Existences and perception of javanese local knowledge for climate change adaptation

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Abstract. Farmer perception of their environment is a factor of climate change. Adaptation to climate change requires farmers to realize that the climate has been changed and they must identify useful adaptations and implement them. This study analyzed the adaptation of climate change among rural farmers using local knowledge and knowing the existence of it. Local knowledge was examined by descriptive qualitative. The results showed that Pranata Mangsa crop calendar was used by Javanese society for a long time ago, where, practiced by the indigenous people through their different beliefs, culture, and traditions. Pranata Mangsa comes from two words, Pranata which means rule and Mangsa which means season or time, where, divided into four (4) seasons: Katiga (dry season), Labuh (dry to rainy season), Rendheng (rainy season), and Mareng (rainy to dry season), which each season has natural signs for warning system and move to next season. In addition, the results showed that the Javanese societies said Pranata Mangsa is still relevant (31.71%), need to re-evaluate (22%), not relevant (13.3%), and not answered (33%).

1. Introduction

Rural areas are defined as regions where half or more of the adult population is active in agriculture [1]. People who live in rural areas are known as rural residents, and the majority of them are farmers. In their physical and biological context, rural farmers are understood to be in direct contact with natural elements. All physiographic components, such as inorganic soil components, natural forces such as wind, radiation, and gravity, insects, parasites, wild plants, and animals, compose up the physical environment. Farmers in rural areas are directly exposed to these factors, which have an impact on their lives in some way. In psychology and cognitive science, Perception is the process of becoming aware of or interpreting sensory information. Receiving, collecting, and the act of taking ownership of the mind or senses are all examples of perception. The interaction between past cultural experiences and the interpretations given to the perceived results in what is felt. What is perceived cannot be called to be felt if it is not supported by any of the above-mentioned bases for perception. Humans perceive their surroundings based on how they react to them. He reacts to ensure his comfort and future based on how he perceives and understands the surroundings. Humans place such a high value on their safety that they do not want their social, physical, or biological relationships to be harmed easily. Man is likely to react in the same way, depending on how he observes and interprets climate change.

Climate change is the term used to describe changes in the climate over periods ranging from decades to hundreds [2]. They go on to explain that both natural and human-caused changes are to fault. It is now obvious that human survival is in great danger as a result of its actions. This problem
has become a major source of concern for everyone in the world since it has spread like a pandemic, bringing everyone and everything at hazard. Yadav et al. [3] Despite great recorded and calculated improvements in agricultural technology and the accumulated richness of agricultural knowledge and systems, some believe that agricultural production is still weather and climate-dependent. Agriculture is being impacted by climate change. Crop and livestock growth and performance are affected by climatic conditions in the topsoil and the environment in which they are raised [4]. Macrofauna and microfauna are not ignored. Food production is in the hands of rural farmers, who make up the majority of our farmers. They are in control of the natural resources that are essential to their livelihood and existence. This means that climatic influences have a direct impact on them and their work. Although climate change is a global phenomenon, those living in rural areas in the tropics will face a greater risk [5]. They are in control of the natural resources that are essential to their livelihood and existence. This means that climatic influences have a direct impact on them and their work. This study aims to find out if the local wisdom of "Pranata Mangsa" exists and what farmers think about it as a climate change adaptation strategy.

2. Methodology and data analysis

The study was carried out in the Indonesian region of Central Java, where the majority of people work in the farming production. The research will be conducted from November 2020 through March 2021. The farmers in this area plant rice and Palawija or arable crops such as peanut, maize, and soybean. The people here are mostly farmers and they farm on a small scale. This study used a multistage sampling method. A total of 396 farmers were randomly chosen from each area in Central Java for the study.

Because most of the farmers had little formal education, data was collected from them utilizing a structured interview schedule. Of the 396 copies of the structured interview schedule and questionnaires were sent. The data collected will be analyzed descriptive statistics such as calculating the frequency, percentage and mean obtained from a four-point Likert-type scale as follows: 4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree. On a Likert scale, affirmative questions are asked, such as whether the afternoons are hotter? Where responses are scored according to their perceptions and the mean boundary score is derived by adding the rating to the top (4 + 3 + 2 + 1 = 10) and dividing the sum by 4 to provide 2.5 as the mean score limit. For each statement, the total score divided by the number of respondents, for example, a statement such as "warmer days are experienced these days" might have a very agreeable response (f = 65); agree (f = 26); disagree (f = 28) and strongly disagree (f = 12). Now it will be 65 x 4 = 260, 26 x 3 = 78, 28 x 2 = 56 and 12 x 1 = 12. Then 260 + 78 + 56 + 12 = 406.The sum is divided by the total f so, 406/131 = 3.09. The mean score in this case is 3.09, which is higher than the cut-off mean score of 2.50. The ranking is determined by the average score, with '1' being the highest average score. A linear regression model was used to test the hypotheses. The hypothesis suggests that respondents’ socioeconomic features, such as gender, agricultural land area, formal education, and farming experience, have no effect on farmers’ opinions of climate change, but it is hoped that these variables will affect their judgments.

