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INNOVATIVE FOOD SYSTEM RISK MANAGEMENT OF THE BADUY TRIBE

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Abstract: This study aimed to identify and analyze the food system risk management of the Baduy Tribe and its managerial implications for food security. The scope of this study was limited to the huma rice food system. The research method utilized was the ethnographic study to obtain primary data. The data were analyzed using the ISO 31000 risk management process approach. Based on this study's results, the creative and innovative determination in Baduy Tribe did not lead to the modernization of technology but referred to a facilitated way of life in achieving goals. The risks associated with the development of science and technology, as well as its dependence on nature, were in the high category for the Baduy's indigenous ban (pikukuh) did not accept the use of technology and formal education. The risks associated with food availability and post-harvest food access were in the low category due to the risk management process implemented by the Baduy Tribe hereditarily through the leuit storage system. The findings on an innovative food system risk management of the Baduy Tribe is expected to provide a managerial perspective on the food system to achieve national food security.

Keywords: Baduy Tribe, ethnographic study, food security, food system, risk management

Abstrak: *Penelitian ini bertujuan mengidentifikasi dan menganalisis manajemen risiko pada sistem masyarakat Suku Baduy serta implikasinya terhadap manajerial ketahanan pangan. Ruang lingkup penelitian ini terbatas pada sistem pangan padi huma. Metode penelitian berupa studi etnografi untuk memperoleh data primer. Data dianalisis menggunakan pendekatan proses manajemen risiko ISO 31000. Berdasarkan hasil penelitian, determinasi kreatif dan inovatif di lingkungan masyarakat adat Suku Baduy tidak mengarah pada modernisasi kecanggihan teknologi, namun merujuk pada cara hidup yang dipermudah dalam mencapai tujuan. Risiko-risiko yang berhubungan dengan perkembangan ilmu pengetahuan dan teknologi (IPTEK) serta ketergantungannya pada alam berada pada kategori tinggi karena dalam pikukuh suku Baduy tidak menerima adanya penggunaan teknologi serta pendidikan formal. Risiko-risiko yang berhubungan dengan ketersediaan pangan dan akses pangan pasca panen berada dalam kategori rendah dikarenakan adanya proses manajemen risiko yang telah dilakukan masyarakat Suku Baduy secara turun temurun melalui sistem penyimpanan padi huma di leuit. Temuan-temuan manajemen risiko inovatif pada Suku Baduy diharapkan dapat memberikan perspektif pada manajerial sistem pangan guna mencapai ketahanan pangan Nasional.*

Kata kunci: *Suku Baduy, studi etnografi, ketahanan pangan, sistem pangan, manajemen risiko*

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INTRODUCTION

Food is one of the primary human needs that must be met for the sake of survival. Food security is an all-time access that everyone has in obtaining nutritious, safe, and sufficient foods in terms of quality, quantity, and diversity for an active and healthy life (FAO, 1996). The three main aspects of food security, according to the FAO, consist of (1) food availability; (2) food access; and (3) food utilization. Food security is defined as the ability to have a sufficient amount of food for basic needs (FAO, 1996). Food access is the ability to have economic and physical resources to gain nutritious foods. Meanwhile, food utilization is defined as the ability to utilize foods appropriately and proportionally. Besides, FAO stated that the stability of the three components must be maintained in a long period of time.

According to FAO (2003), there are five stages in the food system, namely (1) preparing for the planting; (2) planting food crops; (3) harvesting; (4) processing, selling, or storing foods; (5) preparing and consuming the foods. The Indonesian food system can not be separated from the agricultural system adopted by certain tribes (Khomsan and Wigna, 2009). Baduy is one of the tribes in Indonesia that makes agriculture as its source of livelihood. Baduy Tribe lives in Kanekes Village, Leuwidamar Subdistrict, Lebak District, Banten Province. The agricultural system adopted by the Baduy is huma agriculture (Satriadi, 2015). Huma is farming lands in the form of paddy and second crop fields that are abandoned after harvested, with the cultivator moves from one land to another in the next farming season by opening a new field or recultivating the long-abandoned field (Rosidi, 2000). In terms of farming systems, the Baduy upholds an indigenous ban (pikukuh) of not altering the land contour of the field. Therefore, its way of farming is simple by planting the rice with a sharpened bamboo (tugal) in a non-irrigated field (relying solely on the rain) so that the harvest produced is only once a year (Suryani, 2014).

