flooding injected is three PV and the volume of surfactant flooding injected is four PV, so the total injection using the core flooding method is seven PV.

5. CONCLUSION

From this research, it is based on a compatibility test with a concentration of 0.5% at a temperature of 60 °C and a concentration of 1.75% at a temperature of 90 °C, which is compatible, which can proceed to phase behavior testing. In the phase behavior test, the two concentrations formed a middle phase with a different total emulsion volume, where the 0.5% concentration was 1.25% greater than the 1.75% concentration. In the oil palm MES surfactant core flooding test with 2 different temperatures, it was found that the temperature had no effect on oil recovery because the total Recovery Factor value at both temperatures was 92.50%.

6. ACKNOWLEDGEMENTS

The authors would like to express the highest gratitude towards Petroleum Engineering Department, Universitas Trisakti Jakarta, Indonesia for the valuable assistance, support, and facilities and funding of the research. The authors would also thank tp 9th International CEO Communication,Economic,Organization & Social Sciences Congress for the opportunity to publish this article.

REFERENCES

A. Fattahanisa, R. Setiati, and S. Kasmungin, "The Effect of Interfacial Tension and Thermal Stability on Surfactant Injection," *Journal of Earth Energy Science, Engineering, and Technology*, vol. 1, no. 2, Aug. 2018, doi: 10.25105/jeeset.v1i2.3944.

A. Rachman, R. Setiati, and K. F. Hartono, "Laboratory Studies to Increase Oil Production Using Methyl Ester Sulfonate Injection on X Field," *Journal of Earth Energy Science, Engineering, and Technology*, vol. 2, no. 3, Feb. 2020, doi: 10.25105/jeeset.v2i3.6385.

E. M. Tobing Pusat Penelitian dan Pengembangan Teknologi Minyak dan Gas Bumi, J. Ciledug Raya Kav, K. Lama, and J. Selatan, "SIMULASI PERCOBAAN COREFLOODING INJEKSI SURFAKTAN POLIMER PADA BATUAN RESERVOIR (Surfaktan-Polymer Core Flooding Experiments Simulation in Reservoar)," 2016. [Online]. Available: http://www.journal.lemigas.esdm.go.id

H. Eni *et al.*, "SURFAKTAN BERBASIS MINYAK SAWIT UNTUK APLIKASI EOR PADA LAPANGAN MINYAK INTERMEDIET (Surfactant based on Palm Oil for EOR Application at Intermediate Oil Field)," *Journal Lemigas*, vol. 51, pp. 2–7, 2017, [Online]. Available: http://www.journal.lemigas.esdm.go.id

H. Eni, E. Syahrial, P. Pertama, P. Teknologi, P. Madya, and pada Pusat Penelitian dan Pengembangan Teknologi Minyak dan Gas Bumi, "Screening Test dan Karakterisasi Surfaktan yang Efektif untuk Injeksi Kimia," 2010.

H. Wicaksono, Sutijan, and T. A. Yuliansyah, "Karakterisasi Larutan Polimer KYPAM HPAM untuk Bahan Injeksi dalam Enhanced Oil Recovery (EOR)," *JURNAL REKAYASA PROSES*, vol. 9, pp. 9–15, 2015.

J. J. Sheng, "Status of surfactant EOR technology," *Petroleum*, vol. 1, no. 2, pp. 97–105, Jun. 2015, doi: 10.1016/j.petlm.2015.07.003.

M. R. Ansyori, "Mengenal Enhanced Oil Recovery (EOR) Sebagai Solusi Meningkatkan Produksi Minyak," *Swara Patra : Majalah Ilmiah PPSDM Migas*, pp. 16–22, 2018.

N. H. Jihan *et al.*, "JURNAL REVIEW: TRANS-SULFONASI BERGANDA UNTUK PRODUKSI PALM ESTER SULFONAT (PES) BAGI PENGEMBANGAN TEKNOLOGI ENHANCED OIL RECOVERY (EOR) REVIEW JOURNAL: MULTIPLE TRANS-SULFONATIONS FOR PALM ESTER SULFONATE (PES) PRODUCTION FOR ENHANCED OIL RECOVERY (EOR) TECHNOLOGY DEVELOPMENT," 2020.

