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Sustainability of Adoption of New Improved Rice Variety Innovation in West Kalimantan Coastal Areas: Review of Social and Cultural Aspects

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ABSTRACT

As a staple food in Indonesia, rice has significant socio-economic value, especially in regions such as West Kalimantan. However, the variability of rice production poses a challenge to food security and economic stability. This study assesses the sustainability of the adoption of new improved rice varieties (VUBs) in West Kalimantan, focusing on social and cultural aspects using Multi-Aspect Sustainability Analysis (MSA). Focus group discussions and expert interviews were used to identify important factors affecting VUB adoption. The results indicated a sustainable adoption status (54.17%), with potential for improvement (58.33%) in the future. Farmer education emerged as the most sensitive factor, highlighting the need for educational interventions to improve technology access and adoption. In addition, farmers' knowledge of VUB, culture of mutual cooperation, the absence of social conflict, and positive consumer preference for VUB rice are also critical for adoption. Recommendations include targeted educational interventions, improved knowledge dissemination strategies, consideration of the cultural context, conflict management approaches, and market-oriented strategies to sustainably increase VUB adoption. Addressing these factors can contribute to sustainable agriculture and rural development in West Kalimantan and similar contexts, ensuring long-term benefits for farmers and food security.

INTRODUCTION

Rice is the staple food for the people of Indonesia and plays an important role in economic, social, political and security matters. Its existence must be guaranteed in terms of quality and quantity. Roza et al (2023) say rice as identity and social role: According to research, regional specialties play an essential part in Indonesian cultural and social identity. These one-of-a-kind dishes add to the diversity and richness of Indonesian cuisine. The government aspires to make Indonesia the world's food barn by 2045 (Ministry of Agriculture, 2014). The same thing will also happen in West Kalimantan Province. After South Kalimantan, this province is the

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center of rice production on Kalimantan Island. Most of the rice production areas are in coastal areas, which are the main source of rice for other regions (Yustian et al., 2014). Over the past four years, rice production has experienced fluctuations with a downward trend. In 2021, total production decreased to 711,898.01 tons, a decrease of 16.04% compared to the previous year. The average productivity reached 31.9 quintals per hectare, which is lower than the national average productivity of 52.26 quintals per hectare (Badan Pusat Statistik, 2022). In the coastal areas of West Kalimantan, barriers to development include environmental degradation, particularly sodium pollution due to seawater intrusion into agricultural land (Rachman et al., 2018).

Various efforts have been made to increase rice production through cultivation, including introducing various technological innovations that are scientifically proven to increase agricultural yields (Gunawan et al., 2019; Sirajuddin, 2021). An important technological innovation is the use of improved varieties, this technology is considered an economical and effective way to increase production yields (Rizieq et al., 2023). The most dominant factor in increasing productivity is the use of improved varieties, which is also a key element in pest and disease control (Sution & Agus, 2020). The developed variants have tolerance to environmental threats and also display unique special characteristics (Pebriandi et al., 2021). Developing rice varieties aims to create VUB that have characteristics that are suitable for cultivation conditions in a particular region (Aryawati & Sutami, 2021), and to fulfill consumer preferences (Haryati et al., 2020) tested over a long period of time. Integrated Crop Management (ICM) is a crucial approach for farmers aiming to enhance rice production yields at the farm level. One key technology in implementing ICM is the adoption of new improved rice varieties (VUB) (Rizieq et al., 2023). Research has shown that farmers' adoption of improved varieties can have a positive impact on productivity and income levels (Tesfay & Teshale, 2019). These VUBs have been proven effective in increasing rice production and are considered a practical method for farmers to adopt due to their demonstrated impact on yield improvement (Rizieq et al., 2023). Additionally, the adoption of agricultural innovations, like VUBs, is essential for ensuring food security and poverty reduction by increasing farming households' income and reducing staple food prices (Ogundari & Bolarinwa, 2018).

There have been many studies on the adoption of VUB, including: the use of new lowland rice varieties (Gunawan & Haryanto, 2020; Ismilaili et al., 2015; Noviyanti & Sulistyowati, 2020), farmers' perceptions of the adoption of the new improved varietal innovations (Beding, 2015; Fachristal & Sarwendah, 2014), production of new improved varieties(Waluyo et al., 2022), and economic factors that affect the adoption of the new improved

varietal innovations (Issukindarsyah et al., 2022; Setiani & Prasetyo, 2020). Nevertheless, none of the studies review the sustainability of the innovation adoption.