The rice harvest conducted only once a year causes a variety of risks that are closely related to the food security of the Baduy as the deepest tribe. Zazili (2019) revealed that the control over the food system could be done in the form of risk-management-system-based supervision. Risk in ISO 31000 is defined as the effect of uncertainty on the target, which can result in losses. Risk can be handled well if there is clarity that is specific, measurable, affordable, and predictable in time of occurrence. Risk management is in place to manage risks so that optimal results are achievable. Based on the prevailing international standard in ISO 31000, risk management processes typically use an Enterprise Risk Management (ERM) approach. ERM is a structured approach in managing the uncertainty related to threats; or a series of human activities consisting of risk assessment, strategy development to manage the risks, and risk mitigation by using resource empowerment/ management. Wadu et al. (2019) revealed that a risk management strategy in the agricultural sector before the emergence of risk aims to minimize the variability of the reception.

As the deepest tribe in Banten Province, the Baduy has a local wisdom that lies in its view on the universe, simplicity, and tolerance on the surrounding environment (Pham, 2014). This study aimed to identify and analyze the food system risk management of the Baduy Tribe and its managerial implications for national food security. The novelties of this study were the identification of risk management undertaken by the Baduy in managing its food system and its managerial implications for food security. This study focused on the Outer Baduy and huma food system, which is the uniqueness and farming duty of the Baduy.

METHODS

The data used in this research were primary and secondary data. Primary data were collected from the results of an ethnographic study carried out in the Baduy's village, while secondary data were obtained from the relevant literature. Kamarusdiana (2019) conveyed that an ethnographic study is conducted by profoundly analyzing the culture of the studied communities. The ethnographer is directly involved in everyday life as a form of field observation and data collection (Son, 1987). The analysis in the ethnographic study is not only based on the researchers' interpretation, but also from the understanding of the community members' way of thinking (Windiani and Nurul Farida, 2016).

In this study, the Baduy's culture that was closely related to the food system management was analyzed comprehensively using an ethnographic approach. Spradley (1997) saw ethnography as a methodology to describe a culture either implicitly or explicitly expressed through words in the form of a simple

comment or long interview. In the view of Spradley (1997), the ethnographic study does not run linearly, but in the form of a research cycle, consisting of (1) selecting ethnographic location; (2) asking questions; (3) collecting data; (4) recording data; (5) analyzing data; and (6) writing the ethnographic report.

The Baduy's village was selected as the ethnographic location because the Baduy is one of the tribes that makes agriculture as a source of livelihood. In addition, its location that was not far from the capital, as the center of technological advances, is on the contrary to the Baduy's pikukuh that refused technology. Therefore, the Baduy's culture in managing its food system was interesting to be studied further. The questions posed in the process of asking questions were in the form of explicit objective questions, explanations, and ethnographic questions. The data were collected through observation, interviews, and staying with the Baduy. The interviews were conducted on three sources of experts consisting of Pu'un, three farmers and huma leuit owners, and two rice pounders who were the housewives of Outer Baduy. The study was carried out on 7-8 March 2020 by staying at the Outer Baduy's place. The data were recorded in the form of photographs, videos, audio recordings, as well as field notes to facilitate the ethnographic analysis. The data were analyzed simultaneously using domain analysis, taxonomy analysis, componential analysis, and cultural theme analysis. The domain analysis was used to obtain a general overview. Taxonomy analysis functioned to describe the selected domain in more detail so that its internal structure was identified. The componential analysis was used to deepen the data, while cultural theme analysis was utilized in making conclusions. The analyzed data were then written as an ethnographic report of the Baduy's food system culture.

The identification and risk management analysis of the Baduy's food system harnessed the risk management process based on ISO 31000. The collected data were utilized as inputs in the risk assessment process. The risk assessment process began with risk identification on each activity going on in the food system. The impact and probability of occurrence of the identified risks were analyzed and evaluated. The level of risk was determined and mapped into a risk map. The acceptable risks need to be communicated and informed. However, the unacceptable risks need supervision and monitoring in designing treatment strategies for risks and formulating managerial implications, as listed in Figure 1.

Risk Identification Stage

The risk identification process, according to ISO 31000, is the process of finding, identifying, and providing an overview of the risk. Risk identification process based on the five food systems activity targets (FAO, 2003) includes: Preparing for the planting; Planting food crops; Harvesting; Processing, selling or storing food; Preparing and consuming foods.