The following is the model's implicit form for regression analysis:

Y = f (X1, X2, X3, X4, U)  \[ (1) \]

Where:
Y =perception (total Likert’s type scale of each respondent)
X1 =gender (male = 1, female = 0)
X2 = education (number of years of schooling)
X3 = farming experience (years)
X4 = farm size (ha) U = error term
3. Results and discussions

3.1. Respondent characteristics in the study site

From Table 1 it can be seen that most of the farmers (71.46%) were males, while 28.54% were females. This is due to the fact that man has had a significant impact on the agricultural sector, such as the strategy and opinion for cultivating, which includes time, method, and crop kind. The majority of the farmers (63.88 percent) were between the ages of 41 and 60. The responders were 45 years old on average. This means that the majority of them are adults who are active, and that the young are not actively participating in farming.

The majority of the farmers (34.09%) had only a primary education, while 27.78% had a secondary education, 25.25% had a postsecondary degree, and 4.55% had a university education. This indicates that the majority of the responders have received some type of formal education. This is predicted to have an impact on their views on climate change. Some farmers (22.98%) had 26-30 years of farming experience, with 16.67% having 21-25 years, 18.18% having more than 16-20 years, 18.94% having 11-15 years, and 9.09% having 1-5 years. The average number of years of farming experience was over 15 years. This suggests that the majority of them have extensive farming expertise and have had extensive interactions with the climate as it relates to their farming activities. Given this, they have a thorough understanding of meteorological elements as they relate to their farming activities, as well as current technology and local knowledge. Household heads' education raised the likelihood of a greater understanding of climate change. The household heads' level of education influenced their views on climate change.

Table 1. Respondent farmers characteristics in Central Java (n = 396).

| Variable                             | Percentage | Mean |
|--------------------------------------|------------|------|
| Gender                               |            |      |
| Male                                 | 71.46      |      |
| Female                               | 28.53      |      |
| Age (years)                          |            |      |
| 20-30                                | 6.57       |      |
| 31-40                                | 10.86      |      |
| 41-50                                | 31.31      | 16.67|
| 51-60                                | 32.58      |      |
| 61-70                                | 14.65      |      |
| >70                                  | 4.04       |      |
| Educational attainment               |            |      |
| No formal education                  | 8.33       |      |
| Primary Education                    | 34.09      |      |
| Secondary education                  | 27.78      | 20.00|
| Tertiary education                   | 25.25      |      |
| University                           | 4.55       |      |
| Farming experiences (years)          |            |      |
| 1 to 5                               | 9.09       |      |
| 6 to 10                              | 14.14      |      |
| 11 to 15                             | 18.94      | 16.67|
| 16 to 20                             | 18.18      |      |
| 21 to 25                             | 16.67      |      |
| 26 to 30                             | 22.98      |      |
3.2. Perception of farmers in climate change phenomenon

Table 2 shows that farmers noticed hotter afternoons, a later start to the wet season, a longer dry season, and an increase in drought events. This means that the wet season will be shorter and the temperature will rise. According to the findings, 73.98% of farmers believe the climate has altered in the last ten years. This discovery is consistent with several of Indonesia’s drought occurrences, such as decreasing precipitation in west and east Java over the last 60 years [6], farmers have seen a decrease in precipitation and a temperature change over time [7], [8]. Intensified agriculture, population growth, chemical fertilizer use, deforestation, soil deterioration and erosion, increased fossil fuel usage, and the loss of local cultural knowledge practices were all seen as drivers of climate change by the farmers. To increase climate resilience, adaptation measures such as knowing local knowledge in the area of farmers and agricultural patterns in the land are required.

| Perception                          | Mean | Rank |
|-------------------------------------|------|------|
| Hotter afternoon                    | 3.35 | 1    |
| Longer dry season                   | 3.28 | 3    |
| Increasing incidence of drought     | 2.99 | 4    |
| Delay in onset of the wet season    | 3.3  | 2    |

3.3. Pranata Mangsa as Javanese local knowledge

The Pranata Mangsa crop calendar is divided into four primary Mangsa: Mangsa Ketiga (88 days), Mangsa Labuh (95 days), Mangsa rendheng (94 days), and Mangsa mareng (88 days). The primary Mangsa are in turn divided into secondary Mangsa: kasa (22 June–2 August: 41 days), karo (2–25 August: 23 days), and katelu (25 August–18 September: 24 days) in Mangsa Ketiga; kapat (18 September–13 October: 25 days), kalima (13 October–9 November: 27 days), and kanem (9 November–22 December: 43 days) in Mangsa Labuh; kapitu (22 December–3 February: 43 days), kawolu (3 February–1 March: 26 days), and kasanga (1 March–26 March: 25 days) in Mangsa rendheng; and kadhasa (26 March–19 April: 24 days), dhesta (19 April–12 May: 23 days), and sadha (12 May–22 June: 41 days) in Mangsa Mareng (Figure 1).