Based on this explanation, the objective of this study is to evaluate the sustainability status and performance index of VUB innovation adoption, as well as the factors that encourage or hinder the adoption of these innovations from a social and cultural perspective. Information on the reasons why farmers do not use VUB in a sustainable manner is essential to identify solutions that can help realize the vision of making coastal areas as rice barns, as expected in regional development.

METHODS

This research was carried out in 2022 in the coastal areas of West Kalimantan. Sambas and Kuburaya districts were chosen as research locations. The determination of the location of this research was based on 1) it is the central area of rice production in West Kalimantan Province; 2) There have been many high-yielding varieties that have been imported and disseminated to farmers over the past 10 years. From each district, 3 (three) sub-districts were selected.

Data collection was carried out in two stages. The first stage was focus group discussions (FGD) that were carried out in those regencies. The FGD was attended by farmers, seed breeders, agricultural extension workers, researchers, and government officials. From the FGDs, the aspects and factors that support the sustainability of the adoption of the VUB innovations were obtained. The second stage was expert interviews. These experts consist of experts in the fields of agriculture, seeding, economics, and agricultural extension. There were 10 experts interviewed to find out their opinions on the factors that support the sustainability of the adoption of the VUB innovations based on each aspect. The results of the FGD conducted in Kubu Raya and Sambas Districts, and referring to several studies with the theme of sustainability as a basis, the factors that support the sustainability of the adoption of VUB innovations in terms of social and cultural aspects are as follows: 1) Farmer Education, 2) Farmer Knowledge of VUB, 3) Culture of mutual cooperation Culture, 4) Social Conflicts, 5) Farmer Perceptions of VUB, 6) VUB Rice Flavor Status Value Ordination.

Multi-aspect Sustainability analysis was used in this study. This analysis is used to find the value of sustainability status and the performance index of adoption of VUB better in the context of condition assessment and description, to determine the strategy that should be carried out in the future. This assessment is also called rapid assessment because it uses an existing database sent through selected experts who meet the specified criteria. The calculation results include social and cultural status value, possible value in the future (future condition), the driving factor in aspects (leverage factor), validation with random

