Potential Sustainability Scenarios for Gringsing Weaving: How Important is Education?

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Abstract
The Gringsing weaving craft industry is a culture-based creative industry with its values and characteristics as a local cultural heritage with innovation and creativity that are important for developing countries and economic growth. Karangasem, Bali, is full of culture-based weaving craft industries such as gringsing weaving. With the rapid modernization of technology, Bali Aga ethnic weavers must adapt to changing times by improving education, skills, and knowledge to maintain the continuity of local traditions. This research aims to determine the probability scenario for the sustainability of ikat weaving in Tenganan Pegringsingan Village, Karangasem. This research is quantitative, with primary data from the results of FGDs with experts who will later determine probability scenarios for sustainability. Researchers will place more emphasis on educational probability scenarios to improve the skills and knowledge of craftsmen. The analysis technique used is SMIC-Prob analysis. The analysis results show that of the five scenarios formulated, there is the best combination with a probability of 0.104, namely the scenario of craftsmen producing as usual, opening a fashion stall, increasing production, and increasing knowledge. The conclusion of the sensitivity of the scenario shows the highest elasticity in the sustainability of gringsing weaving by realizing an educational scenario to increase skills and knowledge of 1.102. It can be concluded that the sustainability of gringsing weaving is largely determined by the educational scenario to improve the skills and knowledge of craftsmen. Training programs and instilling character values as support for gringsing weaving craftsmen need to be improved to maintain the sustainability and development of gringsing weaving.

Keywords
Gringsing Weaving; Continuity; Education

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1. INTRODUCTION

Karangasem, as one of the administrative regions of Bali, is full of cultural-based textile industries such as endek, songket, and gringsing. Data (BPS Karangasem Regency, 2021) shows the number of industries in 2016 (last data updated 2/11/2019) was 14,846, an increase from 2015 of 14,699 (Statistics, 2019). One of the Karangasem cultures in Tenganan Pegringsingan village is Gringsing weaving, a legacy of past generations from a combination of elements of traditional art technology and is well known internationally. This woven fabric is a textile industry resulting from the creativity of the people of Tenganan Pegringsingan Village.

Gringsing is a woven fabric characterized by techniques, colors, motifs, and noble meanings (Lodra, 2015). The uniqueness of its attraction is combined in a piece of Gringsing Woven Cloth. Etymologically, Gringsing comes from the word "Gering," which means disease, and "Sing," which means non-existent. So, Gringsing Cloth has the meaning and function of being a medium for repelling disease (Utami, 2015). Gringsing woven cloth is an aesthetic work full of meaning as a symbol believed to have spiritual power by indigenous peoples. This reflects the religious function of Gringsing cloth, which tends to be strong and not limited to body protection. Furthermore, as a work of art, Gringsing Woven Cloth goes through a dyeing process by being tied tightly. This technique then reflects the characteristic that Gringsing Weaving is a double ikat weave that is not owned by any community in Indonesia and takes years for just one piece of cloth. Double ikat weaving binds and unifies nature and noetic to create harmony (Lodra, 2015).

During the COVID-19 pandemic, the economic sector has become one of the most difficult and unavoidable sectors, including for indigenous communities who own land in the traditional tourism sector, such as Tenganan Pegringsingan. Restrictions on visitors from outside the region, including various policies, both lockdown and PPKM, also significantly impact the community. This has a big impact on gringsing weaving craftsmen in Tenganan Pegringsingan Village. They are haunted by uncertainty regarding the sale of ikat fabrics. Their sales gradually decreased, resulting in a decrease in production and income. In 2021, the Minister of Tourism and Creative Economy (Menparekraf), Sandiaga Salahuddin Uno ordered 120 Gringsing weavings to be presented to world leaders attending the November 2022 G20 meeting in Bali. This weaving order revealed that he could employ 400 craftsmen in Tenganan Village, ManggGIS District, Karangasem Regency, Bali Province. This number is almost the same as the population of Tenganan Village. Especially during the pandemic, this order means a lot to the craftsmen (Nation, 2021).

