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Sustainability Strategy of Gringsing Woven Fabrics on the Basis of Multifunction Through the PROMETHEE Approach

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ABSTRACT: Gringsing weaving is a multifunctional traditional fabric of Bali, it's used in various activities such as traditional ceremonies, war rituals, souvenirs, fashion, and medication. The objectives of this research are: (1) Identifying respondent's perceptions of the multifunctionality of gringsing woven fabric (2) Analysing the sustainability strategy for gringsing woven fabric as a typical woven fabric of Tenganan Village. This research uses analytical methods, descriptive analysis to analyse respondents' perceptions of the multifunctionality of gringsing woven fabric involving 19 respondents (consisting of craftsmen and stakeholders) and Preference Ranking Organization METHODs for Enrichment Evaluation (PROMETHEE) analysis to analyse alternative sustainability strategies for gringsing woven. The research results show that respondents have a good perspective on the potential of gringsing woven as a modern fashion classic product with sustainable principles. An alternative priority sustainability strategy to make gringsing woven fabric a sustainable industry is to develop innovations in modifying gringsing woven fabric motifs.

KEYWORDS: Gringsing Woven Fabric, Industrial Sustainability, Multifunction, Perception, PROMETHEE

INTRODUCTION

Bali Province is a province in Indonesia that is famous for its strong artistic and cultural values in the lives of its people. Balinese culture has become an offering where cultural aesthetics are accompanied by Hinduism religiosity (Suadnyana, 2020). This art is expressed in the form of products with economic value so that it becomes one of the economic pillars of the Bali Province. In the economic concept, indicators of human creativity are production factors that are able to contribute to economic movements, these ideas and innovations create economic concepts (Pratomo et al., 2021). The textile industry is the basis for sustainable economic growth, prioritizing small businesses, and improving people's living standards (Burkhanov & Bakhodirovna, 2021). Based on data from the Badan Pusat Statistik (2022), the number of textile industries in Bali Province in 2022 reached 25 companies with a value of output production amounted to IDR 147.69 billion. One of the villages in Bali that has high local potential while still maintaining its customs and uniqueness is Tenganan Pegringsingan Village, located in Karangasem Regency. The people in Tenganan Village strictly adhere to the village *awig-awig* (village regulations) and are part of the Bali Aga tribe, the form of belief in *awig-awig* can be seen in every ritual that considers the value and integrity of tradition which in practice is by the standards (Sumarjo, 2018). Gringsing woven fabric is a multifunctional cloth, that the Tenganan people use this cloth in traditional rituals, during traditional ceremonies the gringsing woven fabric is placed together with offerings. In the pandan war ritual, gringsing woven fabric is believed to be a repellent that can ward off pain during the war ritual (Lodra, 2015). The function of gringsing woven fabric can also be viewed from an aesthetic perspective, gringsing woven fabric is a work with aesthetic value both in material and taste (*taksu*) which is believed by the community to have strength where gringsing woven fabric is believed to be stronger than just a body protective function (Juliawan, 2023).

The uniqueness and high aesthetic value of gringsing cloth can add to the function of the woven cloth. The Ministry of Tourism and Creative Economy of Indonesia has a high concern for the importance of preserving and introducing local cultural heritage globally, this is proven by making gringsing woven fabric as souvenirs at the G20 event and introducing it as a creative economy product typical of Tenganan Village. As is known, the gringsing woven fabric craft of Tenganan Village is a craft with a high selling price (Fadli et al., 2022). The promotion carried out by the ministry is intended to continue to maintain the existence of gringsing woven fabric, which is the only woven cloth made using the double tie technique. Apart from that, observers of traditional art up to Make Up Artist (MUA) has currently innovated gringsing woven fabric as part of its development fashion design which has high value. Gringsing woven fabric is not only used as traditional bridal clothing but is also used as a material fashion modern, from bags to modified clothing (Sukmadewi, 2021). The concept of sustainable development has become a development concept accepted by all countries which is intended as a form of balance control of various development goals to create sustainable conditions.