N. Pal, S. Kumar, A. Bera, and A. Mandal, "Phase behaviour and characterization of microemulsion stabilized by a novel synthesized surfactant: Implications for enhanced oil recovery," *Fuel*, vol. 235, pp. 995–1009, Jan. 2019, doi: 10.1016/j.fuel.2018.08.100.

P. W. Kesuma and S. Kasmungin, "STUDI LABORATORIUM PENGARUH KONSENTRASI SURFAKTAN TERHADAP PENINGKATAN PEROLEHAN MINYAK," *Seminar Nasional Cendekiawan* , pp. 569–575, 2015.

R. Setiati, S. Siregar, T. Marhaendrajana, and D. Wahyuningrum, "Influence of middle phase emulsion and surfactant concentration to oil recovery using SLS surfactant synthesized from bagasse," *IOP Conf Ser Earth Environ Sci*, vol. 212, p. 012076, Dec. 2018, doi: 10.1088/1755-1315/212/1/012076.

R. Widyaningsih, "Pengaruh Konsentrasi Surfaktan Anionik Terhadap Salinitas Optimum dalam Mikroemulsi Spontan dengan Sample Minyak Lapangan M," 2017.

S. Hidayati *et al.*, "Optimasi MES dari Minyak Jarak Pagar Sri Hidayati et al OPTIMASI PROSES PEMBUATAN METIL ESTER SULFONAT (MES) DARI MINYAK JARAK PAGAR (Jatropha Curcas L.) DAN PENGARUHNYA TERHADAP NILAI TEGANGAN ANTARMUKA MENGGUNAKAN METODE PERMUKAAN RESPON (Optimation Condition for Methylester Sulphonate (MES) Processing from Jatropha Oil (Jatropha Curcas L.) and its Effect on the Interfacial Tension by Using Response Surface Methodology)," 2009.

S. Migas, "SKK Migas. 2015. Pedoman Tata Kerja Tentang Peningkatan Recovery Factor Melalui Kegiatan Pilot Tertiary Recover.," 2015.

S. Suparwoto, R. Setiati, P. A. Rahkmanto, Muh. T. Fathaddin, S. Prakoso, and D. A. Mardiana, "UJI KESTABILAN LARUTAN DAN PERUBAHAN FASA SEBAGAI KARAKTERISTIK DARI SCREENING SURFAKTAN METIL ESTER SULFONATE KELAPA SAWIT TERHADAP MINYAK RINGAN LAPANGAN "X"," *JURNAL PENELITIAN DAN KARYA ILMIAH LEMBAGA PENELITIAN UNIVERSITAS TRISAKTI*, pp. 268–275, Jan. 2024, doi: 10.25105/pdk.v9i1.18790.

Y. Chen, Q. Xie, A. Sari, P. V. Brady, and A. Saeedi, "Oil/water/rock wettability: Influencing factors and implications for low salinity water flooding in carbonate reservoirs," *Fuel*, vol. 215, pp. 171–177, Mar. 2018, doi: 10.1016/j.fuel.2017.10.031

EDITORS' BIOGRAPHIES

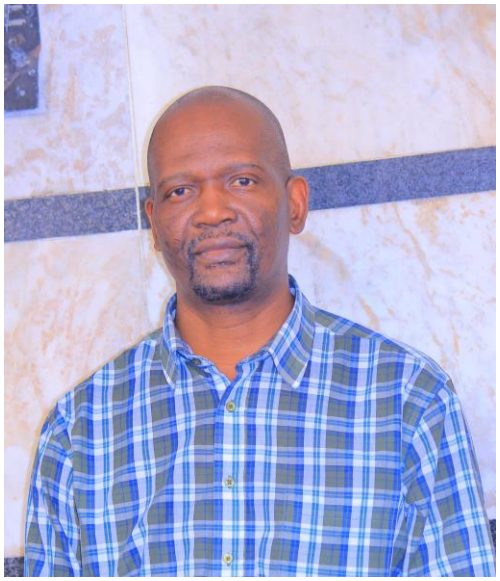
Dr. MUHAMMAD ALI TARAR (Ph. D Rural Sociology)