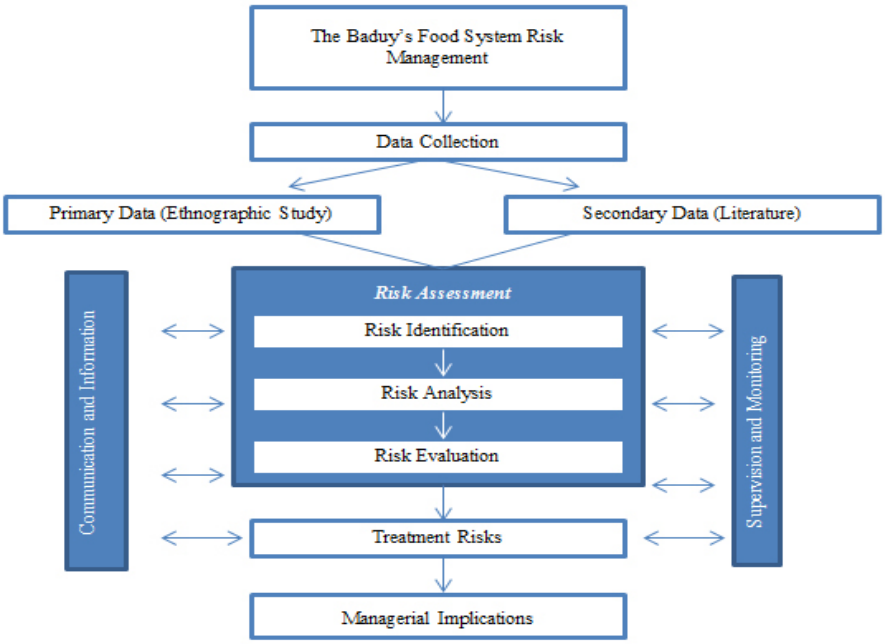

Figure 1. ISO 31000's risk management process (COSO, 2004)

In addition to identifying the risk overview emerging on the food system activity targets, the identification process was also directed to identify the cause of the risk either controlled or not, the impact area, as well as the potential impacts that may arise when the risk events occur. According to Zuhriyah and Amalia (2012), the sources of risks in farming activities are categorized as follows: Climate change and weather, Attack of pests, High input prices, Low output prices, Limited availability of capital, Low mastery of technology, Lack of farmers' managerial ability. The risk variables examined in Table 1.

Risk Analysis Stage

The risk analysis process is a continued stage of the risk identification process. It was carried out by mapping the risks identified in the risk map by considering the probability of occurrence and the impact of the risks. Wiryani et al. (2013) classified the risk based on the number of risk events within one year. Table 2 shows the categories of probability and impact of the risks.

Table 1. Risk variables

Activity	Risk variables
Preparing for the planting	Landslide
	Wild-grassed huma
	Not using technology
	Hereditary land management
Planting food crops	Drought
	Affected by pests
	Affected by plant diseases
	Conventional and hereditary way of planting
Harvesting	Crop failure
	Difficulty in post-harvest transport
	Conventional harvesting
Processing, selling or storing foods	Damaged food storage
	Perishable
	Fire in food storage
	Stolen
	Low selling prices
	Food crisis
	Uneven food distribution
	Conventional food processing
Preparing and consuming foods	Nutritional needs were not fulfilled
	Imbalanced nutrition
	Lack of knowledge about the nutritional needs

Table 2. Categories of probability and impact of the risks

Categories of risk probability			
Scale	Probability	Indicators of risk probability	
		Frequency of event	Percentage of activity
3	Often (high)	>12 times per year	>30% of total activity
2	Sometimes (moderate)	2-12 times per year	5%-30% of the total activity
1	Rarely (low)	<2 times per year	<5% of the total activity
Categories of risk impact			
Scale	Impact	Indicators of risk impact	
3	High	Lost almost all its food	
2	Moderate	Lost an amount of food	
1	Low	No visible loss of food	

Godfrey (1996) stated that the risk is the product of the risk's probability of occurrence with its impact. The results of the risk value obtained were plotted on a risk map that is divided into three categories, namely: 1) High category. The category of unacceptable risk for risks having a value between 6 and 9. The risks in this category were classified into risks that should be mitigated to reduce the occurrence of the risks. They are the major risks that had a significant impact on the Baduy's food system, so that they should receive the main priority treatment. The red color on the risk map characterized them; 2) Moderate category. The category of undesirable risk for risks having a value between 3 and 5. The risks in this category were classified into risks to watch out for. The yellow color on the risk map characterized them; 3) Low category. The category of acceptable risk for the risks having a value between 1 and 2. The risks in this category were classified into risks that were still acceptable, even became obstacles for the Baduy's food system. The green color on the risk map characterized them.