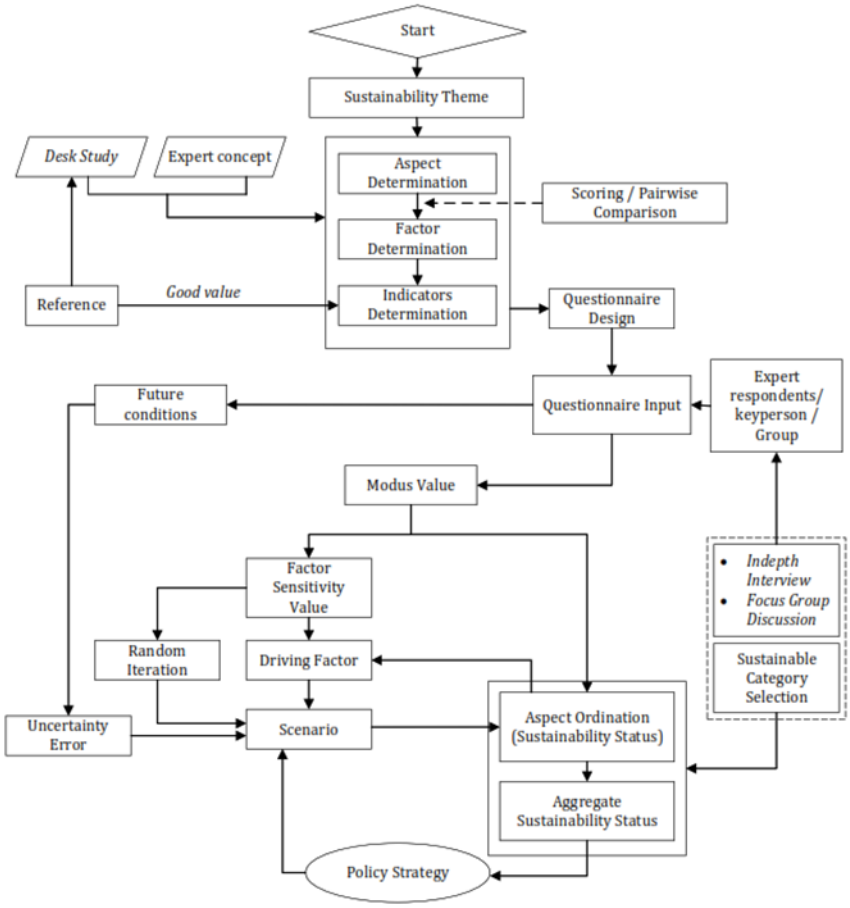

Figure 1. Conceptual framework of the Multiaspect Sustainability Analysis approach
Source: (Firmansyah, 2022)

iteration and policy priority scenarios (Firmansyah, 2022; Kusrini, 2018).

One modeling method that has been developed to evaluate sustainability is a sustainability assessment technique that uses Multi-Aspect Sustainability Analysis (MSA) through Exsimpro software. This software is an evolution of the previous software, RAPFISH (Firmansyah, 2022). The principle applied is a rapid evaluation method, where respondents are not simply a random sample, but key stakeholders or relevant individuals, who can be discussed through in-depth interviews or through observation and focus group discussions (Paulus et al., 2018). Some of the steps in applying the MSA sustainability analysis include an analysis phase that includes assessment of aggregate status values, aspect status values, projections of future conditions, structuring of status values, aspect leverage factors, error uncertainty, validation by random iteration, and identification of policy priority scenarios (Paulus et al., 2023).

In the MSA Sustainability Analysis, scenario selection is based on the identified status values. In addition to the scenario values, leverage factors are also the basis for analyzing the emerging scenarios. If researchers want to conduct a multilevel scenario analysis, such as a moderate scenario, an optimistic scenario, and a progressive scenario, they can specify the number of scenarios and leverage factors to be analyzed. MSA Sustainability Analysis is used to evaluate the sustainability status score, performance index, or performance index of various entities such as activities, sites, activities, institutions, or companies. This is done as part of a self-assessment or to evaluate the existing conditions and picture in order to determine appropriate strategies for the future. These assessments are often referred to as rapid evaluations as they utilize existing databases provided in consultation with experts or respondents selected according to certain criteria. Furthermore, this assessment can be adjusted at any time if new data or conditions arise, without the need to re-analyze with updated formulations or build new models (Paulus et al., 2023). Figure 1 illustrates the conceptual framework for the MSA approach.

The formula (1-3) for calculating the sustainability status value in these aspects is as follows:

$$y = \frac{y_{f_1}+y_{f_2}+y_{f_3}+\cdots+y_{fn}}{f_n} \times 100\% \quad (1)$$

$$y = \frac{\Sigma y_{fn}}{f_n} \times 100\% \quad (2)$$

$$y_{fn} = \frac{Mofn}{Gfn} \quad (3)$$

Where the y is sutainability status value, yf is aspect factor, Mo is modus value on factor, G is the highest score (good) on the factor of the indicator assessment and f is factor value (Firmansyah, 2022).

The formula (4) calculates the values of performance is as follows:

$$Fc = \frac{MoC_1 + MoC_2 + MoC_3 + MoC_4 + \cdots + MoC_n}{n} \times 25$$

Where Mo is modus value, C is future condition value on factor. The values include 0 (strongly decresing), 1 (decresing), 2 (fixed), 3 (increased) and 4 (highly increased). The value of 25 as the standard in multiplied to normalize to a value of 100, because the highest future condition value is 4, so if it equalized with a value of 100, it needs to be multiplied by 25. Tabel 1 shows the sustainability status and performance index (Firmansyah,

Table 1. The value of sustainability status and performance index

Value	Sustainability Status	Performance Index
0 – 25	Unsustainable	Bad Performance
>25 – 50	Low Sustainability	Low Performance
>50 – 75	Sustainable	Good Performance
>75 - 100	Highly Sustainable	Very Good Performance

Source: Firmansyah, 2022

2022). The mapping of conditions based on the status values in the created
ordinance must be seen beforehand in order to enhance the conditions and the selection of policy scenarios after getting the status value. The ordinance lists a number of conditions, including good, priority, important, urgent, terrible, and illogical. An order of importance exists for the distribution or status position based on conditions as shown in the figure below.

