

# Promethee: Agricultural Extension Workers' Strategy to Strengthen Their Identity for Sustainable Food Production

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**Abstract.** This research aims to select the priority strategies for strengthening the identity of agricultural extension workers according to the perspective of agricultural extension workers. Data was collected through interviews with 20 agricultural extension workers in Magelang Regency and analyzed using Promethee decision-making analysis to obtain priority rankings for the selected strategies. The analysis results of the most appropriate strategic decision-making implemented by agricultural extension workers obtained the following order: 1) strengthening the motivation and role of agricultural extension workers, 2) Improving competence and digital literacy to be adaptive in the digital era, 3) Improving qualifications and competencies in agriculture, 4) Improving agricultural literacy skills of extension workers, 5) Being responsive and adaptive to all changes in the environment, 6) Strengthening interpersonal and group approaches with farmers, 7) Improving interpersonal communication competencies and 8) Building partnerships with agricultural stakeholders.

## 1 Introduction

The agricultural sector in Indonesia plays a key role in ensuring national food security. Data from the Central Bureau of Statistics shows that there has been a decrease in rice production for population food consumption by 480.04 thousand tons or 1.54% compared to rice production in 2023 [1]. The agricultural sector faces various structural challenges, ranging from limited land, declining interest of the younger generation in agriculture, to the low adoption of innovations at the farm level [2]. Therefore, the existence of agricultural extension workers as agents of change is crucial, especially in bridging government policies, research results, and field practices.

Agricultural extension officers have a strategic role in increasing sustainable food production to maintain national food security. They play a role in disseminating knowledge, providing training, and encouraging innovation in the agricultural sector [3]. The majority of

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farmers in Indonesia are elderly, so they only rely on extension workers as the primary source of information.

Based on Law No. 16/2006 on the Agricultural, Fisheries and Forestry Extension System, the duties and roles of agricultural extension workers cover various aspects of agricultural extension activities, including the preparation, implementation, evaluation, and development of extension services. Agricultural extension workers act as agents of change in farmer behaviour to help farmers improve their knowledge, skills, and attitudes in farming and facilitate the development of institutions and partnerships among main actors and business actors. In line with this, Presidential Regulation Number 35 of 2022 concerning Strengthening the Function of Agricultural Extension emphasises the importance of strengthening working relationships, institutions, and the capacity of agricultural extension workers and the use of information and communication technology in extension.

Agricultural extension workers often face various problems in supporting sustainable food production. Environmental, social, and economic changes of farmers in Magelang Regency are a challenge for agricultural extension workers. Agricultural problems in Magelang Regency include the conversion of agricultural land, the lack of farmer regeneration and the low level of farmers' income. Meanwhile, regarding extension workers, the challenges faced include limited resources, infrastructure, and farmers' readiness to accept innovations. Therefore, policy support and capacity building are necessary [4].

In this era of digitalisation, the digital transformation of the agricultural sector in Magelang Regency has not been entirely equitable. Many farmers and even some elderly extension workers do not have adequate skills or access to information and communication technology. On the other hand, there are 597 digital native millennial farmers in Magelang Regency, the highest number in Central Java Province [5]. This is undoubtedly a challenge for extension workers to keep up with the development of information technology, such as Artificial Intelligence (AI)-based communication. The existence of AI can affect or potentially replace the role of extension workers as an extension of the government. In the face of various changes that occur among farmers, strategies are needed to strengthen the identity of extension workers as reform agents and their role to support sustainable food production.

Various policies for agricultural extension workers are needed to support sustainable food production in this situation. To select the most appropriate policy scenario, a multi-criteria decision aid (MCDA) approach is relevant and necessary [6]. One MCDA method that is widely used to solve alternative evaluation and selection problems is the PROMETHEE (Preference Ranking Organisation Method for Enrichment Evaluation) method, which can accommodate multiple criteria simultaneously and rank the available alternatives objectively [7].

There has been a lot of research on ways to strengthen the role of agricultural extension workers, improve their competencies, and enhance their role in improving farmers' performance [8] [9], but not much research has examined the priority strategies chosen by agricultural extension workers based on their perspectives. This research aims to select the priority strategies for strengthening the identity of agricultural extension workers according to the perspective of agricultural extension workers in Magelang Regency. The results of this study are expected to contribute to strengthening the capacity of agricultural extension workers and formulating more dynamic and adaptive agricultural policies.

## 2 Method

This research employs a qualitative method using a case study approach in Magelang Regency, Central Java, Indonesia. The primary data used in this research were collected through in-depth and structured interviews. The data sources were 20 agricultural extension

informants, taken by purposive sampling. They consist of agricultural extension workers from the millennial generation, agricultural extension workers who own farming businesses, and agricultural extension workers who are elderly. The interviews were conducted twice. The first interview was conducted in depth to find out the efforts made by extension workers in dealing with environmental, social, economic, and technological issues. From the results of the first interview, the researcher reduced them to strategic scenarios that could be used by extension workers. In the second interview stage, extension workers had to rank the scenarios by considering suitability, convenience, availability of supporting infrastructure, efficiency, and impact [10]. The collected data were then analyzed using PROMETHEE II, an analysis using Visual PROMETHEE software.