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Sustainability concerns multi-criteria decision-making issues that include economic, social, and environmental aspects (Acar et al., 2015). The balance that we want to create through sustainable development is a balance of economic aspects, environmental aspects, and socio-cultural aspects (Setiawan, 2020).

As part of cultural heritage, gringsing woven fabric requires wider recognition which can be done by collaborating with the tourism sector in promoting the potential of local resources while still paying attention to environmental, socio-cultural, and economic aspects. Tourism has great opportunities for the economy and is closely related to the sustainable development of tourist destinations and the provision of tourism that is environmentally friendly and guarantees the protection of the natural environment (Streimikiene et al., 2021). The development of the tourism sector refers to the development of other sectors. The tourism sector is able to improve the welfare of the population and have an impact on fairly rapid economic growth in the long term (Prastyadewi et al., 2023). The more famous the gringsing fabric is, the higher demand for the fabric will be, so it is very important to carry out further analysis regarding the sustainability of the gringsing woven fabric. Based on the explanation above, business continuity is a business that periodically operates in decline over a long period to maintain production results. The objectives of this research are (1) Identifying the perceptions of weaving craftsmen and stakeholder regarding the multifunctionality of gringsing woven fabric (2) Analysing the sustainability strategy for gringsing woven fabric as a typical woven cloth of Tenganan Village.

METHOD

This research is a case study that uses a quantitative approach with a location in Tenganan Village, Manggis District, Karangasem Regency. The location was chosen because Tenganan Village is the centre for making gringsing woven fabric. The data used in the research is primary data. Primary data was obtained through questionnaire results, in-depth interviews, followed by Focus Group Discussion (FGD) which was attended by 19 participants consisting of weaving craftsmen, experts in the field of gringsing woven fabric, art observers, Make Up Artists, Karangasem Regency Government, Bali Provincial Department of Industry and Trade, community leaders of Tenganan Pegringsingan Village, tourists, and others.

The analytical method used to analyse the perceptions of weaving craftsmen is a quantitative descriptive method, analysing respondents' perceptions through assessment weights with 5 rating options on the questions in the questionnaire, namely very agree (5), agree (4), neutral (3), disagree (2), and very disagree (1). The analytical method used to determine the sustainability strategy for gringsing woven fabric is the PROMETHEE (Preference Ranking Organization Methods for Enrichment Evaluation) analysis method. In the PROMETHEE method, decision-makers solve multi-criteria problems starting with the transformation of sustainability criteria into a decision matrix using expert knowledge (Yuan et al., 2022). According to (Fauzi, 2019) There are six types of preferences, namely general preference criteria, quasi-preference criteria, linear preference criteria, level preference criteria, linear and non-different area preference criteria, and Gaussian criteria. This research uses general preferences (Type I Usual Criteria) for each sustainability strategy criterion for the gringsing woven fabric industry. Determination of the unit is carried out first before providing the sustainability strategy assessment which is presented in the following recap:

Table 1: Recapitulation of Units in Sustainability Strategy Assessment Criteria

Criteria	Min/Max	Unit	Preference Type	Weight
Craftsman Income Level	Max	IDR (Indonesian Rupiah)	Usual	1
Product Production Costs	Max	IDR (Indonesian Rupiah)	Usual	1
Comprehension of Gringsing Fabric	Max	5-point	Usual	1
Cultural Heritage Preservation	Max	Yes/No	Usual	1
Village Environmental Preservation	Max	5-point	Usual	1
Externalities in Other Villages	Min	IDR (Indonesian Rupiah)	Usual	1

Source: Fauzi (2019)

Determination outranking in PROMETHEE is calculated based on outgoing flow (ϕ^+) and incoming flow (ϕ^-).

$$\phi^+ = \frac{1}{(N-1)} \pi_A(a, b)$$

$$\phi^- = \frac{1}{(N-1)} \pi_A(b, a)$$

The difference between ϕ^+ and ϕ^- then calculated as net flow or

$$\phi(a) = \phi^+(a) - \phi^-(a)$$

The results of the ranking of alternative sustainability strategies for the Gringsing woven fabric industry were carried out by referring to the calculation results from net flow. After net flow is obtained, then sorted from the highest value to obtain the best priority alternative sustainability strategy.

