Strategy for developing pearl millet (*Pennisetum glaucum*) as the local food of West Sulawesi, Indonesia

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Abstract. In Indonesia, West Sulawesi is one of the potential areas for the development of pearl millet, and it is potential local food which strengthens food security as a source of carbohydrates, anti-oxidant, and fiber. This research aims to analyze IFE and EFE, then SWOT analysis, in order to figure out the strategies to develop pearl millet (*Pennisetum glaucum*) farming. This research was conducted in West Sulawesi, Indonesia. This research results ten strategies are 1) plotting pearl millet as a potential superior local food of West Sulawesi with high fiber content and anti-oxidants, 2) building adequate infrastructure to facilitate the distribution of pearl millet marketing to potential markets, 3) maximizing the potential of land and the use of farming equipment to maximize production, 4) Ease of access to capital by activating microfinance institutions in rural areas, 5) Increasing the capacity of farmer human resources by strengthening institutions, counseling and training based on local resources, 6) Procurement of farming equipment to assist farmers in increasing production and productivity, 7) Introducing pearl millet to the market and consumers as a local Mandar food in order to substitute rice and other foods, 8) support of government in training of processing and diversifying pearl millet into industrial products, 9) the use of environmentally friendly agricultural technology and inputs in an effort to produce quality products, 10) Maintaining the pearl millet to continue to exist by continuing to support farmers with a variety of policies.

1. Introduction
Food development is intended to strengthen resilience at the micro as well as at the macro level. The micro-level is aimed at meeting food needs at the individual and household of society while at the macro level that is increasing security and ensuring the availability of food consumed by the public. In addition, according to the Food Security Council, 2009, it is also expected to be able to recognize, anticipate, and handle the problem of food insecurity in a country.

Pearl millet (*Pennisetum glaucum*) is a food commodity that has the potential to be developed in an effort to strengthen food security as a source of carbohydrates instead of rice and other health nutrition such as bioactive compounds, anti-oxidant, and fiber [1]. This plant can grow in various regions in Indonesia, including in West Sulawesi. Pearl millet planting areas in South Sulawesi are Enrekang, Sidrap, and Maros, while in West Sulawesi is in Polewali Mandar and Majene regions. Pearl millet has the advantage over other carbohydrate plants that can grow on almost all types of soil, including dry and less fertile soils, easy to cultivate, short plant life, and its various uses [2].
Pearl millet, as a food source, supports food security and anticipates the problem of hunger [2] and ranks sixth as the most important grain consumed by a third of the world's population. It grows well in high-temperature areas, limited water availability, without the application of fertilizers and other technological inputs, and in critical lands that are difficult to plant other grains such as wheat and rice [3]. A plant that contains fiber and high antioxidant content is energy sources [4], which has a chromosome number of 14 pairs [5,6].

Food plays a role in meeting the needs of human life as well as measuring the level of quality and intelligence of a nation's human resources. Thus, food security and independence become a joint task between the community and the country itself. Developed countries like the United States develop food security based on local products based on natural, human, technological, and local potentials that are consistently pursued continuously [7].

Building a country's food security is based on its superiority towards food independence. Therefore it is crucial to improve sectoral performance in the context of food security and job creation, as well as from the perspective of rural development [8]. Based on these directions and objectives, strategies are needed to reach the achievement of food security. Various efforts have been carried out, namely, to build an income-based economy and meet food for the poor and food-insecure groups through direct assistance so as not to deteriorate and empowerment so that they are able to realize their food security independently. The strategy is carried out through government alignments, conducive policies, and optimizing the role of related parties in handling the functions of market operations, buffering of stocks, distribution, stocks, exports, and imports [9].

2. Research methods
This research was conducted in West Sulawesi, Indonesia. Data were collected by investigating three groups of pearl millet farmers' who continuously plant pearl millet. Data were analyzed by descriptive analysis based on internal and external factors or identify SWOT where SWOT is an analysis method used to evaluate the “strengths, weaknesses, opportunities and threats involved in organization, plan, project or also in a personal business [10]. Then, data will be shown by using tables, diagrams, and graphics based on primary data [11].

3. Results and discussion

3.1. Internal factor evaluation (IFE)

| Score | Strengths                  | Score | Weaknesses                  |
|-------|----------------------------|-------|----------------------------|
| 0.432 | Potentially local food     | 0.251 | Cost of production          |
| 0.340 | Rich health nutrition; fiber and anti-oxidants | 0.239 | Capital for farming         |
| 0.350 | Land farming availability  | 0.220 | Post-harvest processing     |
| 0.340 | Alternative income         | 0.167 | Equipment for farming       |
| 0.168 | Short time production period | 0.076 | Human resources             |
| 0.103 | Resistant to climate       |       |                            |

**Figure 1.** Diagram of internal factors evaluation.
In the evaluation of the internal factors, it is how to identify the strengths and weaknesses of the internal, which influenced the development of pearl millet farming in West Sulawesi. In this research, we found the strength factors are potentially local food, rich in health nutrition; fiber and anti-oxidants [1], land farming availability, alternative income, short-time production period and resistant to climate while the weaknesses which are the cost of production, capital for farming, post-harvest processing, equipment for farming and human resources.

