Farmers' Motivation Towards Environmentally Friendly Farming: A Cluster Analysis of Sociodemographic Profiles

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Abstract. Various factors influence farmers in Ngawi Regency in their efforts to transition toward environmentally friendly agriculture. Sociodemographic characteristics are important and interesting indicators to study. By comprehending farmers' motivations through their sociodemographic profiles, policy design for sustainable agriculture can be more effectively aligned with farmers' potential. This study attempts to analyze the sociodemographic characteristics of farmers and their motivation to adopt environmentally friendly practices, including organic, conversion-based, or conventional methods. The sociodemographic variables examined include age, education, occupation, and farming status. Data was collected from 200 respondents in Ngawi Regency using ordinal and Likert scales. The primary analytical tool used was the Two-Step Cluster Analysis, which grouped farmers into three distinct clusters. Cluster 1 (50.5%) had moderate motivation (average score: 54.8) and education (9.0 years); Cluster 2 (20.0%) had the highest education level (11.4 years) but the lowest motivation (54.3); Cluster 3 (29.5%) showed the highest motivation (58.1) with moderate education (9.5 years). These results indicate that higher education does not always correlate with higher motivation. The findings offer critical insights into designing targeted sustainable agriculture policies based on farmers' profiles. These findings provide valuable implications for the formulation of sustainable agricultural development strategies tailored to farmer typologies.

1 Introduction

Sustainable agriculture is a global problem and a chance to change how food is grown, especially in agrarian countries like Indonesia. A key approach to achieving sustainability is

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to adopt environmentally friendly farming methods that prioritize resource conservation, optimize input efficiency, and ensure that farming is both ecologically and economically beneficial. In this system, farmers' motivation and traits are crucial, as they provide food safety and improve farmers' welfare. Conventional farming methods, which rely heavily on synthetic inputs, have been linked to biodiversity loss, soil degradation, and water pollution [1]. In this context, organic and conversion-based farming systems have emerged as strategic alternatives that preserve environmental quality and give economic benefits to farmers [2].

Ngawi Regency is one of the most extensive rice-producing areas in East Java Province, as well as. However, the adoption of environmentally friendly practices among farmers remains uneven. These conditions suggest that farmers' readiness and motivation vary significantly, influenced by their social background, economic conditions, and internal factors.

Some studies on farmers' sociodemographics have shown that several characteristics (such as age, education, employment status, and farming experience) affect farmers' interest in adopting sustainable agriculture practices [3]. Sapbamrer and Thammachai also conducted a comprehensive review examining sociodemographic (age, education), social (networking), and motivational factors influencing the adoption of organic farming [4]. This study aims to examine the motivation and characteristics of farmers in Ngawi Regency in promoting sustainable agricultural progress, particularly through organic and conversion-based rice farming. We categorized farmers based on age, education, farming status, motivation, and occupation. The results are expected to help policymakers design more effective, targeted, and practical strategies based on the profiles of farmers.

2 Research method

2.1 Research location

This study was conducted in Ngawi Regency, a central hub for rice production in East Java, Indonesia. The regency is well known for its crucial role in supplying rice to the region. The regency government has also made efforts to promote sustainable and environmentally friendly farming practices.

2.2 Sampling procedure and data collection

Respondents were randomly selected from farmers in 19 sub-districts that have implemented Sustainable, Environmentally Friendly Agriculture (Pertanian Ramah Lingkungan Berkelanjutan—PRLB). A total of 200 farmers participated in the survey. Structured questionnaires and interviews were used to gather primary data on farming practices, demographic characteristics, and attitudes toward environmentally friendly agriculture practices.

2.3 Analytical technique

The study employed the Two-Step Cluster method, a clustering technique designed to handle variables of different measurement scales—both continuous and categorical—and suitable for large datasets [5][6]. This method uses the Log-Likelihood distance for data types that are mixed and the Euclidean distance for data types that are numbers. The log-likelihood distance is based on three ideas: that the variables are independent, that categorical variables follow a multinomial distribution, and that numeric variables are normally distributed. Nevertheless, this method is considered robust to violations of these assumptions.

The clustering procedure consists of two stages: pre-clustering and final clustering. In the pre-clustering stage, cases are grouped based on dense regions in the attribute space. In the final stage, these pre-clusters are combined statistically to form the best clusters [7]. SPSS 25 was used to do cluster analysis.

3 Results and discussion

The clustering method was based on the farmers' age, education, farming system, secondary employment, participation in farmer groups, and desire to adopt environmentally friendly or organic methods. Farmer clusters were distinguished based on a definition obtained from diverse academic sources. Each cluster was defined by a distinct mix of sociodemographic attributes and the degree of motivation to implement environmentally sustainable agricultural practices.

In this study, the term "progressive farmer" refers to a group of farmers who show a significant awareness of the significance of sustainable agriculture and a strong motivation to implement it. These individuals typically possess extensive knowledge of new farming technologies and are open to adapting their farming practices to achieve better results. Progressive farmers generally are younger, more educated, and often already practicing or transitioning to organic farming. They are very motivated. This group also has numerous social connections. Since farming is their primary occupation, they are more receptive to change and could serve as agents of change in their communities and institutions. These characteristics align with prior research indicating that education and information accessibility are critical determinants in the adoption of sustainable agricultural innovations [8].