Gringsing weaving can be said to be a culture-based creative industry. Cultural industries provide symbolic, authentic, historical, and aesthetic meaning from cultural values to certain cultural products and visual attributes (Fahmi & Dijk, 2016). One strategy for the sustainability of culture-based creative industries is economic activities that combine a cultural approach, namely cultural values and creative industries, which are closely related to innovation, creativity, and copyright. As already mentioned (Anugerah & Prasetia, 2015). Through creative activities that utilize local cultural resources, it is hoped that we will be able to preserve culture sustainably. One of the Sustainable Development Goals (SDGs) goals is to improve the quality of learning (Aji et al., 2022). Efforts and community involvement are needed to preserve and develop local characteristics so that foreign cultural invasions do not erode them.

The creative industry culture of connecting traditional knowledge with innovation and creativity is important for several countries because it has economic potential and impacts economic development (Pessoa et al., 2009). For example, handicrafts in the cultural industry play an important role in people's income and job creation and have been recognized throughout the world alleviation (Balaji & Mani, 2014).

In addition, according to Cooke & de Propris, the cultural industry has deep roots in local values. It allows the diversification of rural economic activities sustainably and wisely. (Cooke & Propris, 2011).
However, Y. Yang et al., 2018, which studies the sustainability and preservation of traditional craft cultural industries that have cultural capital, is still not much, and most research focuses on the sustainability and preservation of tangible cultural heritage among other historical buildings. remains or archaeological sites(Hou & Chan, 2017). Meanwhile, in some countries, the output of the cultural industry is a unique, significant cultural heritage safely pursued to fulfill cultural and economic goals for sustainable development. (Throsby, 2014). Meanwhile, Nugroho's research results show that the technology that accompanies the Industrial 4.0 era provides opportunities that can be exploited for the development of creative industries, even though there are challenges faced, such as limited human capabilities, resources, copyright problems, infiltration of foreign cultures and creativity which is still low. his confession(Nugroho, 2019).

Gringsing preservation by integrating cultural knowledge with rules and verification of design applications, the natural coloring process in gringsing weaving is relevant to environmental and cultural aspects(Widiawati et al., 2012). However, the obstacles faced by craftsmen, apart from the problem of raw materials, especially threads, are difficult, the dyeing process is long, and the development of factory-made fabrics resembling grinsing which is destroying the market is spreading on the market, threatening environmental sustainability. Balinese woven cultural products, including gringsing. This phenomenon will greatly affect prices and trigger a flood of counterfeit goods. Currently, modernization with technology and information is developing very rapidly. It is feared that it could change people's mindset regarding developing their regional culture. Bali Aga ethnic weavers must fight the current of changing times and protect their traditions so that they are not eroded(Sudarmanto, 2022). Rural communities who do not have good knowledge have to face the fact that access to technology and training is still unequal(Sarah, 2022). In this case, craftsmen need educational development by increasing weaving skills and knowledge. Education aims to encourage creativity in a mindset that supports the growth of charity and work in the creative industry. The role of research is to provide input on creative industry development policy models and the instruments needed and to produce technology that supports working methods and efficient use of resources and makes the national creative industry competitive. Community service's role is to form a society with institutions/social order that supports the growth of the national creative industry(Sulastri & Dilastri, 2015).

Previous research by Saraswati et al. (2023) stated that authenticity and social media influence the sustainability of the Gringsing Weaving Industry(Saraswati et al., 2023). This is supported by the results of research by Sudarmanto (2002), which states the existence of Gringsing Bali weaving in Tenganan village by teaching weaving skills to the younger generation, especially those living there. (Sudarmanto, 2022). With previous research stating the advantages of each variable, the sustainability of gringsing weaving requires scenario analysis to determine potential scenarios as the best steps in the sustainability of gringsing weaving. This can be known by using SMIC-Prob analysis to determine the probability scenario for the sustainability of Gringsing ikat weaving in Tenganan Village.