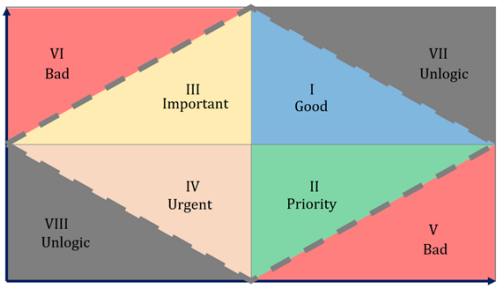

Figure 2. Determination of Conditions Based on Ordination
Source: Firmansyah, (2022)

RESULTS AND DISCUSSION

MSA sustainability analysis of the five aspects of sustainability can identify sensitivity lever variables for ecological aspects, economic aspects, social and cultural aspects, social and cultural aspects, institutional aspects, and technological and infrastructure aspects that affect the sustainability of the adoption of seedling innovations of VUB in West Kalimantan but in this study specifically on social and cultural aspects. The results of MSA analysis on social and cultural aspects are described as follows.

The sustainability index of the adoption of seed innovations of VUB in West Kalimantan in the social and cultural aspects is 54.17% with a sustainable category, where in the future this value can increase significantly because it has a future condition value of 58.33%.

From the results of the social and cultural aspect leverage factor analysis, shown in figure 3, there are six factors analyzed. Of these factors, five were identified as sensitive in influencing the sustainability of VUB innovation adoption in West Kalimantan, namely: (1) farmer education, (2) farmers knowledge of VUB, (3) culture of mutual cooperation, (4) social conflict, (5) taste of VUB rice.

The most sensitive factor affecting the sustainability of the adoption of rice seed innovations of VUB in West Kalimantan is farmer education. From the results of observations and interviews, the farmer education indicator is relatively low because farmers only have elementary school education, and some are not even in school.

Numerous studies have emphasized the crucial role of education in driving the adoption of agricultural innovations (Fosso & Nanfosso, 2016; Onyeneke, 2017). Farmers with higher levels of education are more inclined to adopt improved rice varieties, agrochemicals, fertilizers, mechanized harvesting, improved nursery practices, timely transplanting, and optimum seed rates (Onyeneke, 2017). According to Murtiati & Setiapernas, (2019), farmer education can aid farmers in gaining

access to the necessary resources to embrace VUB seed technology. This includes access to high-quality VUB seeds, the appropriate agricultural tools and equipment, and the assistance of agricultural specialists. With enough access to these resources, VUB seed technology can be readily adopted by farmers. Providing education to farmers can facilitate the adoption of new technologies and business methods, such as smart commerce, leading to enhanced agricultural practices and heightened competitiveness in the market (Chen & Liu, 2021). Education can help farmers learn about different seed varieties and their characteristics, such as disease resistance, yield potential, and suitability for different growing conditions. This knowledge can help farmers make informed decisions about which varieties to plant, leading to better crop outcomes (Mefo et al., 2023).

The next sensitive factor is farmers knowledge of VUB, from field conditions when conducting observations and interviews farmers have begun to understand about VUB, many farmers have planted and used VUB although there are still those who use local seeds. But there is still a lack of knowledge of farmers in alternative technology in rice cultivation faced by farmers, low human resource capacity becomes a problem in the application of technology (Nurlaela et al., 2022). In accordance with prior studies, farmers can choose varieties that are better suited to the soil and climate conditions in their region if they have a better understanding of VUB (Gusti et al., 2022). Farmers who use VUB have a greater likelihood of achieving higher yields than those who use conventional types of rice. Therefore, an understanding of VUB can help farmers in increasing agricultural yields (Eka Putra et al., 2022). Increased yields and crop quality from VUBs can help farmers increase their income. Therefore, an understanding of VUBs can help farmers maximize their income and improve their standard of living (Honorita et al., 2020). Farmers' knowledge of a technology is crucial for its successful implementation and adoption. Technological advancements, whether in the form of new farming practices or equipment, can significantly improve agricultural productivity and sustainability. However, for these technologies to be effective, farmers need to understand how they work, how to use them, and how they can be adapted to local conditions (Kravchenko et al., 2017).