Risk Evaluation Stage

Risk evaluation is the continued stage of the risk analysis process. The risk analysis results were then evaluated by determining which risks that need further treatment or included in the next 'Risk Treatment' process. The determination of risk resulting from the evaluation is done by comparing the results of risk analysis with risk criteria (Priyarsono et al. 2017).

Risk Treatment Stage

According to ISO 31000, risk treatment is a process to modify risks, especially in terms of lowering exposure to risk. According to Priyarsono et al. (2017), risk treatment may include several activities as follows: Reject or avoid the risk by avoiding the causes of risk; Lower or mitigate the risk by performing certain activities to improve the effectiveness of risk control, both for lowering the exposure to risk impact and probability; Share or transfer the risk by sharing the risk exposure with others; Accept the risk by not doing any particular treatment on the risk because the risk exposure had been in line with the organization's risk appetite. Thus, only the necessary monitoring of the movement or change in risk exposure was required.

RESULTS

General Overview

Baduy Tribe is one of the tribes in Indonesia that still keep the traditions, customs, and culture of the ancestors amidst the increasingly modern technology era. The Baduy's population amounted to 11 620 people consisting of 3 495 families (KK) (Kanekes Village Statistics, 2015). The main job of the Baduy was farming with a field system known as 'ngahuma' (Ichwandi and Shinohara, 2007; Jamaludin, 2012; Suparmini et al. 2013; Iskandar and Iskandar, 2017). Ngahuma for the Baduy was considered as a duty in the belief of Sunda Wiwitan (Alexander and Alexander, 2017). The agricultural areas of the Baduy were really limited. According to the calculation of the Baduy's ulayat land area, a total of 5 100 hectares, there were only 274 hectares of agricultural area, while the rest were indigenous forests (Dachlan et al. 2019).

There were several Baduy's custom rules (pikukuh), closely related to the food system. For example, not cultivating the rice fields (can only use huma/field system), not selling the rice produced from ngahuma, not using synthetic and inorganic pesticides and fertilizers, and others. The Baduy primarily used huma rice for various ceremonies, celebration events, and daily consumption. Huma rice produced from fields was taboo for sale. Iskandar (2017) stated that the Baduy had an ecological wisdom to store huma rice in the granaries known as 'leuit'. It was a local institution that took care of the public economy, including food, to develop a discourse and construction of social cooperation that were useful in strengthening the national food security system, especially in terms of rice provision from domestic production (Martius, 2015).

The Baduy stored their huma rice in the leuit, located separately from their residential area, specifically under the lush trees of the village forest area (dukuh lembur) that was still exposed to sufficient sunlight, but sheltered from the rain in the rainy season. There were three types of Baduy's leuit, namely leuit lenggang, leuit mandiri, and leuit karumbung. Each Baduy family generally had at least one leuit (Iskandar and Iskandar, 2017).

The rice grains stored in leuit were in the form of rice bunches (pocongan pare) that were dried under the sun. The procedure of storing the rice bunches followed the hereditary tradition. The new leuit floor that had not been filled with the rice bunches should be covered by teureup leaves (Ficus elastica Roxb) and patat leaves (Phrynium pubinerve BI) to maintain the room temperature of the leuit. The rice storing technique on the first layer was using a tajur pinang technique in which the rice was stored by arranging them diagonally. Then proceed with the gilir naga technique on the second and the next layers. The piles of rice were stored in a clockwise direction to maintain the air circulation in the leuit, so that the humidity was stable. The rice bunches stored in the leuit could last a long time.

The creative and innovative determination of the Baduy did not lead to the modernization of technological sophistication, but rather referred to facilitated ways of life in achieving goals. In attaining food security, many risks arose as the effects of the occurring uncertainty. The Baduy had innovative ways of managing risks, which were reflected in the pikukuh that must be obeyed.

Risk Identification

Based on the analysis of the five food systems activities, according to FAO (2003), which include (1) prepare the planting; (2) planting food crops; (3) harvesting; (4) processing, selling or storing foods; and (5) preparing and consuming foods, there were 22 risks in the Baduy's food system Baduy. Besides, the causes, impact areas, and the potential impacts due to such risks were identified as listed in Table 3.