With the uniqueness and attractiveness of gringsing woven fabric that needs to be preserved, based on the results of the Focus Group Discussion (FGD), there are five main scenarios, namely 1) continuing to produce as usual, 2) apart from production, other businesses such as opening a fashion stall, 3) increasing production, 4) apart from producing, they also open other businesses outside the gringsing weaving industry such as Banten businesses, food stall businesses, and 5) improving weaving skills and knowledge. In this research, researchers will emphasize educational probability scenarios to improve the skills and knowledge of craftsmen. Training programs and instilling character education to love one's own culture as support for gringsing weaving craftsmen need to be improved to maintain the sustainability and development of gringsing weaving for the sustainability of grising weaving in Tenganan Pegingsingan Village Karangasem scenario.
2. METHODS

The research location is Tenganan Pegrisingan Village, Karangasem Regency, Bali, and will be carried out in 2023. The sample was taken from 50 percent of weavers from around 150 weaving craftsmen, namely 75 craftsmen plus related elements to make 120 respondents, as well as 19 stakeholders totaling 19 respondents. The strategy design model carried out for the sustainability of gringsing weaving by including aspects of uncertainty is by SMIC-Prob-Expert. This method, based on probability theory, assesses the possibility of an activity occurring. SMIC-Prob then calculates a combination of scenario scores that may or may not be implemented (Fauzie, 2019). Combinations are generated based on the number of scenarios or events observed with a combination of \( r = 2n \), where \( n \) is the number of scenarios observed. Determining various event scenarios is based on the opinions of gringsing weaving experts carried out through FGD or filling out questionnaires, which can be written: \( H = (e_1, e_2, \ldots, e_n) \), where \( e_1 - e_n \) means an event or activity. FGD also determines simple probability \( P(i) \), the conditional probability of each scenario in the form of:

\[
P(i) = P(e_i) = \frac{Pr(i)}{Pr(i)}
\]

SMIC-Prob also requires requirements for every opportunity to operate, namely:

\[
0 \leq P(i) \leq 1
\]

\[
P(i/j)P(j) = P(i/j)P(i) = P(ij)
\]

\[
P(i/j)P(j) + P(i/j)P(j) = P(i)
\]

By using the quadratic programming method to determine the probability combination score through the objective function:

\[
\min \sum_{ij}^n \left[ P^2(i) - \sum_{k=1}^r t(ijk)\pi_k \right]^2 + \sum_{ij}^n \left[ P^2(j) - \sum_{k=1}^r s(ijk)\pi_k \right]^2
\]

With constraints:

\[
\sum_{k=1}^r \pi_k = 1, \text{ and } \pi_k \geq 0 \text{ for all } k
\]

“\( \pi_k \)” symbol describes the probability scenario \( k \) whose value is sought from the minimization solution above. The value of \( t(ijk) \) will be equal to 1 if events \( i \) and \( j \) occur in scenario \( k \), and 0 if events \( i \) and \( j \) do not occur in scenario \( k \). The value of \( s(ijk) \) will be equal to 1 if the value of event \( i \) occurs in scenario \( k \) but event \( j \) does not occur. Conversely, the value of \( s(ijk) \) will be 0 if event \( i \) does not occur, but event \( j \) occurs in scenario \( k \). Completion of the quadratic program produces probability scores from highest to lowest which are presented in tabular form, as well as probability elasticity values for each event in the form:

\[
e_{ij} = \frac{P(i)\Delta P(j)}{P(j)\Delta P(i)}
\]

In FGD, experts based on the appropriateness of their responses or considering them determine the hypothesized probability. Uncertainty analysis with SMIC-Prob has several stages to produce a combination of scenarios. Generally, this stage concerns collecting information on the sustainability of the observed gringsing weaving, data analysis, and interpretation of the results. Figure 1 below shows experts’ determination of opportunities, which is the determining step in producing analysis results, where the second and third stages are the main components of the SMIC-Prob analysis stage.
3. FINDINGS AND DISCUSSIONS

Based on the SMIC-Prob analysis stage, the initial stage is to identify the probability scenario to be analyzed. The scenarios in this research are possible actions of gringsing weaving craftsmen in production. Based on the results of the questionnaire, which were adapted to the results of the FGD, there are five scenarios (in the SMIC-Prob data input, they are called hypotheses), which were identified for the sustainability of the gringsing weaving industry, namely: (1) continuing to produce as usual, (2) in addition to producing opening other businesses such as opening a shop, fashion (commercial), (3) increasing production, (4) apart from producing, also opening other businesses outside the gringsing weaving industry such as Banten businesses, food stall businesses (side economy), and (5) increasing weaving skills and knowledge (education).