The next sensitive factor is culture of mutual cooperation, through observations and interviews this activity is still well maintained among farmers until now so that farmers help each other, mutual cooperation is also the culture of Indonesian society itself. In Langkoroni Village, Muna Regency, mutual cooperation in agriculture primarily aims to bolster family economic prospects and foster a sense of kinship. On the other hand, mutual cooperation in social and cultural aspects places greater emphasis on kinship ties and the expression of

religious devotion (Sinaini & Iwe, 2020). In East Kolaka Regency, the customary tradition of Mekambare has played a crucial role in fostering social cohesion among lowland rice farming communities, empowering them to assist each other in addressing issues pertaining to food security and sustainable agricultural practices. In East Kolaka Regency, the customary tradition of Mekambare has played a crucial role in fostering social cohesion among lowland rice farming communities, empowering them to assist each other in addressing issues pertaining to food security and sustainable agricultural practices (Jers et al., 2023).

The next sensitive factor is social conflict, through observations made this has never happened related to the use of VUB. However, according to the farmers who can bring conflict in the future is between farmers who use VUB and not, because according to the farmers using VUB can give them higher production than local seeds so that it can provide more income than farmers who use local seeds. The adoption of high-yielding seed varieties can also lead to conflicts between farmers who may have different levels of access to these varieties or different levels of knowledge about their use. For example, farmers who have traditionally relied on locally adapted varieties may struggle to adapt to the new varieties, while those who have more access to resources and knowledge may be able to more easily adopt and benefit from the new seed varieties (Meng & Brennan, 2019). Understanding farmers' risk tolerance is crucial in explaining variations in the adoption of new improved rice varieties (Begho, 2021).

To address these conflicts and ensure that the adoption of high-yielding seed varieties is beneficial for all farmers, it is important to implement policies that support the conservation of agricultural biodiversity and provide farmers with access to the knowledge and resources they need to adapt to new technologies, additionally, providing farmers with access to knowledge and resources can help them adapt to new technologies and make more informed decisions about their farming practices, which can lead to improved sustainability and environmental performance (Bisht et al., 2020; Santos et al., 2021). This may involve supporting the development of local seed systems, promoting farmer-to-farmer knowledge exchange, and providing education and training on the use of new seed varieties (Meng & Brennan, 2019).

The next sensitive factor is the taste of VUB rice, through observations and interviews it was found that consumers prefer rice produced from VUB, from the shape, softness, and taste of VUB rice according to them the rice produced is fluffier. Creating a consistently good taste of rice is an important factor in increasing consumer satisfaction and building a solid relationship between producers and consumers. High levels of consumer satisfaction have the potential to provide long-term benefits such as strong consumer loyalty,

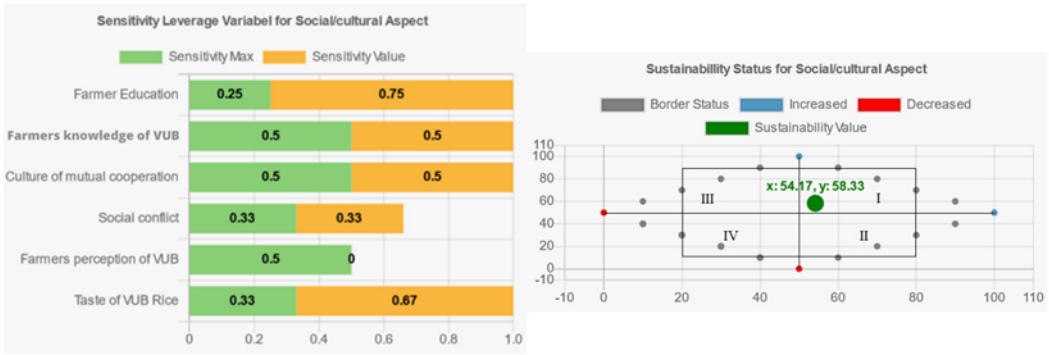

Figure 3. The sensitivity leverage variables and sustainability status for the social and cultural aspects