### 3 Result and Discussion

The strategic scenario that was successfully compiled from the results of in-depth interviews with extension workers and members of the Agriculture and Food Service Office of Magelang Regency are:

- Strategy 1 : Being responsive and adaptive to all changes in the environment
- Strategy 2 : Improving competence and digital literacy to be adaptive in the digital era
- Strategy 3 : Improving interpersonal communication competencies
- Strategy 4 : Strengthening interpersonal and group approaches with farmers
- Strategy 5 : Improving qualifications and competencies in agriculture
- Strategy 6 : Build partnerships with agricultural stakeholders
- Strategy 7 : Strengthening the motivation and role of extension workers in realising better farming, better business, better living, better environment, and better community
- Strategy 8 : Improving agricultural literacy skills of extension workers

The eight alternative strategies above were then analysed using PROMETHEE II. The initial stage of the Promethee analysis was carried out by observing the preferences as shown in evaluation table of Table 1. This table compares strategies based on each criterion, provides preference values that indicate the superiority or weakness of a strategy compared to other strategies, and serves as the basis for calculating the preference flow (Phi+, Phi-, Phi) to rank the best strategies.

**Table 1.** Promethee flow: Preference values based on criteria

	Suitability	Convenience	Availability	Efficiency	Impact
Strategy 1	-0.5714	0.7143	-0.1429	-0.4286	-0.5714
Strategy 2	0.5714	0.7143	-0.1429	0.7143	0.5714
Strategy 3	-0.5714	-0,2857	-0.1429	-0.4286	-0.5714
Strategy 4	-0.5714	-0,2857	0.8571	-0.4286	-0.5714
Strategy 5	0.5714	-0,2857	-0.1429	0.7143	0.5714
Strategy 6	-0.5714	-1.000	-1.000	-0.4286	0.5714
Strategy 7	0.5714	0.7143	0.8571	0.7143	0.5714
Strategy 8	0.5714	-0,2857	-0.1429	-0.4286	-0.5714

Strategy 1 is mostly chosen due to its ease of implementation, but is less prioritised due to its lack of suitability and impact. Strategy 2 was selected for its efficiency and simplicity. Meanwhile, strategy 3 was less prioritized with all criteria having negative values, as it was considered less effective and did not contribute significantly to the expected impact. Strategy 4 was mainly selected and considered due to the availability of resources, but this strategy has shortcomings in other criteria. Strategy 5 was chosen because it was deemed effective and efficient in providing a significant impact, and in accordance with the current needs of extension workers. Strategy 6 displays a dominant negative value, meaning that this strategy is not highly prioritised due to difficulty in implementation and lack of resource availability. This contrasts with strategy 7, which most extension workers selected as a top priority due to its suitability to their needs, ease of implementation, availability of resources, efficiency, and significant impact. Strategy 8 was mainly chosen due to its suitability for the needs of the extension workers.

Then, observations were made by looking at the Net Flow (Phi), Leaving Flow (Phi+), and Entering Flow (Phi-) values listed in Table 2 to see the ranking of each strategy. The top rank is supposed to be prioritised immediately. The Net flow value reflects the outranking relationship based on the consideration of each strategy. Leaving Flow illustrates the superiority of a strategy preference, which is considered better than the others. Meanwhile, Entering Flow provides an overview of a strategy's weaknesses compared to the other strategies. The principle used in Promethee II analysis is that if a strategy has the highest net flow value among other alternatives, it is a priority to be selected.

**Table 2.** Promethee flow: The ranking of each strategy

	Strategy	Phi	Phi+	Phi-
Rank 1	Strategy 7	0.6857	0.6857	0.000
Rank 2	Strategy 2	0.4857	0.5429	0.0571
Rank 3	Strategy 5	0.2857	0.4286	0.1429
Rank 4	Strategy 8	-0.1714	0.1714	0.3429
Rank 5	Strategy 1	-0.2000	0.1714	0.3714
Rank 6	Strategy 4	-0.2000	0.2000	0.4000
Rank 7	Strategy 3	-0.4000	0.0571	0.4571
Rank 8	Strategy 6	-0.4857	0.1143	0.6000

The assessment is based on multi-criteria preferences, where a positive net flow value indicates a preferred or more effective strategy. The analysis found that the highest Net Flow (NF) value belongs to Strategy 7 with  $NF = 0.6857$ , while the lowest value belongs to Strategy 6 with  $NF = -0.4857$ .

**Strategy 7** is the most chosen by the extension workers, with a net flow value of 0.6857. This shows that extension workers consider strengthening their motivation and role as the most comprehensive solution to challenges in the agricultural sector. Strengthening the motivation and role of extension workers is crucial because they are strategic drivers of change at the farmer and community levels. Increased motivation is needed because it positively affects performance, perseverance, and productivity in every activity. Motivation can be enhanced by fulfilling the needs of extension workers (including basic needs, security, social/affiliation, appreciation, and self-realisation). Meanwhile, rewards can be given in some aspects, including wage increases, promotions, awards or recognition, peer acceptance, achievements, and incentives such as increased wages/salaries and benefits and promotions [11]. Motivation is not only a fundamental factor in improving performance because it functions as an internal driver that affects the intensity, direction and perseverance of individuals in carrying out tasks. Motivation is also a key element in determining the success of individual and organizational performance, in this case the Agriculture and Food Service Office.