SMIC-Prob Analysis Results

a. Scenario for Determining the Probability of Sustainability of Gerinsing Weaving

Calibration from raw data to clean data is the initial process of SMIC-Prob analysis so that the data becomes more accurate so that simple and conditional probability data from raw data is recalculated into clean data. Calibration results from raw data to simple opportunity data for ikat weaving craftsmen’s action scenarios according to Figure 2:

![Figure 2. Simple Probability of Raw Data and Clean Data (Pi)](image)

The change in raw data to clean data on simple occasions, according to Figure 2, shows that craftsmen continue to produce as usual, from 0.4 (40%) to 0.413 (41.3%) after calibration. There is a scenario that shows a decrease in opportunities, namely that craftsmen besides producing also open fashion stalls decreased from 0.6 (60%) to 0.518 (51.8%), and the actions of craftsmen besides producing also open other businesses from 0.55 (55%) up to 0.474 (47.4%).

To see the ranking of possible scenario combinations, which produces 2^n combinations where n in this study is five possible scenarios, there are 32 scenario combinations, as shown in Figure 3. The numbers "1" and "0" in each combination indicate whether the scenario is realized. No. As in the results of Figure 3 (a), the lowest combination is 10110, which has a chance of 0 (0%), meaning that the combination of scenarios hypothesized by craftsmen is to continue producing as usual, increase production, and the craftsmen’s actions apart from production are also to open another business without...
opening a stall. Fashion (commercial) and does not improve skills and knowledge (education) have very little chance of being implemented.

Figure 3. (a) Probability of Different Scenarios and (b) Measure of Probability of Combination Sequences Based on Scenarios

Meanwhile, the one with the highest probability of an alternative combination is combination 03, namely 11101, which is 0.104 (10.4%), which means that in this combination scenario, craftsmen continue to produce as usual, apart from producing as usual, there is also a fashion stall business (commercial), increasing production (increase), and increase in skills and knowledge (education) by 10.4%. This can be explained based on the results of questionnaires, FGDs, and in-depth interviews with elders (senior experts). It can be seen that the craftsmen maintain hereditary traditions, and some craftsmen follow tourism developments. There are important visits such as the Minister of Tourism and the G20 Presidency... Apart from that, based on the results of the FGD, training in developing woven fabric production designs using weaving techniques and management development can increase the income of craftsmen in Tenganan Village.

b. Scenario Analysis of Sensitivity Drivers of Sustainability in the Gringsing Weaving Industry

Sensitivity analysis of SMIC-Prob results is measured by elasticity, namely how responsive changes in opportunities are from one scenario to another. The results of the elasticity analysis in this research are shown in Figure 4, where the last column is the absolute value of the elasticity for each scenario (horizontal summation), which can be interpreted as the “prime mover” or main driver of the existing system. Analyzed. Meanwhile, the last line (vertical addition) is a scenario or conditional action.
Elasticity analysis clearly shows the sensitivity of one scenario to another, whether the craftsmen’s actions are the “main driver” or a contributor to the sustainability of Gringsing weaving. As usual, increasing the skills and knowledge of weaving craftsmen and production is a “prime mover” with elasticities of 1.102 and 1.039, respectively, which means the sustainability of gringsing weaving will be better, very determined by both scenarios. Indeed, in reality, craftsmen survive to continue producing as usual, which is the most common thing. It is the result of work handed down from generation to generation by their ancestors. Therefore, increasing skills and knowledge in weaving makes it easier for craftsmen to work. On the other hand, in the last line, the scenario of increasing weaving skills and knowledge is greatly influenced by an elasticity of 1.248, which is the largest contributor to education, namely -0.237, which can be said if the opportunity for craftsmen to produce as usual increases by 100%, then the opportunity for craftsmen to increase their skills and knowledge weaving will decrease by 0.237 (23.7%).