RESULT AND DISCUSSION

Respondent's Perception of the Multifunctionality of Gringsing Woven Fabrics in Tenganan Pegringsingan Village

Respondent's perceptions of the multifunctionality of gringsing woven fabric are views or assessments given by respondents regarding the various functions of gringsing woven fabric which is identified based on several criteria in each aspect (economic, socio-cultural, and environmental aspects). The perception of each respondent varies depending on experience and information possessed in carrying out weaving business activities. Craftsmen's perceptions of the multifunctionality of gringsing cloth are divided into three assessment aspects, namely economic, socio-cultural, and environmental aspects (Table 2). This research involved 19 respondents consisting of gringsing woven fabric craftsmen in Tenganan Village and stakeholders. This was done to obtain valid and accurate information so that informants could understand the functions of gringsing woven fabric for both Tenganan Village residents and interested parties from economic, socio-cultural, and environmental aspects. Details of the perceptions of respondents selected as respondents regarding the multifunctionality of gringsing woven fabric are presented in the following table.

Table 2: Summary of Stakeholder's Perception of Multifunctional Gringsing Woven Fabric

	Criteria		
	Economy	**Socio-cultural**	**Environment**
Stakeholder's Perception Regarding the Multifunctionality of Gringsing Woven Fabric	Gringsing woven fabric can be commercialized as part of modern fashion trends	Gringsing woven fabric can be used as a cultural icon from Tenganan Village	Gringsing woven fabric can become an environmentally friendly textile industry
	Gringsing woven fabric has the potential to become a textile industry that fits market needs	Gringsing woven fabric has potential as trendsetter fashion design with classic value	Gringsing woven fabric can become a pioneer of sustainable fashion trends

Source: Data Analysis Results (2024)

Based on respondent's perceptions of the multifunctionality of gringsing woven fabric, from an economic aspect, it is considered good because both criteria in the economic aspect have a positive impact on the economic needs of the community. As many as 80% of respondents stated that they agreed that the existence of gringsing woven fabric could become a cultural product that could be commercialized into various types of modern fashion products through modification of the motif so that it can be sold in large quantities at a more affordable price. This causes the modern fashion product from woven fabrics can enter the global market. When viewed from a socio-cultural aspect, 80% of craftsmen agree that gringsing woven fabric can be used as a cultural icon as well as the identity of Tenganan Village. This woven fabric, with its unique pattern, high aesthetic value, and philosophy can be created into a classic fashion trend that can tell a story through every motif in a fashion product. In terms of the environmental aspect, 100% of respondents agreed with the function of gringsing woven fabric as an environmentally friendly textile industry because the raw material for the fabric is made from natural fibers so it does not cause environmental pollution. The physical environment in Tenganan Village has great significance as part of the Tri Hita Karana philosophy which applies to the Tenganan Village community and is strictly adhered to by the Tenganan community (Sukawati, 2020). Through the manufacturing process, gringsing woven fabric can become a pioneer of innovative fashion products with sustainability principles.

Alternative Strategy for Sustainability of Gringsing Woven Fabric

Alternative policy strategies to create a sustainable industry in gringsing woven fabrics are made based on the needs of the gringsing weaving industry which is based on modernization and is sustainable. These policy alternatives are (1) Innovation Development of the Gringsing Fabric Industry; (2) Quality Development of Industrial Human Resources; (3) Protection of Gringsing Woven Fabric Through The Awig-awig (Regulation) of Tenganan Village: (4) Continuity of the Availability of Raw Materials. These alternatives are designed based on an assessment of economic, socio-cultural, and environmental aspects. Each alternative is presented in the form of a multicriteria analysis matrix in Table 3.