On the contrary, "traditional farmers" are more concerned about using new technologies and tend to stick to old-fashioned farming methods. They may not be open to change because they still employ farming methods that have been in use for a long time. The traditional cluster typically includes older farmers who aren't highly educated and still practice traditional methods. They also don't seem very motivated. The third cluster identified in this study comprises farmers who are more educated than the first two groups but less motivated. This cluster highlights a novel finding, indicating that higher education does not necessarily correlate with higher motivation.

Farmer segmentation revealed distinct groups based on different levels of engagement in both conventional and Sustainable, Environmentally Friendly Agriculture (Pertanian Ramah Lingkungan Berkelanjutan—PRLB), as well as motivation and demographic attributes [9]. Using the two-step cluster analysis on 200 respondents, the study identified three clusters: Cluster 1 consisted of 101 respondents (50.5%), Cluster 2 had 40 respondents (20.0%), and Cluster 3 included 59 respondents (29.5%). In proportion to the total data, each cluster represented 38.4%, 15.2%, and 22.4% of all respondents, respectively.

In terms of demographic profiles, the average age across clusters was relatively similar, ranging from 49.5 to 53.3 years. However, significant differences were observed in education and motivation scores. Cluster 2 had the highest average years of education (11.38 years) but the lowest motivation score (54.30). Meanwhile, Cluster 3 showed the highest motivation score (58.05) despite having only moderate education (9.52 years). Cluster 1 occupied the middle ground, with a motivation score of 54.82 and an education level of 9.06 years.

Overall, these findings suggest that education level does not consistently align with motivation, and each cluster has unique characteristics that can serve as a basis for developing targeted intervention strategies or development programs.

The empirical clustering results indicate that farmer clusters based on actual field characteristics do not entirely align with the previously established theoretical classifications. The theoretical approach assumes that progressive farmers are typically younger, highly

educated, and strongly motivated to implement environmentally friendly farming practices. Conversely, traditional farmers are expected to be older, less educated, and less motivated. However, the empirical findings reveal a more complex dynamic.

For instance, Cluster 2, which had the highest education level (±11.38 years), paradoxically showed the lowest motivation score (±54.30). This contradicts the general assumption that higher education is positively correlated with environmental motivation. All members of Cluster 2 were engaged in non-agricultural employment, which is likely a key factor behind their lower motivation levels. On the other hand, Cluster 3, which had the highest motivation score (±58.05), had a moderate education level (±9.52 years) and was not the youngest cluster. Table 1 presents a comparison of age, education, and motivation levels across the three clusters.

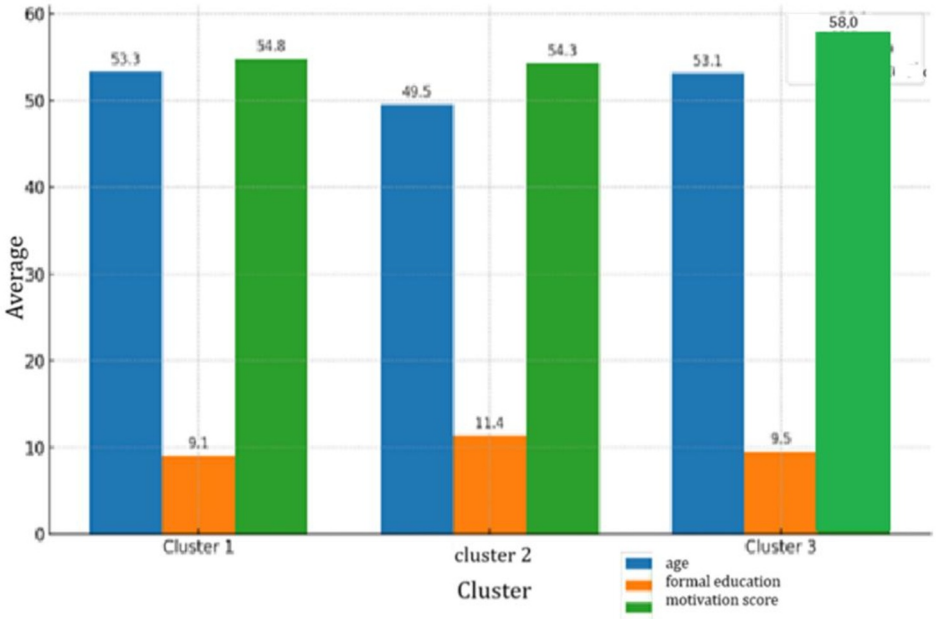

Fig. 1. Average profile diagram of each cluster

Table 1. Summary of each cluster's characteristics based on field empirical data

Cluster	Proportion (%)	Average Age (years)	Average Formal Education (years)	Motivation Score	Secondary Occupation	Interpretation of General Characteristics
1	50.5%	53.3	9.0	54.8	None (100%)	Middle-aged farmers, moderate motivation, predominantly conventional farming
2	20.0%	49.5	11.4	54.3	None (88.1%) Present (11.9%)	Highly educated but with the lowest motivation, likely influenced by external constraints
3	29.5%	53.2	9.5	58.1	Present (%100)	Highest motivation, strong potential as agents of change