Here, the senior craftsmen will survive and continue to choose authenticity and history, even if it is commodified, without reducing the sacredness of Gringsing woven cloth. As (Lodra, 2015), (Parameswara et al., 2022) (and Anugerah & Prasetia, 2015) argue, economic activities make Geringsing cloth experience commodification of meaning by craftsmen, designers, and creators but do not abandon its cultural values. It is contained therein. He believes that commodification has a role in preserving and developing Gringsing weaving. However, its sacredness is still strong, as seen in making Gringsing, materials, motifs, accompanying rituals, ethics, and beliefs.

According to Sudarmanto (2022), there is great encouragement from the older generation to continue to preserve Balinese Gringsing weaving by teaching weaving skills and knowledge to the younger generation, especially those living in rural areas. Can stop efforts by outside parties to speed up the Gringsing weaving production process by imitating original woven motifs on other types of fabric with different materials and dyes or synthetic dyes. So, as a precaution against the threat of people outside Tenganan Pegingsingan village to produce Gringsing Bali weaving illegally, which could result in a decline in the quality and reputation of Gringsing Bali weaving. Increasing skills and knowledge influence the sustainability of gringsing weaving. This is supported by the results of research from (Seminary et al., 2019), which states that training in developing pegingsingan cloth production in Tenganan Village, Manggis District, Karangasem Regency has had a positive impact on the community because it has gained a lot of knowledge in developing woven fabric production through design diversification, business management so that it can improve management in the fields of marketing, production and finance, increase competitiveness in the market, and of course increase the weavers’ income.

A table can be used to see further the sensitivity analysis results regarding the most likely scenarios and what opportunities exist between implementation and non-implementation. The data is presented in Table 1. A recapitulation of each scenario shows that the scenario of increasing craftsmen’s skills and knowledge is the scenario that has the highest overall chance, namely 0.605 or 60.5%.

Table 1. Recapitulation of Opportunities for Each Scenario
Table 2 presents a combination of scenarios for weavers increasing production between realized (with code "1" at the end) and unrealized (code "0" at the end). Stratigea et al. (2010) and Stratigea and Papadopoulou (2013) have also used this presentation technique.

### Table 2. Comparison of Educational Realization

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Table 2. Comparison of Educational Realization
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Based on Table 2, the odds between realizing an increase in skills and knowledge (0.605) versus not realizing it (0.395) are greater if it is realized. This shows the importance of increasing skills and knowledge in weaving because gringsing weaving has high cultural value. It also has an economic value, which is no less important for the local community’s income.

**Discussion**

There are five scenarios (in the SMIC-Prob data input called hypotheses) identified for the sustainability of the gringsing weaving industry, namely: (1) continuing to produce as usual, (2) apart from producing, also opening other businesses such as opening a shop, fashion (commercial), (3) increasing production, (4) apart from producing, also opening other businesses outside the gringsing weaving industry such as Banten businesses, food stall businesses (side economy), and (5) increasing weaving skills and knowledge (education). Furthermore, from the five scenarios, the sustainability of gringsing weaving was largely determined by the educational scenario to improve the skills and knowledge of craftsmen. Based on Table 2, the odds between realizing an increase in skills and knowledge (0.605) versus not realizing it (0.395) are greater if it is realized. This shows the importance of increasing skills and knowledge in weaving because gringsing weaving has high cultural value. It also has an economic value, which is no less important for the local community’s income.