Table 3. The risk identification of the Baduy's food system

Activity target	Risk	Cause	Impact area	Potential impact(s)
Preparing for the planting	Landslide	The land was located on a mountain/hill slope	Food availability	Land for planting was not available
	Wild-grassed huma	Huma was abandoned in a long time	Food availability	Stunted crop growth
	Not using technology	Indigenous ban	Food availability	Non-optimal productivity
	Hereditary land management	Close-minded to the development of science and technology	Knowledge of food systems	Static and undeveloped knowledge
Planting food crops	Drought	No rain	Food availability	Decreasing yields and crop failures threat
	Affected by pests	Not using pesticide	Food availability	Decreasing yields
	Affected by plant diseases	Lack of fertilizers	Food availability	Decreasing yields
	Conventional and hereditary way of planting	Close-minded to the development of science and technology	Knowledge of food systems	Undeveloped knowledge
Harvesting	Crop failure	Disaster and drought	Food availability	Foods were not available
	Difficulty in post-harvest transport	The road access was only a footpath	Food access	Uneven food access
	Conventional harvesting	Ban of using technology	Food availability	Non-optimal productivity
Processing, selling or storing foods	Damaged food storage	Post-harvest food received less favorable treatment	Food availability	Foods were not available
	Perishable	Temperature and humidity were not according to standards	Food availability	Foods were damaged
	Fire in food storage	Human negligence	Food availability	Foods were not available
	Stolen	Lack of supervision	Food access	Foods moved to another hand

Table 3. The risk identification of the Baduy's food system (continuance)

Activity target	Risk	Cause	Impact area	Potential impact(s)
	Low selling prices	The great harvest	Food availability	Low farmer's profits
	Food crisis	No food stocks	Food availability	Foods were not available
	Uneven food distribution	Limited food access	Food access	Not everyone has access to foods
	Conventional food processing	No processing technology	Food utilization and consumption	Limited food utilization
Preparing and consuming foods	Nutritional needs were not fulfilled	Lack of animal-based nutrition sources	Food utilization and consumption	Malnutrition
	Imbalanced nutrition	The lack of animal-based food sources	Utilization and consumption of food	Malnutrition
	Lack of knowledge about the nutritional needs	No formal education	Knowledge of food systems	Static knowledge

Risk analysis

The risk assessment was carried out on the 22 risks identified in the risk identification process. The risks were assessed using a scale of 1-3 for each category of probability and impact. Hence, the risk values, the multiplication results from probability and impact, could be obtained. The risk assessment results of the Baduy's food system are listed in Table 4. Each risk value was mapped into a risk map. The risk map was a 3×3 matrix with the probability scale on the vertical axis and the impact scale on the horizontal axis. It is depicted in Figure 2. Based on Figure 2, the risks in the high category with high probability and impact covered the risk of not using technology (A3), hereditary land management (A4), drought (B1), conventional and hereditary way of planting (B4), conventional harvesting (C3), nutritional needs were not fulfilled (E1), and imbalanced nutrition (E2). The risks in the high category with high probability and moderate impact included the risk of difficulty in post-harvest transport (C2), conventional food processing (D8), as well as lack of knowledge about the nutritional needs (E3). Meanwhile, the risks in high category with moderate probability but high impact included the risk of the landslide (A1), damaged food storage (A2), and fire in food storage (D3).

The risks related to the development of science and technology were in the high category. So were the risks associated with the dependence on nature. These were because the Baduy's pikukuh did not allow the use of technology and formal education. These led to the Baduy's mindset that was limited to hereditary ways, not adjusting to the external developments that have rapidly changed. The Baduy's high dependence on natural conditions triggered a high risk when the natural phenomena changed and were no longer predictable as they used to be in the days of their ancestors. For example, the change of seasons was currently uncertain. The rain could happen in the dry season or vice versa. However, the ban on using tractors and hoes in the preparation of farming, and the ban on planting the paddy in the rice field system, could indeed reduce the risk of landslide. Other than that, the risk of post-harvest transport was in a high category given the Baduy's environmental condition was located in the foothills that were difficult to access by vehicles so that the post-harvest transport only relied on the conventional way of hand-carrying. This could cause work accidents during the post-harvest transport process.

The risks associated with the storage area were also in the high category as the leuit was made of wood with a kiray-leaves roof that was fragile, flammable, and easily damaged. Although based on the study, the Baduy could mitigate this risk by separating the leuit from the residential village, so that if there was a fire in the village, the leuit could still be saved. In addition, the roof was replaced periodically by the Baduy so that the quality of the huma rice stored there could be maintained and was not damaged. The risks related to food processing and nutritional needs were also in the high category. These were because the Baduy had limited knowledge of food processing and balanced nutrition fulfillment. Huma rice was processed by grinding it using a large mortar that became the grinding place for one village. The Baduy used a firewood-fueled furnace (hawu) as their cooking facility.