positive promotion through recommendations, and the establishment of a positive brand image. Therefore, paying attention to the taste of rice is key to maintaining product quality and meeting consumer expectations (Putri et al., 2016). According to Wibawa (2022) Consumer choices can also influence the extent to which farmers adopt rice varietals. New superior variety can boost rice yield and production, but they must also take into account consumer preferences regarding rice's qualities. Consumer acceptance of new improved rice varieties is crucial for their adoption by farmers and subsequent success in the market. Studies have shown that the sensory properties of rice, including taste, texture, appearance, and aroma, significantly influence consumer preferences (Gondal et al., 2021). Another study of consumer preferences for new rice varieties in Lampung Province found that panelists preferred different varieties based on taste, whiteness, aroma and texture (Yani & Utomo, 2014). Rice produced from this variety tends to be sweeter tasting and fluffier (Sahara et al., 2021). Rice breeders can utilize consumer preference studies to develop new rice varieties that meet consumer expectations and increase acceptability (Bairagi et al., 2019; Suryana et al., 2022).

CONCLUSION AND SUGGESTION

The MSA's sustainability analysis of the social and cultural aspects associated with the adoption of VUB in West Kalimantan provided key insights. The sustainability index of this adoption was 54.17%, classified as sustainable, with potential for significant future improvement indicated by a future state value of 58.33%. Among the factors examined, six were deemed crucial and five were considered sensitive in impacting the sustainability of innovation adoption. Farmer education emerged as the most sensitive factor. Observations and interviews revealed that many farmers have low education levels, hindering their ability to access essential resources for adopting new seed technology. This finding is consistent with existing research highlighting the importance of education in facilitating technology adoption and improving knowledge of VUB was identified as

agricultural practices. Farmers' another sensitive factor, highlighting the need for improved understanding to optimized agricultural productivity and incomes. The culture of mutual cooperation, a hallmark of Indonesian society, emerged as a robust factor supporting adoption by encouraging cooperation among farmers. In addition, the absence of social conflict related to VUB use was noted, although potential conflict between adopters and non-adopters was anticipated. Finally, consumer preferences for the taste of VUB rice were found to be positive, indicating a potential market advantage for farmers. These findings highlight the multifaceted nature of factors influencing the adoption of VUB and emphasized the importance of addressing education, knowledge dissemination, cultural values, potential conflicts, and consumer preferences in promoting sustainable agricultural practices and improving farmers' livelihoods in West Kalimantan.

Based on the conclusions of the study, several suggestions for future research could be proposed:

a. Educational interventions: Further research could explore targeted educational interventions aimed at improving the educational level of farmers in regions such as West Kalimantan. These interventions could include training program, workshops or educational campaigns focused on improving farmers' understanding of new seed technologies and their benefits.
b. Knowledge dissemination strategies: Investigate effective strategies for disseminating knowledge about VUB to farmers, particularly those with limited access to information. This could include assessing the effectiveness of extension services, farmer field schools, or peer-to-peer learning networks in increasing farmers' knowledge and adoption of new seed varieties.
c. Cultural context and adoption: Explore how cultural factors influence the adoption of new agricultural innovations like VUB. Future studies could examine the impact of cultural norms, values, and traditions on farmers' decision-making and adoption behaviors, especially in varied social and cultural settings like West Kalimantan.
d. Conflict management strategies: Examine potential strategies for managing conflicts that may arise between adopters and non-adopters of new seed varieties. This could include exploring mediation approaches, community dialogues or policy interventions aimed at promoting inclusive and collaborative decision-making processes within farming communities.
e. Consumer preferences and market opportunities: Investigate consumer preferences for rice varieties, including taste, texture, and other sensory attributes, and their impact on market demand

and farmer adoption. Future research could explore market segmentation strategies and value-added opportunities for VUB rice to leverage consumer preferences and enhancemarket competitiveness for farmers.

f. Long-term sustainability assessment: Perform longitudinal studies to evaluate the enduring sustainability of VUB adoption in West Kalimantan. These studies should track changes in adoption rates, productivity outcomes, environmental impacts, and socio-economic indicators over time to determine the lasting effects of innovation adoption on farmers' livelihoods and agricultural sustainability.

By addressing these research gaps, future studies can contribute to a better understanding of the complex dynamics underlying the adoption of new agricultural technologies and inform the development of targeted interventions and policies to promote sustainable agriculture and rural development in West Kalimantan and similar contexts.

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