Education, in this case, plays an important role in maintaining cultural values while improving the skills and knowledge of craftsmen. This will help artisans develop, innovate, and continue their cultural traditions while ensuring that their work remains relevant and can compete in an increasingly global marketplace. This aligns with Nahak’s research results, which state that efforts to maintain and preserve Indonesian culture can be done in two ways. That is cultural experience and cultural knowledge. Nahak further explained that various efforts can be made to preserve local culture, including Raising awareness about the importance of culture as a national identity. Take part in preserving culture by participating in its preservation and implementation, studying it, and socializing it with other people so that they are interested in protecting or preserving it and even defending it. (Nahak, 2019).

In line with character education theory, which emphasizes the importance of teaching values such as integrity, hard work, perseverance, and responsibility (August 2021). In the context of Gringsing Weaving, improving skills and knowledge can also be linked to developing character values. For example, efforts to improve weaving skills reflect craftsmen’s hard work and perseverance. Character education also includes respect for local wisdom and cultural heritage. Gringsing weaving is a valuable cultural heritage, and efforts to improve the skills and knowledge of craftsmen can help maintain and respect this tradition. Character education is not only about theory but also about practice. Increasing the skills and knowledge of craftsmen in the Gringsing Weaving production process can also teach values such as collaboration, innovation, and a sense of responsibility. Character education theory emphasizes balancing academic, moral, and skills (Muchtar & Suryani, 2019). In the context of Gringsing Weaving, character education can integrate moral aspects (respect for cultural heritage) and skills (development of weaving techniques) to achieve sustainability. Character education often emphasizes the importance of educating the younger generation. In the context of Gringsing Weaving, education can provide opportunities for the younger generation to understand and inherit this tradition, maintaining the industry’s sustainability so that comprehensive character education is needed from home to community. (August, 2021).

<table>
<thead>
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<th>No.</th>
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<th>Educational Opportunities = 1</th>
<th>No.</th>
<th>Scenario Combination</th>
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<td>Total</td>
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</table>
knowledge of craftsmen in the context of Gringsing Weaving can be done through skills education with the application of character education. This can be done by teaching cultural heritage. Craftsmen must understand and respect the cultural values, history, and meaning of Gringsing weaving. This involves a deep understanding of the traditional processes, motif symbolism, and stories behind the Gringsing Tenun cloth. Technical Skills Development: apart from respect for culture, craftsmen must also continue developing their technical skills in weaving. Structured and ongoing training can help them improve weaving techniques, become familiar with the materials and tools used, and master efficient production processes. Development of Character Values: during the training process, it is important to integrate the development of character values into learning. These include hard work, perseverance, integrity, and a sense of responsibility. For example, craftsmen can be taught to appreciate the hard work and dedication required in running the Gringsing Weaving industry. Collaboration and Innovation: Character education also includes the development of values such as collaboration and innovation. Craftsmen must be taught to work together to create new designs, develop better techniques, and create innovative products. Collaboration with fellow craftsmen or designers can broaden your horizons and help market your products. Responsibility for Sustainability: One important aspect of character education is a sense of responsibility for sustainability. Craftsmen must understand the importance of maintaining environmental sustainability and sustainable practices in the Gringsing Weaving industry. This can include the use of environmentally friendly materials and responsible production practices. Young Generation Education, character education must also include the education of the younger generation in the family and school environment. The younger generation must be allowed to learn about Gringsing Weaving, its cultural values, and the technical skills required. This can create the next generation who cares about cultural heritage and has the skills to continue the gringsing weaving industry.

4. CONCLUSION

The research results concluded that the sustainability of gringsing weaving is largely determined by educational scenarios to improve the skills and knowledge of craftsmen. Training programs and instilling character values as support for gringsing weaving craftsmen need to be improved to maintain the sustainability and development of gringsing weaving. The government can also support research and training related to gringsing weaving techniques and design innovation so that this tradition remains relevant to modern market tastes without losing its essence. Character education emphasizes the importance of achieving a balance between academic, moral, and skills aspects; implementing character education that integrates respect for culture, skills development, and the formation of strong character values, craftsmen in the Gringsing Weaving industry can improve their ability to maintain industrial sustainability while respecting cultural heritage and innovating in production. This also helps ensure the industry remains relevant and competes in an increasingly global marketplace.

REFERENCES


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