**Strategy 2** is in second place with a net flow value of 0.4857. This shows the importance of extension workers mastering technology. The development of digital technology requires extension workers and farmers to adapt to technology to facilitate their work. Agricultural extension workers in the digitalisation era must improve digital literacy, master technology, adapt to online extension methods, and be able to collaborate and adjust materials to local needs. In this era, extension workers are required to master Information and Communication Technology (ICT), because ICT plays a dual role in agricultural extension, both as a tool for information dissemination and an instrument for farmer capacity building [12]. Agricultural extension workers' limited digital literacy skills will prevent them from using digital tools effectively [13]. Therefore, improving extension workers' competence and digital literacy is essential to remain relevant and effective in assisting farmers towards modern and sustainable agriculture.

Digital competencies support a more adaptive and participatory mentoring process through the use of digital media, thereby improving the quality of extension services and strengthening the capacity of farmers in facing the challenges of VUCA (Volatility, Uncertainty, Complexity, Ambiguity) in the agricultural era. For example, digital tools allow extension workers to update real-time data and provide quick recommendations for farmers, extension workers can utilize big data to predict the weather, and extension workers can also filter and simplify information through digital platforms, online education, and social media.

**Strategy 5** is in third place with a net flow value of 0.2857. Extension workers consider this strategy vital because they need to improve their technical quality to provide real solutions to farmers' problems. This is in line with the results of [14] that highly competent extension workers can effectively transfer knowledge, technology, and innovations to farmers, increasing the productivity, efficiency, and sustainability of their farming businesses. Agricultural extension workers in Magelang admitted that the current efforts to improve qualifications and competencies in agriculture are still lacking due to the low number of training activities conducted by the relevant agencies. They often had to search for extension materials and various efforts to solve agricultural problems through Google, YouTube, and relevant social media content, or discuss with other extension colleagues.

**Strategy 8** is in fourth place with a net flow value of -0.1714. Extension workers consider this strategy important because agricultural literacy can help farmers increase food production on increasingly narrow land. Research [15] shows that extension workers with good agricultural literacy can collect, process and deliver agricultural information accurately, so that farmers easily understand that. This increases the effectiveness of knowledge transfer, innovation adoption and problem-solving in the field. Therefore, capacity-building training for extension workers is required.

Meanwhile, **strategies 1 and 4** are in the same position with a net flow value of -0.2000. These two strategies are conceptually good and essential; however, for the extension workers, these strategies are considered less specific regarding technical mechanisms or implementation. In terms of implementation, these strategies face constraints of limited resource support and low operational costs. They are also considered less innovative than more technology-based strategies. Interpersonal and group approaches are conducted through field visits, group meetings, demonstration plots and other activities. However, the extension workers still expect training from the relevant agencies to support this strategy.

**Strategy 3**, with a net flow value analysis result of -0.4000, is less desirable to the extension workers. This strategy is essential but considered a general prerequisite, not a key strategy in developing sustainable food production. Agricultural extension workers have realised that it is necessary to improve interpersonal communication competencies. Systematic communication competencies will help extension workers build relationships with colleagues and stakeholders, promoting farmers' ability to solve their farming problems [15]. Communication skills are essential for agricultural extension workers to carry out their work effectively and help farmers adopt modern agricultural technology.

**Strategy 6** is in the lowest position, with a net flow value of -0.4857. This is due to the perception that partnerships do not always guarantee immediate results in the short term, and that partnerships are perceived to be difficult to implement or lack institutional infrastructure/support. Nevertheless, extension workers and farmers in Magelang Regency have always tried to build partnerships with various stakeholders. Farmers need to be actively involved in the planning, implementing, and evaluating partnership activities for optimal benefits, because through partnerships, farmers can receive training, new technologies, and agricultural innovations to increase the productivity and efficiency of their farms more easily.

## 4 Conclusion

The results of this study show that from the perspective of agricultural extension workers, strengthening the identity of extension workers is determined by three main things: work motivation, digital literacy competence, and technical competence in agriculture. This finding confirms that motivation is the main internal factor that encourages extension workers to carry out extension functions optimally, while digital literacy competencies and agricultural competencies strengthen the professional capacity of extension workers in accessing, managing, and disseminating adaptive and sustainable agricultural innovations. In practical terms, strengthening motivation through institutional support and an adequate reward system, accompanied by an increase in digital literacy and agricultural technical competencies oriented to field needs, will increase the effectiveness of extension in encouraging the adoption of sustainable agricultural practices. Thus, agricultural extension workers can play a strategic role in supporting food sustainability through increased productivity, resilience, and sustainability of agricultural systems.

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