Dr. Muhammad Ali Tarar joined University of Agriculture, Faisalabad- Pakistan as Teaching Assistant in 2005, later as, Lecturer Rural Sociology in November 2007 and presently serving the Department of Sociology, Ghazi University, Dera Ghazi Khan-Pakistan as Associate Professor / Chairman Sociology along with serving as Director Purchase & Store at GU. Additionally, he has also served as Director Financial Assistance & Development (FAD) w.e.f 05-07-2023 to 31-12-2023 as well as Director office of Research, Innovation & Commercialization (ORIC) from 18-11-2015 to 24-10-2022 and awarded a "Certificate of Appreciation" from Vice Chancellor, Ghazi University, Dera Ghazi Khan for excellent services (15-09-2022). As Chief Editor, Kisht-e-Nau (student Magazine, University of Agriculture, Faisalabad) published Centennial Number in 2006 and was awarded UNIVERSITY GOLD MEDAL from Chancellor of University/ Governor of Punjab-Pakistan as-well-as UNIVERSITY ROLE OF HONOR, UNIVERSITY COLOUR & UNIVERSITY CERTIFICATE OF EXCELLENCE was awarded from Worthy Vice Chancellor for publishing the Centennial Number of " Kisht-e-Nau " as Chief Editor on the eve of centenary celebrations of University of Agriculture, Faisalabad (14th to 16th March 2006). He has vast experience in teaching & research. Being Researcher published more than 45 research articles on different social & behavioral issues in National & International high-quality indexes/ impact factor journals that are recognized by Higher Education of Pakistan and at postgraduate level supervised more than one hundred research students and completed their Research Thesis/ Projects. He is also coauthor/ Editor of books (i)"Introduction to Sociology; (ii) "Accounting Inquiries with New Approaches in the Post-Pandemic Era Volume I"; (iii) "Accounting Inquiries with New Approaches in the Post-Pandemic Era Volume II"; (iv) "Abstract E-Book" 5th International CEO Social Sciences Congress (CEOSSC 2022)"; (v) 5th CEO Proceedings Book. 5th International CEO Social Sciences Congress E-Proceeding Book 9-11-December CEOSSC 2022); (vi) CEO Abstract E-Book. 8th International CEO Social Sciences Congress Abstract E-Book 16-17 December, 2023- Portugal; (vii) CEO Proceedings E-Book. 8th International CEO Social Sciences Congress E-Proceeding Book 16-17 December, 2023-Portugal; (viii) Contemporary Exploration of Social Sciences in the Post Pandemic Era-1; (ix) Contemporary Exploration of Social Sciences in the Post Pandemic Era-2; (x) Global Digital Era, Social, Peace & Business Perspectives in Society; (xi) Social Behaviour, Leadership, Sales, Communication, Organization, Branding, Feasibility Analysis for Business Management Inquiries with New Approaches in the Post-Pandemic Era-1; (xii) Social Behaviour, Leadership, Sales, Communication, Organization, Branding, Feasibility Analysis for Business Management Inquiries with New Approaches in the Post-Pandemic Era; (xiii) Social Behaviour, Leadership, Sales, Communication, Organization, Branding, Feasibility Analysis for Business Management Inquiries with New Approaches in the Post-Pandemic Era; and (xiv) Social Green Behaviour, Artificial Intelligence and Business Strategies & Perspectives in Global Digital Society. He is also external examiner of research / paper setter of many universities for postgraduate level as well as examination supervisor of Punjab Public Service Commission, Pakistan. Being Director ORIC made collaboration with sister universities and industries to develop academia to academia