Table 3: Multicriteria Analysis Matrix for Sustainability Strategy for Gringsing Woven Fabric in Tenganan Village

Criteria						
Strategy	**Economic Aspects**		**Socio-Cultural Aspects**		**Environmental Aspects**	
Alternatives	**TPP**	**BPP**	**PKG**	**PWB**	**PLD**	**EPD**
Alternative I	9.000.000	4.000.000	Good	Available	Very Good	200.000
Alternative II	7.500.000	3.500.000	Very Good	Available	Good	375.000
Alternative III	0	2.500.000	Good	Available	Neutral	500.000
Alternative IV	5.000.000	2.000.000	Neutral	Unavailable	Very Good	350.000

Source: Focus Group Discussion (2024)

Information:

Alternative I	: Innovation Development of the Gringsing Fabric Industry
Alternative II	: Quality Development of Industrial Human Resources
Alternative III	: Protection of Gringsing Woven Fabric Through The Awig-awig (Regulation) of Tenganan Village
Alternative IV	: Continuity of the Availability of Raw Materials
CIL	: Craftsman Income Level (in IDR)
PPC	: Product Production Costs (in IDR)
CGF	: Comprehension of Gringsing Fabric. 1: very not good, 2: not good, 3: neutral, 4: good, 5: very good
CHP	: Cultural Heritage Preservation. 0: unavailable, 1: available
VEP	: Village Environmental Preservation. 1: very not good, 2: not good, 3: neutral, 4: good, 5: very good
EOV	: Externalities in Other Villages (Tenganan Village pays compensation for thread dyeing contamination to other villages) (in IDR)

Innovation Development of the Gringsing Fabric Industry

The first alternative sustainability strategy is the development of innovation in the gringsing cloth industry. Development strategies that can be carried out by weaving craftsmen include creating product innovations, increasing the amount of production by forming groups of weaving craftsmen, and setting competitive prices (Laga & Sari, 2020). This alternative has a significant influence on three aspects, in the economic aspect it has an impact in the form of increasing the income of craftsmen with an average income per month reaching IDR 9,000,000. The production cost of gringsing cloth is IDR 4,000,000. Meanwhile, in the socio-cultural aspect, the criteria for comprehension of gringsing fabric is 4, which means that the first alternative can provide the public with a good understanding of the importance of the existence of gringsing cloth as a cultural heritage that has various functions in traditional life. The cultural heritage preservation criteria is 1, which means that the development of innovation in gringsing woven fabric can help preserve gringsing fabric as a cultural heritage. In the environmental aspect, the village environmental preservation criteria is 5, which means that there is the development of innovations in adding fabric color variants with natural materials that can maintain environmental balance. The externalities in other villages criteria are the willingness of Tenganan Village to pay for the pollution caused by the thread dyeing process in other villages amounting to IDR 200,000 because the motif modification innovation has resulted in the efficient use of gringsing woven fabric even though production quantities have increased.

Quality Development of Industrial Human Resources

The second alternative sustainability strategy is developing the quality of human resources. Resources have an important role in the running of the creative industry, the development of the creative industry must be accompanied by skilled, creative, and insightful Human Resources (Heryani et al., 2020). Technology can improve performance to achieve competitive advantage and technology can create obstacles for competitors in the competitive arena (Pryanka & Setyari, 2022). Empowering woven fabric craftsmen can also improve the quality of craftsmen's human resources regarding improvement market share such as providing product sales coaching in e-commerce. Research from Wibowo et al (2023) proves that digital business can support a business vision that is based on the principles of sustainability in competitive advantage, brand loyalty, risk mitigation, and cost reduction. The principles of sustainability implemented by business actors are able to attract investor interest so that they can increase the market value of MSME businesses.

In the second alternative, the impact on the economic aspect is an increase in the average craftsman's income to IDR 7,500,000 per month, the production costs required are IDR 3,500,000 because the expansion of the market can increase the number of sales so that it requires more production costs. In the socio-cultural aspect, the criteria for comprehension of gringsing fabric is 5, meaning that the development of the quality of human resources can increase understanding of gringsing cloth as a cultural heritage. The cultural heritage preservation criteria is 1, which means that the second alternative can increase cultural preservation efforts. Meanwhile, in the environmental aspect, the village environmental preservation criteria is 4, which means that the second alternative can support environmental preservation through education on the use of natural resources as fabric dyeing materials. In terms of the externalities in other villages criteria are amounting to IDR 375,000 due to product marketing training on an online scheme can increase the amount of woven cloth production so that more raw materials are needed.