The results in Figure 1 show that Cluster 1 is the biggest group, which is mostly made up of traditional farmers. Cluster 2 shows results that go against the first idea that higher

education levels always mean higher motivation. In contrast, [10] argued that younger farmers tend to have higher economic motivation and remain actively engaged within farmer communities. Cluster 3 is identified as an emerging group that can serve as agents of change in implementing environmentally friendly farming practices. The two-step cluster analysis conducted with SPSS yielded the identification of three clusters, each characterized by the following attributes.

These findings underscore the importance of adopting data-driven clustering approaches over relying solely on theoretical classifications. Intervention strategies must be tailored to the needs and strengths of each cluster. The theoretically defined "traditional" cluster does not appear explicitly in the empirical clustering results. Cluster 1, although the largest (50.5%), is comprised of relatively older farmers with moderate motivation, but their education levels are not necessarily low. This means that they don't completely fit the definition of a "traditional" group. It strengthens the idea that farmers in the field often have mixed traits, which makes it hard to put them into strict categories. This aligns with the findings of [11], which said that farmers with moderate motivation scores are more likely to be resistant to change or happy with the way things are now. Also, the fact that people in this group don't have much education might make them less willing to try new things, since people with more education tend to use information and communication technologies more in farming [12].

This study also shows that there is a Cluster 2, whose farmers have a lot of formal education but don't seem very interested in practicing organic farming. This suggests that increasing motivation for organic farming requires more than just higher education; strong underlying reasons must also support it. Highly educated farmers do not automatically possess the mental readiness or motivation to change; instead, a profit analysis and an understanding of the perceived benefits of organic rice are necessary to enhance motivation [13]. Additionally, it was found that all farmers in Cluster 2 had secondary occupations, which is suspected to be a contributing factor to their low motivation. This supports the findings of [14], who demonstrated that off-farm employment hurts the adoption of environmentally friendly agricultural techniques. Their research explained that farmers who rely primarily on non-agricultural income tend to treat farming as a secondary priority, thereby reducing their engagement with agricultural innovations due to divided attention, time, and energy.

Empirical data-based clustering provides more contextual and relevant insights than classical theoretical approaches. Cluster 3, which shows high motivation despite having a modest educational background, has strong potential as a primary target group for pilot programs and empowerment initiatives. This aligns with previous studies indicating that older farmers often possess greater resilience in facing disasters or climate change due to their substantial experience [15]. At the same time, Cluster 2 needs more study to find the psychosocial or structural barriers that keep them from being more motivated, even though they have more education. Therefore, intervention strategies aimed at promoting environmentally friendly farming must be designed more adaptively, considering the complex and often unpredictable realities faced by farmers on the ground.

4 Conclusion and recommendation

Field observations indicate that farmer clustering patterns are more intricate than the idealized categories imply, as most farmers are opposed to the "progressive" classification. The initial conceptual framework classified farmers into three groups based on ideal attributes; however, the empirical clustering results reveal more dynamic and nuanced patterns. For example, Cluster 2 has a lot of education but the least motivation, which suggests that both external factors (such as limited institutional support or farming risks) and

internal factors (like personal experiences) can have a significant impact on motivation. Conversely, the cluster exhibiting the highest motivation does not inherently possess the most advanced educational background. These results highlight the importance of participatory, needs-based methodologies in developing policy interventions. In general, this study provides valuable insights into developing cluster-based intervention plans that promote environmentally friendly and sustainable farming practices.

The empirical cluster analysis of 200 farmers revealed that sociodemographic factors, including education and age, were unsuitable in comprehensively elucidating farmers' motivation to embrace environmentally sustainable practices. A comparison of theoretical and empirical clusters shows that the relationships are more specific to the situation and more complicated. High motivation doesn't always mean higher education, and farmers with moderate education levels may be very enthusiastic about sustainable practices. These results underscore the need for adaptive, empirically based intervention strategies.

These findings suggest the need to develop farmer empowerment initiatives that encompass not only sociodemographic factors but also psychological and motivational aspects. A motivation-based framework, exemplified by Self-Determination Theory; which emphasizes autonomy, mastery, and purpose; can provide a foundation for more effective and human-centered policy interventions, as intrinsic motivation has a significant impact on farmers' adoption of sustainable practices. At the policy level, government programs should not use the same methods for all farmers. Instead, they should employ cluster-based strategies that account for the differences among farmers. In practice, extension services and farmer organizations are encouraged to complement technical training with motivational mechanisms, including peer learning, role models, and formal recognition, to strengthen farmer participation. From a research perspective, future studies should integrate behavioral and institutional dimensions—such as values, attitudes, and risk perceptions—to explain the persistence of low adoption rates among highly educated farmers and to inform the design of more comprehensive intervention models.

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