The Pranata Mangsa crop calendar has indicators for determining the beginning and end of Mangsa, or seasons [9]. Titik or natural signs have been observed by Javanese society for a long time and are used as the signs of transitional Mangsa or seasons in Pranata Mangsa. Although there is a specific timing of the Mangsa, natural signs are still used by the older farmers, who modify their behavior accordingly in some areas. As an example of the use of natural signs, when the leaves of the Gadung or Asiatic bitter yam (Dioscorea hispida Dennst.) have opened, the rainy season is considered imminent.

Pranata Mangsa incorporates both primary and secondary crops in the farming system. Paddy, which is cultivated as the primary crop, is planted in Mangsa kalima (14 October–9 November) and harvested in Mangsa dhesta (19 April–11 May). The growing period is very long at up to 6 months for one crop, and there is only one harvest during the whole year. It is due to Pranata Mangsa that local varieties of rice, called Kopo, Ketan hideung, and Marahmay, are still planted and grow to heights of 145–177 cm (Rohaeni & Hastini, 2015). Maize, soybean, and peanut are cultivated as the secondary crops, or Palawija, using mixed cropping to mitigate the risk of drought damage. The growing period for the secondary crop cuts across Mangsa, from the end of the dry season to the earlier rainy season (25 August–13 October; 49 days). A single year’s crop rotation in Pranata Mangsa (starting from 22 June) can be described as follows:

Bero–Palawija–Paddy

Bero means fallow and in this Mangsa no crops are cultivated in the field [10]. Bero is used in Pranata Mangsa during the period from Mangsa kasa to karo (22 May–24 August; 64 days). Pranata Mangsa dictates that the farmer burns the rice straw after harvesting.
3.4. Existences of Pranata Mangsa as adaptation strategies of climate change

Adaptation, according to the IPCC, is a "process of adjustment to existing or predicted climate and its effects." Adaptation in human systems is to minimize damage while maximizing benefits." [11]. Medium- to long-term changes are required for adaptation in socio-ecological systems. Coping skills, on the other hand, are short-term efforts made by households to reduce the negative effects of climate variability on their livelihoods over a period of time typically less than a year [12]. It is necessary to adapt to existing climate change in addition to pursuing mitigation efforts to reduce the extent of warming.

As a result of their ability to address climate change at the grassroots level, indigenous peoples and their local knowledge have received more attention [13]. On the other hand, indigenous peoples have their own concept of local knowledge, which shows the complexity of their cultural knowledge systems. In essence, they represent local knowledge as a "way of life"; rather than simply knowing how to live, they are concerned with actually living life. This study presents Javanese local knowledge, namely Pranata Mangsa, for managing agricultural activities that encompass crop pattern, type, and ceremony. The results showed that the farmers knowing about Pranata Mangsa (87.62%) within 22.72% of farmers still use it, currently. Even, farmers are knowing but do not use it (26.26%), hearing (21.71%), and not knowing (12.37%). In the modern era, the existence of Pranata mangsa as the big question for us, still relevant or not. According to Zaki et al. [6], Pranata ever Mangsa can be integrated and combined with scientific knowledge and modern technology, such as satellite database support for analyzing climate and crop patterns in Pranata Mangsa. In this study, the results showed that the Javanese societies said Pranata Mangsa is still relevant (31.71%), need to re-evaluate (22%), not relevant (13.3%), and not answered (33%). One of Pranata Mangsa need to re-evaluate is crop pattern, which has mostly farmer used Paddy – Paddy – Paddy (42.17%), Paddy – Paddy – Palawija (30.05%), Paddy – Palawija – Palawija (12.37%), and others (16%), currently.

Based on the previous, incorporating indigenous knowledge into climate change policy can lead to the creation of cost-effective, participative, and long-term mitigation and adaption policies. [14]. Integrating indigenous knowledge into the problem of climate change, on the other hand, must not come at the expense of modern/western scientific knowledge. Indigenous knowledge should work in tandem with global knowledge systems rather than competing with them.
4. Conclusion
Effective adaptation strategies to drought can be derived from a revaluation of *Pranata Mangsa*, which has been guided by farming activities. It is based on *Titen*, i.e., observations of the dry and rainy season, natural signs, and local resources. However, the application of strategies such as those derived from *Pranata Mangsa* is not straightforward. Future challenges include difficulty in predicting weather anomalies and changes in and the appearance of new natural signs, such as animal extinctions. Furthermore, *Pranata Mangsa* is unfamiliar to younger generations, and there are increasingly fewer people with this knowledge. Revaluation and a better understanding of *Pranata Mangsa* are important for researchers and government authorities, who can advocate its benefits to the general population, especially to farmers, to promote effective drought adaptation strategies, in the context of climate change mitigation.

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