Table 4. The risk analysis/assessment of the Baduy's food system

Code	Risk	Scale		Risk value
		Probability	Impact	
A. Preparing for the planting				
A1	Landslide	2	3	6
A2	Wild-grassed huma	3	1	3
A3	Not using technology	3	3	9
A4	Hereditary land management	3	3	9
B. Planting food crops				
B1	Drought	3	3	9
B2	Affected by pests	2	2	4
B3	Affected by plant diseases	2	2	4
B4	Conventional and hereditary way of planting	3	3	9
C. Harvesting				
C1	Crop failure	1	3	3
C2	Difficulty in post-harvest transport	3	2	6
C3	Conventional harvesting	3	2	6
D. Processing, selling or storing foods				
D1	Damaged food storage	2	3	6
D2	Perishable	1	2	2
D3	Fire in food storage	2	3	6
D4	Stolen	1	2	2
D5	Low selling prices	2	2	4
D6	Food crisis	1	3	3
D7	Uneven food distribution	1	2	2
D8	Conventional food processing	3	2	6
E. Preparing and processing foods				
E1	Nutritional needs were not fulfilled	3	3	9
E2	Imbalanced nutrition	3	3	9
E3	Lack of knowledge about the nutritional needs	3	2	6

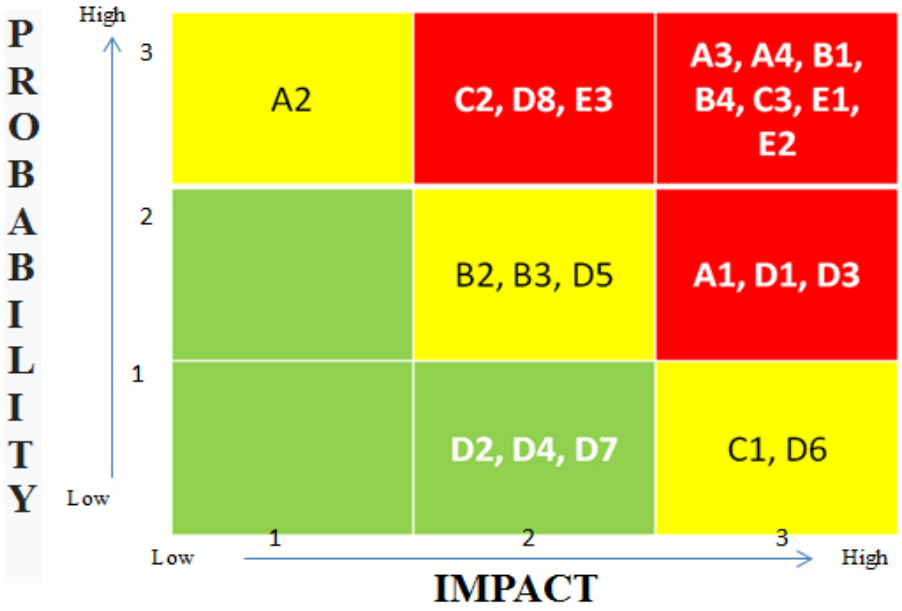

Figure 2. Risk map of the Baduy's food system

The risk in the moderate category with high probability but low impact covered the risk of wild-grassed huma. The risks in the moderate category with moderate probability and impact included the risk of affected by pests (B2), affected by plant diseases (B3), and low selling prices (D5). The risks within the moderate category with low probability but high impact included the risk of crop failure (C1) and food crisis (D6). These risks were categorized moderate because the probability of risk occurrence on the Baduy was low to moderate despite the high impact. This categorization happened because the Baduy's custom rules indirectly mitigated the risks. The risk of affected by pests and plant diseases could be resolved through the ceremonies performed by the Baduy, starting from before to during the planting. The risks in the low category with low probability and moderate impact covered the risk of perishable (D2), stolen (D4), and uneven food distribution (D7). They were in the low category because the leuit became the symbol of the Baduy's food security. It proved that the Baduy had a prevalent food stock so that the risk probability of theft and uneven food distribution was very small.

Risk Evaluation

The risk analysis results mapped into the risk map were evaluated based on each category. The risks in the high category (red) should be given priority handling. The risks in the moderate category (yellow) were in the alert category. They need monitoring and supervision so that the risks would not rise to the high category. In addition, the risks in the low category (green) were acceptable risks. They need only be communicated and informed. The risk evaluation results of the Baduy's food system were presented in Table 5.