3.2. External factor evaluation strategy (EFE)

![External Factors Evaluation](image)

| Score | Opportunities                          | Score | Threats                              |
|-------|----------------------------------------|-------|-------------------------------------|
| 0.712 | Access to the market                   | 0.366 | Competition among food farming businesses |
| 0.447 | Infrastructure and communication network | 0.258 | Competition among other farming businesses |
| 0.330 | Supporting in the policy price         | 0.138 | Innovation and diversification other food |
| 0.232 | Supporting in farming equipment        |       |                                     |

**Figure 2.** Diagram of external factors evaluation.

External factors evaluation consists of opportunities and threats. This factor is from the external, which influenced the development of pearl millet farming in West Sulawesi. We identify some opportunities such as access to the market, infrastructure, and communication network, supporting in policy price, and supporting in farming equipment while the threats are competition among food farming business, competition among others farming businesses, innovation, and diversification of other foods.

3.3. SWOT (Strength, Weakness, Opportunity, Threat)

After analyzing internal and external factors in the IFE (Internal Factors Evaluation) and EFE (External Factors Evaluation) tables above, a SWOT analysis is used to determine how to optimize strengths and opportunities and minimize weaknesses and threats [10,12]. strategies then performed based on the SWOT analysis diagram below:

![SWOT quadrant of pearl millet](image)

**Figure 3.** SWOT quadrant of pearl millet.
The results from the IFE and EFE tables above can be seen that the resulting strategy is in quadrant I where the X-axis = the result of total strengths - total weaknesses (S - W) = 0.391 and the Y-axis = results of total opportunities - total threats (O - T) = 0.691. This is a very favorable situation. The pearl millet farming has opportunities and strengths so that it can take advantage of existing opportunities. The strategy that could be applied in this condition is to support an aggressive growth policy (growth-oriented strategy). This strategy recommends how to use strengths-opportunities (SO) strategy in implementing the existing opportunities with owned strengths [12]. This strategy applied for development is an aggressive growth strategy [13], including agricultural business.

Table 1. SWOT matrix for developing of pearl millet farming.

| Internal factors | External Factors |
|------------------|-----------------|
| **Strengths (S)** | **Weaknesses (W)** |
| 1. Potentially local food | 1. Cost of production |
| 2. Rich health nutrition; fiber and anti-oxidants | 2. Capital for farming |
| 3. Land farming availability | 3. Post-harvest processing |
| 4. Alternative income | 4. Equipment for farming |
| 5. Short production period | 5. Human resources |
| 6. Resistant to climate | |
| **Opportunities (O)** | **S – O Strategies** |
| 1. Access to the market | 1. plotting pearl millet as a potential superior local food of West Sulawesi with high fiber content and anti-oxidants |
| 2. Infrastructure and communication network | 2. Building adequate infrastructure to facilitate the distribution of pearl millet marketing to potential markets |
| 3. Supporting in the policy price | 3. Maximizing the potential of land and the use of farming equipment to maximize production |
| 4. Supporting in farming equipment | |
| **Threats (T)** | **S – T Strategies** |
| 1. Competition between food farming business | 1. Introducing pearl millet to the market and consumers as a local Mandar food in order to substitute rice and other foods |
| 2. Competition among other farming businesses | 2. Support of government in training of processing and diversifying pearl millet into industrial products |
| 3. Innovation and diversification other farmings | |

Based on table 1 above, several alternative strategies for the development of pearl millet farming can be formulated. The results of the formulation of the pearl millet farming development strategy referred to are as follows:

a. **S - O (Strength-Opportunity) strategy**
   - Plotting pearl millet as a potential superior local food of West Sulawesi with high fiber content and anti-oxidants
   - Building adequate infrastructure to facilitate the distribution of pearl millet marketing to potential markets
   - Maximizing the potential of land and the use of farming equipment to maximize production

b. **W-O (Weakness-Opportunity) strategy**
   - Ease of access to capital by activating microfinance institutions in rural areas
- Increasing the capacity of farmer human resources by strengthening institutions, counseling, and training based on local resources
- Procurement of farming equipment to assist farmers in increasing production and productivity

c. S-T (Strength-Threat) strategy
- Introducing pearl millet to the market and consumers as a local Mandar food in order to substitute rice and other foods
- Support of government in training of processing and diversifying pearl millet into industrial products

d. W-T (Weakness-Threat) strategy
- The use of environmentally friendly agricultural technology and inputs in an effort to produce quality products
- Maintaining the pearl millet to continue to exist by continuing to support farmers with a variety of policies

4. Conclusion
To sum-up, this research results in any strategy for developing pearl millet in West Sulawesi are:
- Plotting pearl millet as a potential superior local food of West Sulawesi with high fiber content and anti-oxidants. Building adequate infrastructure to facilitate the distribution of pearl millet marketing to potential markets. Maximizing the potential of land and the use of farming equipment to maximize production. Ease of access to capital by activating microfinance institutions in rural areas. Increasing the capacity of farmer human resources by strengthening institutions, counseling, and training based on local resources. Procurement of farming equipment to assist farmers in increasing production and productivity. Introducing pearl millet to the market and consumers as a local Mandar food in order to substitute rice and other foods. Support of government in training of processing and diversifying pearl millet into industrial products. The use of environmentally friendly agricultural technology and inputs in an effort to produce quality products. Maintaining the pearl millet to continue to exist by continuing to support farmers with a variety of policies.

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