Protection of Gringsing Woven Fabric through the Awig-awig (Regulation) of Tenganan Village

The third policy alternative is the protection of gringsing woven fabric through traditional village *awig-awig*. To protect the traditional culture and the environment, traditional village governments use *awig-awig* as village regulations (Suprapto et al., 2021). Enforcement of customary law in the form of sanctions is applied from generation to generation in *awig-awig* and agreed upon by village residents (Sumarmi et al., 2020). From a population perspective, the Tenganan Pegringsingan Traditional Village has made *awig-awig*, a regulation in maintaining the harmonization of traditional village manners. This protection is carried out so that there

is legal recognition of ownership rights from Tenganan Village and to avoid duplication of fabric designs and patterns. Woven fabrics in the cultural industry are able to become a place identity that shows the authenticity of the place as a strength of cultural products (Parameswara et al., 2021). In the third alternative, the impact on the economic aspect is production costs of IDR 2,500,000. In terms of criteria, the craftsman's income level does not increase or it is worth IDR 0. Meanwhile, in the socio-cultural aspect, the criteria for comprehension of gringsing fabric is 4, meaning that the third alternative is able to provide an understanding of the importance of gringsing cloth as a cultural heritage in Tenganan Village. The cultural heritage preservation criteria is 1 means that protecting woven fabrics with traditional village *awig-awig* is able to preserve the local culture of Tenganan Village. In the environmental aspect, the village environmental preservation criteria is 3, which means that the third alternative has no effect or is considered constant. The externalities in other villages criteria are amounting to IDR 500,000 because with the recognition of absolute ownership of gringsing woven fabric by the *awig-awig* of Tenganan Village, a sustainable production process will occur.

Continuity of the Availability of Raw Materials

The fourth alternative is the continuity of the existence of raw materials by carrying out further analysis of the existence of natural raw materials so that there are no raw material limitations. Limited raw materials indicate limitations in the use of technology and human resources in producing and processing textile raw materials (Pratiwi, 2020). Due to the intensive consumption of natural resources, the development of new alternative sources of natural fiber is urgently needed to contribute to reducing resource (Luján-Ornelas et al., 2020). In the fourth alternative, the impact on the economic aspect is that the craftsman's income level has increased with an average craftsman's income per month of IDR 5,000,000. The production cost is IDR 2,000,000 because the continuity of the presence of natural raw materials helps craftsmen reduce the purchase of textile raw materials when prices increase. In the socio-cultural aspect, the criteria for comprehension of gringsing fabric is 3, which means that the existence of the fourth alternative does not affect the understanding of gringsing woven fabric as a cultural heritage. The cultural heritage preservation criterion is 0, which means the fourth alternative has no effect on cultural preservation. In the environmental aspect, the village environmental preservation criteria is 5, which means that the fourth alternative is able to help maintain environmental quality because of the presence of natural raw materials in making gringsing woven fabric. The externalities in other villages criteria are amounting to IDR 350,000, which means that with the presence of raw materials the gringsing cloth production process will continue and the thread dyeing will continue to be carried out in other villages.

Sustainability Strategy for Gringsing Woven Fabric in Tenganan Village

After compiling criteria for each aspect of the four alternatives industrial sustainability strategies. Then, the best alternative strategy is determined using PROMETHEE Visual Software. The selection of the best strategic alternative can be seen from the ranking and score results from net flow. Mark net flow obtained from the difference in value outgoing flow (ϕ+) and incoming flow (ϕ-). Mark outgoing flow (ϕ+) shows the superiority of an alternative over other alternatives, while value incoming flow (ϕ-) shows the weakness of an alternative against other alternatives. Net flow, outgoing flow, and incoming flow of each alternative sustainability strategy can be seen in table 4.