Risk Treatment

Risk treatment is the continuance of the risk evaluation. Risk treatment in this study included mitigating the risk, avoiding the risk, transferring the risk, and accepting the risk that was adjusted to the Baduy's risk criteria. The details of the risk treatment formulated based on the risk evaluation are shared in Table 6.

Table 5. Risk evaluation of the Baduy's food system

Code	Risk	Impact area	Risk category level	Level code
A3	Not using technology	Food availability	High	3.3
A4	Hereditary land management	Knowledge of food systems	High	3.3
B1	Drought	Food availability	High	3.3
B4	Conventional and hereditary way of planting	Knowledge of food systems	High	3.3
C3	Conventional harvesting	Food availability	High	3.3
E1	Nutritional needs were not fulfilled	Utilization and consumption of food	High	3.3
E2	Imbalanced nutritional	Utilization and consumption of food	High	3.3
C2	Difficulty in post-harvest transport	Food access	High	3.2
D8	Conventional food processing	Utilization and consumption of food	High	3.2
E3	Lack of knowledge about the nutritional needs	Knowledge of food systems	High	3.2
A1	Landslide	Food availability	High	2.3
D1	Damaged food storage	Food availability	High	2.3
D3	Fire in food storage	Food availability	High	2.3
A2	Wild-grassed huma	Food availability	Moderate	3.1
B2	Affected by pests	Food availability	Moderate	2.2
B3	Affected by plant disease	Food availability	Moderate	2.2
D5	Low selling price	Food availability	Moderate	2.2
C1	Crop failure	Food availability	Moderate	1.3
D6	Food crisis	Food availability	Moderate	1.3
D2	Perishable	Food availability	Low	1.2
D4	Stolen	Food access	Low	1.2
D7	Uneven food distribution	Food access	Low	1.2

Table 6 Risk treatment of the Baduy's food system

Code	Risk	Risk level	Treatment
A3	Not using technology	High	Mitigate the risk
A4	Hereditary land management	High	Mitigate the risk
B1	Drought	High	Mitigate the risk
B4	Conventional and hereditary way of planting	High	Mitigate the risk
C3	Conventional harvesting	High	Mitigate the risk
E1	Nutritional needs were not fulfilled	High	Mitigate the risk
E2	Imbalanced nutritional	High	Mitigate the risk
C2	Difficulty in post-harvest transport	High	Mitigate the risk
D8	Conventional food processing	High	Mitigate the risk
E3	Lack of knowledge about the nutritional needs	High	Mitigate the risk
A1	Landslide	High	Mitigate the risk
D1	Damaged food storage	High	Mitigate the risk
D3	Fire in food storage	High	Mitigate the risk
A2	Wild-grassed huma	Moderate	Avoid the risk
B2	Affected by pests	Moderate	Avoid the risk
B3	Affected by plant disease	Moderate	Avoid the risk
D5	Low selling price	Moderate	Transfer the risk
C1	Crop failure	Moderate	Transfer the risk
D6	Food crisis	Moderate	Transfer the risk
D2	Perishable	Low	Accept the risk
D4	Stolen	Low	Accept the risk
D7	Uneven food distribution	Low	Accept the risk

The risks in the high category were the main priority that should be handled through risk mitigation. Risks related to knowledge and technology could be mitigated by gradually changing the Baduy's mindset on the development of science and technology. The risks in the moderate category with avoidable causes could be treated by avoiding the causes of the risks. Meanwhile, the risks in the moderate category with low probability but high impact could be treated by transferring the risk. The risks in the low category were acceptable as they became the advantages of the Baduy in food system risk management.

Food system risk analysis generated the Baduy's creative and innovative thinking without leaving the long-uphold pikukuh as their daily life guidelines. Schumpeter (1947) suggested that the theoretical definition of invention and innovation needs to go into the details of the modus operandi in everyday economic life. One of the broad definitions of the invention can be found in the creative response concept. The first of the three essential properties for creative economic activity is the uncertainty.

The Baduy, especially the outer ones, faced uncertainty as identified from the risks encountered. Still, life must go on, so that the creative process was born in the food security system. This process ran starting from land management faced with uncertain weather. There were times when the drought struck the rainy season, and continuous rain hit the dry season. These had an impact on cropping patterns, pests, rice setting in the leuit, and even landslide and fire. Such situations required new thinking that was by planting food-based alternating-crops like tubers and natural medicinal plants around the main crops. Several alternative roads were made through the addition of umpagan on the road to minimize the landslide and risk of accidents. Some of the activities carried out seem common to happen in other societies in the past. However, the creative process experienced by the Baduy faced uncertainty, but they still adhered to their pikukuh.