& Academia-Industry linkages for better knowledge and research sharing and signed more than 20 MOUs and strengthen the external linkages, developed a Business Incubation Center (Regional Plan9) & Women Development Center at Ghazi University with collaboration of Govt. of Punjab, Pakistan. He is Member selection/ recommendation Committee of Ghazi University to recommend BS-1 to BS-16 candidates to the Vice Chancellor for Approval of Appointment, Terms, and conditions of Services); Member Board of Faculty for a period of three years for faculty of Arts; Member Consultative Committee; Member Convocation Organizing Committee for 1st & 2nd Convocation of the Ghazi University; Convener University Disciplinary Committee ; Convener University Disciplinary Advisory Committee; Member Compliance Implementation Plan Committee (CIPC) to prepare Compliance Implementation Plan (CIP) in coordination with respective offices; Nominated as Focal Person to collaborate with QEC regarding IPE Review visit at Ghazi University; Member Affiliation Committee (to affiliate & Disaffiliate Govt. & Private Educational Institutes / colleges with Ghazi University); Member University Grievance Redress Committee; Member University Monitoring, Evaluation and Learning Committee; Member University Scrutiny Committee for Administration Posts; Member Selection Committee Grade 1-16 Employee; Member Harassment Committee Ghazi University, Member Standing Committee for vetting of non-schedule items with the term of Reference (TORs); Member Surveillance committee of Ghazi University; Member Online Quality Assurance (OQA) Task Force of Ghazi University; Members University General Purchase Committee; Member University Semester Rules Committee; Member Inquire committee about matter/ issue regarding allegations on social & print media against employees, Member University Prospectus Committee to prepare prospectus and Member University Admission Committee year 2019, 2020 & 2021; Focal Person Kamyab Jawan Innovation League; Member Plagiarism Standing Committee (PSC) Ghazi University; Member Self Institutional Performance Evaluation (IPE) Committee and Focal person to conduct quantitative research on Beggary in Punjab with collaboration of Department of Social Welfare, UCDP, D. G. Khan (December 2016 to To-date).

Dr. Muhammad Ali Tarar, Associate Professor/ Chairperson, Department of Sociology, Ghazi University, Dera Ghazi Khan

Mr. Lawrence Walambuka



Lawrence Walambuka holds BA international Relations and BA Honours in International politics and currently doing Masters in international politics at University of South Africa. Lawrence is an award winner, second runner up in the College of humanities for the 11th Annual University of South Africa Student and Innovation Showcasing in November/December 2023. The author is an analytically-minded international relations specialist who has a strong focus on strategic analysis of foreign markets to help realize organizational goals, ability to accurately assess foreign laws, regulations, sociopolitical and socioeconomic factors and their potential impact on organizational goals. Experience in designing public relations strategies in foreign markets for true global involvement. He has a thorough understanding of South Africa's constitution and other statutory instruments. And experienced in lecturing, has Passion for Research, business management, accounting and financial management and worked in diverse sectors including construction, retail, agriculture, government parastatals, workforce solutions and education. Lawrence has been in South African education sector since 2011 as a lecturer and Head of Department of Commerce and academic manager/campus manager since 2020 to date. His focus has been on the meaning, construction and practice of leadership in Higher Education in South Africa. He has been an active practitioner in the Higher Education Sector for over 12 years. He has risen from the ranks of being a Lecturer to that of Senior Lecturer, Head of Commerce Depart and Campus Manager in a multi-campus context of Private College set up. Lawrence has a record of accomplishments in managing complex departments, which include student affairs, academic operations, marketing, finance and health and safety in a large Multi- Campus Private Colleges. During his tenure in higher education, he had a privilege of being exposed to the higher education regulatory environment as a campus manager. A major focus of the Campus Manager during his tenure was on transformation and ensuring improvements in the quality of the student experience in all campuses. In the DHET management of Private colleges, as campus manager: he was responsible for Monitoring Quality Assurance of all examination procedures and implementing DHET, CHE, QCTO and SETA policies.

Doğrulama Kodu : f70b63cb-4c05-4132-bec8-804f1f8a5950

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