Table 4: Phi, Phi+ and Phi- Values for Alternative Sustainability Strategies for Gringsing Woven Fabric in Tenganan Village

Rank	Action	Phi	Phi+	Phi-
1	Alternative I	0,6667	0,7222	0,0556
2	Alternative II	0,2222	0,5556	0,3333
3	Alternative IV	-0,3889	0,2778	0,6667
4	Alternative III	-0,5000	0,1667	0,6667

Source: Data Processed (2024)

After getting the value of net flow, outgoing flow, and incoming flow from each alternative strategy, each alternative can be ranked based on net flow value. Figure 1 shows that the most optimal alternative for the sustainability strategy of gringsing woven fabric is the development of innovations in modifying gringsing woven fabric motifs. Innovation development is a modification of the motif without eliminating the religious meaning and magical value of the fabric. Development fashion which is very dynamic, also provides an opportunity for craftsmen to produce innovative gringsing woven fabric in accordance with market trends/needs. The Innovation Development of the Gringsing Fabric Industry can increase sales volume and awareness the community regarding the existence of gringsing woven fabric as a timeless cultural heritage with various creativity that can continue to be produced.

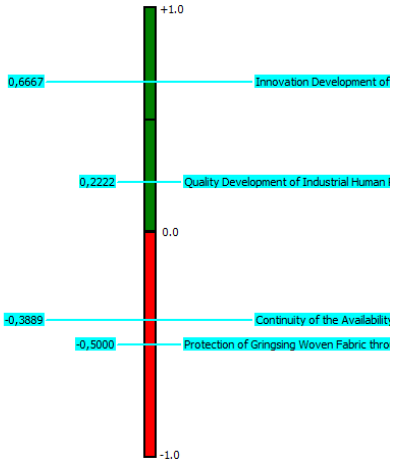


Figure 1. Promethee Ranking for Sustainability Strategy for Gringsing Woven Fabric in Tenganan Village
Source: Data Processed (2024)

The contribution of each criteria to the score obtained for each alternative can be seen through the PROMETHEE Rainbow analysis. Each block describes the criteria with labels in order based on ϕ^+ and ϕ^-. In alternative I, the criteria that contribute positively are all criteria including the craftsman's income level, product production costs, externalities to other villages, village environmental preservation, cultural heritage preservation, and comprehension of gringsing fabric. For alternative II, criteria that contribute positively include comprehension of gringsing fabric, craftsmen's income level, product production costs, and cultural heritage preservation. Meanwhile, the criteria that contribute negatively to alternative II are village environmental preservation and externalities in other villages. In alternative IV, the criteria that contribute positively are village environmental preservation and externalities in other villages. Meanwhile, the criteria that contribute negatively to alternative IV are the craftsman's income level, product production costs, comprehension of gringsing fabric, and cultural heritage preservation. In alternative III, the criteria that contribute positively are the cultural heritage preservation and comprehension of gringsing fabric. Meanwhile, the criteria that contribute negatively to alternative III are the craftsman income level, village environmental preservation, and externalities in other villages.

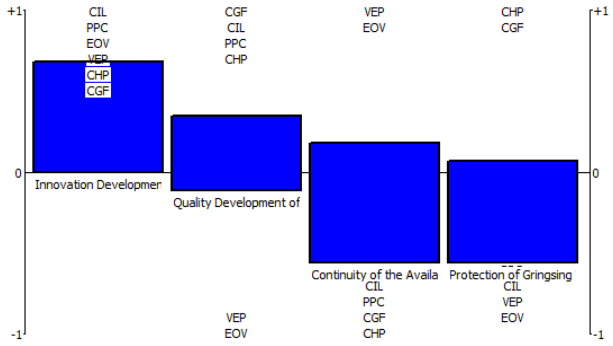


Figure 2. PROMETHEE Rainbow for Alternative Sustainability Strategy for Gringsing Woven Fabric in Tenganan Village
Source: Data Processed (2024)