According to Schumpeter (1912), technological change has three phases, each of which creates a sufficient condition for economic development, namely: The invention (The creation of new ideas that are systematically converted into technology); The innovation (The commercialization of the ideas

found to be a marketable product); The diffusion (The dissemination of new ways of getting things done through the various layers of production). Schumpeter (1947) added that innovation is achieved only with the first commercial transaction involving a new product, process, system, or device. It was part of the economic system.

Baduy's economic system was alive, rotating, and developed through innovations. In the state of holding their strong pikukuh, they could still live amidst the currently growing risks. The currently undertaken innovation referred to the commercialization or tradable transactions. Food, as the primary commodity produced, previously was only used for subsistence consumption. Currently, it could be sold and converted into other needs, such as the Baduy's clothing materials. Plantation products, either fruit like durian, mangosteen, duku, and petai, tubers, or nuts, were now could help the Baduy's economy. Other additional income came from the creation of crafts like keychains, scarves, Baduy-typical woven fabrics, and temporary houses.

The Baduy's creative and innovative process in facing various uncertain risks indeed did not use technology like the general public. However, that could protect their ancestors' heritage and local wisdom known as pikukuh. The Baduy's life went on with their typical creativity and innovation.

Managerial Implications

Based on this study, the Baduy had sufficiently strong food security. It could be seen from the three risks concerning food availability and food access that had low risk-values, namely the risk of perishable, stolen, and uneven food distribution. The Baduy used to store rice for a long time and sustainably using leuit system that was governed by the prevailing pikukuh. This fact could provide a perspective for the food security system management.

The leuit that was located separately from the residential village could mitigate the risk of fire there. Therefore, the Baduy's food would be safe even though there was a fire in the village. This practice can be applied in Bulog warehouse that should be located away from the residential place to minimize the risk of fire in the warehouse. The warehouse's temperature stability also must be considered to maintain food quality. Besides, the variety of non-rice foods was also widely cultivated using the intercropping system with huma rice cultivated on the field (traditional agroforestry system). In terms of food access, the staple food was distributed evenly as the Baduy growing huma rice and owned a leuit. Those were the duties contained in the pikukuh of the Baduy as the followers of Sunda Wiwitan. Then, in terms of food utilization/consumption, plant-based nutritional needs had been fulfilled, but the animal-based nutritional needs could not be fulfilled if the Baduy family had no enough money.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Amidst the increasingly modern technology era, the Baduy still kept their ancestral traditions, customs, and culture that rejected the development of science and technology. Based on the results of this study, there were twenty-two risks identified in the Baduy's five food system activities. Four risks were identified in preparing the planting activity, four in planting crops activity, three in harvesting activity, eight in processing, selling or storing food activity, and three in preparing and consuming food activity. Based on the distribution on the risk map, there were thirteen risks in the high category, six in the moderate category, and three in the low category.

The risks associated with the development of science and technology and its dependence on nature were in the high category because the Baduy's pikukuh did not allow the use of technology and formal education. Meanwhile, the risks related to post-harvest food availability were in a low category due to the Baduy's hereditary risk management through leuit system. Leuit was the symbol of the Baduy's food security, as well as their creative way of managing risk. The separate location of the leuit to the residential village was the Baduy's way to mitigate the risk of fire in the leuit. The findings of the Baduy's risk management practices were expected to provide a managerial perspective on the food system to achieve national food security. The Baduy's creative and innovative determination did not lead to the modernization of technological sophistication. Instead, it referred to the eased ways of life that make it easier to achieve goals through food system risk management.

Recommendations

The object of this study was limited to the Outer Baduy because this study was conducted in Kawalu month in which people other than the Inner Baduy were not permitted to enter the Inner Baduy's residential village. For further research, it is recommended to carry out the study on the Inner Baduy to obtain a comprehensive risk management. For the Baduy, the results of this study can be utilized as additional knowledge as the natural situation currently has been changing so that the necessary discussions with the visitors or other researchers in addressing food system management without having to leave the pikukuh. The travel agents to Baduy need to pay attention to the capacity of visiting the Baduy's residentials so that their everyday life and structure are not distracted. For visitors and the general public, it is advisable to be able to understand and preserve the Baduy's residentials. Furthermore, the results of this study concerning food system risk management that separates the food storage area and the residential can be an inspiration for the national food system management.

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