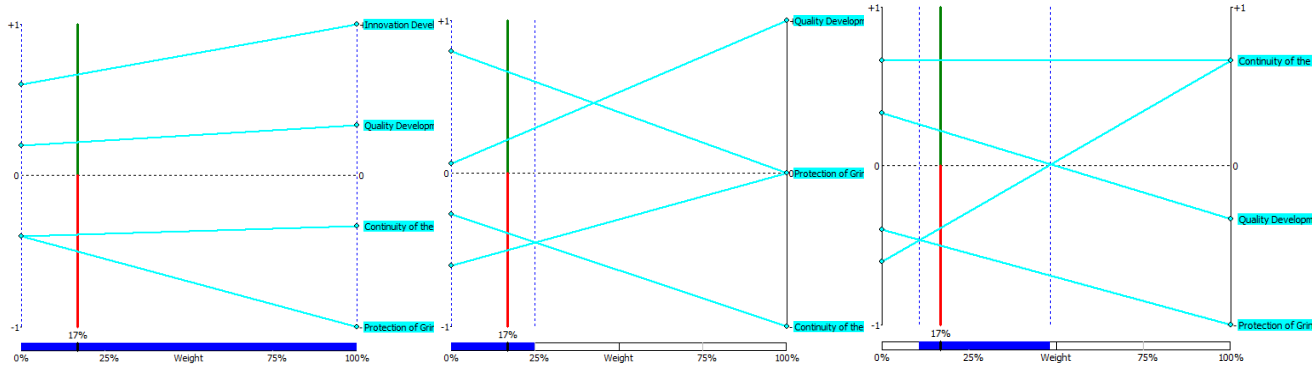
Information:

CIL	: Craftsman Income Level
PPC	: Product Production Costs
CGF	: Comprehension of Gringsing Fabric
CHP	: Cultural Heritage Preservation
VEP	: Village Environmental Preservation
EOV	: Externalities in Other Villages

Sensitivity Analysis

Sensitivity analysis shows the criteria for each aspect that are sensitive and not sensitive to ranking changes. In the economic aspect (figure 3a) which consists of the craftsman income level and product production costs, it is stable (not sensitive) because it

does not change the order of choice, namely alternatives I, II, IV, and III even when the weight of the Craftsman Income Level (CIL) criteria is changed from 0% on baseline up to 100%. Meanwhile, in the social-cultural aspect (figure 3b), which consists of comprehension of gringsing fabric and cultural heritage preservation, it has sensitive (unstable) criteria, the sensitivity of Comprehension of Gringsing Fabric (CGF) experiences a weight change of more than 25%, so sequentially that will be an alternative The sustainability strategy for gringsing woven fabric is alternatives II, III, I, IV. In the environmental aspect shown in Figure 3c, the criteria are village environmental preservation and externalities in other villages, which have criteria that are sensitive or unstable to changes in weight. The sensitivity of the Village Environmental Preservation (VEP) criteria experienced a change in weight above 48.28%. So, in sequence, the strategic policy for the sustainability of gringsing woven fabrics is alternatives IV, II, I, III.



(a) Craftsman Income Level (b) Comprehension of Gringsing Fabric (c) Village Environmental Preservation

Figure 3. Sensitivity Analysis for Three Criteria
Source: Data Processed (2024)

CONCLUSIONS

The conclusions obtained from the analysis show that the perceptions of respondents consisting of weaving craftsmen and stakeholders has a good assessment of the multifunctionality of gringsing woven fabric in Tenganan Village as a trend fashion modern through modification of woven fabric into products fashion which is environmentally friendly without reducing the philosophical value of the fabric as a cultural heritage of Tenganan Village, this means that respondents can feel the various functions it has both in terms of *sekala* (visible) and *niskala* (invisible). The policy alternative that is a priority in the sustainability strategy for gringsing woven fabric in Tenganan Village is The Innovation Development of the Gringsing Fabric Industry, where the innovation development in question is the development of woven cloth as a fashion modern product produced according to market needs. The guaranteed access to fashion modern is able to increase the motivation of craftsmen to continue producing woven fabrics with sustainable principles.

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