Strategy for Developing the Organic Fertilizer Industry to Support Sustainable Agricultural Practices in Indonesia

Irshan Zainuddin[1], Ignatius Subagjo[2], Wenny Ayunisa[3], Noor Asfa Fuad[4], Murbantan Tandirerung[5], Sih Parmiyatni[6], Sri Mumpuni Handayani[7], Suharto Ngudiwaluyo[8]

{irsh001@brin.go.id[1], igna002@brin.go.id[2], wenn003@brin.go.id[3]}

Directorate of Environment, Maritime, Natural Resources, and Nuclear Policy, Deputy for Development Policy, National Research and Innovation Agency, Jl. M.H. Thamrin 8 Jakarta 10340 Indonesia[1,2,3,4,5,6,7,8]

Abstract. The Indonesian government is committed to implementing sustainable agriculture. One of the ways to implement sustainable agriculture is to implement an Organic Farming System. However, the level of consumption and availability of organic fertilizers in Indonesia is still very low. As we know, organic fertilizer is able to retain CO2 in the soil, so that it can reduce carbon emissions which cause climate change. For this reason, a strategy for developing the organic fertilizer industry is needed. In this study, the strategy was formulated using the method of SOAR (Strengths, Opportunities, Aspirations, Results) analysis and the QSPM (Quantitative Strategic Planning Matrix). It was found 3 (three) main strategies, namely: 1). Encouraging the involvement of research institutions, universities and industry in developing the organic fertilizer industry. 2). Encouraging farmer awareness to use organic fertilizers. 3). Conduct education, dissemination, and sosialization to officials and farmers about organic fertilizers. Furthermore, to realize these strategies, it is necessary to elaborate in more detail in operational policies and programs.

Keywords: Development strategy, organic fertilizer industry, sustainable agriculture, climate change.

1 Introduction

Indonesia is committed to implementing sustainable agriculture by issuing Law Number 22 of 2019 concerning Sustainable Agricultural Cultivation Systems. According to this law, a Sustainable Agricultural Cultivation System is the management of biological natural resources in producing agricultural commodities to meet human needs better and more sustainably by preserving the environment [1]. Sustainable Agricultural Cultivation Systems use facilities, infrastructure, procedures and technology that do not interfere with environmental functions, whether biologically, mechanically, geologically or chemically. This system emphasizes food production techniques that integrate and are compatible with local natural processes such as nutrient cycling, biological nitrogen fixation, soil regeneration, and natural enemies of pests.

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One of the ways to implement sustainable agriculture is to implement an organic farming system, that is an agricultural production system that makes organic materials as the main factor in the agricultural production process [2]. Synthetic fertilizers are only used to supplement natural inputs when necessary. Organic fertilizer can retain CO_2 in the soil. The greater the use of organic fertilizer, the greater the reduction in carbon emissions that cause climate change. Besides, the application of organic fertilizer is believed to be able to make land able to produce well and stable throughout the year with the productivity of arround 7 ton/hectare [3]. However, until now consumption of organic fertilizer in Indonesia is still very low compared to consumption of other types of fertilizer, which is only around 8% [4]. Complete data on consumption of fertilizer types in Indonesia for 2017 – 2022 can be seen in **Figure 1**.

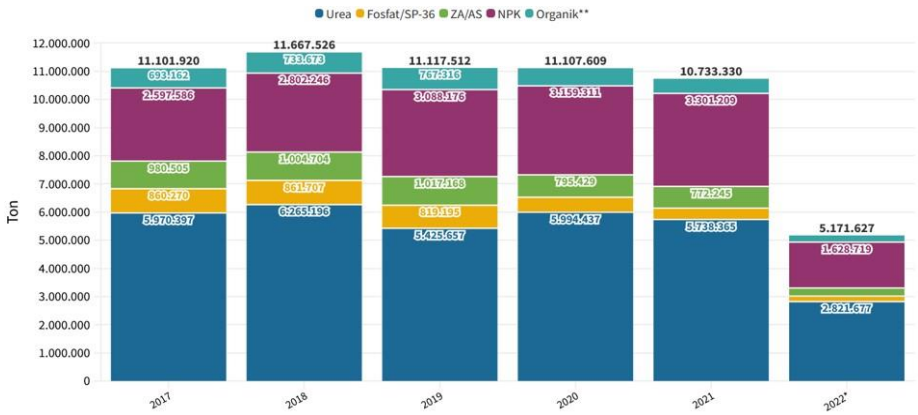

Fig. 1. Fertilizer consumption in Indonesia by type 2017-2022 (tons/year)

The cause of the low consumption of organic fertilizer in Indonesia is due to the lack of interest of farmers in using organic fertilizer and also due to the low production of organic fertilizer itself. The comparison of organic fertilizer production with inorganic fertilizer PT. Indonesian Fertilizer for 2017-2021 can be seen in **Figure 2** [5]. Therefore, appropriate strategies are needed to increase farmers' interest in using organic fertilizer and improve the organic fertilizer industry in Indonesia by referring to the strategic factors that influence it.

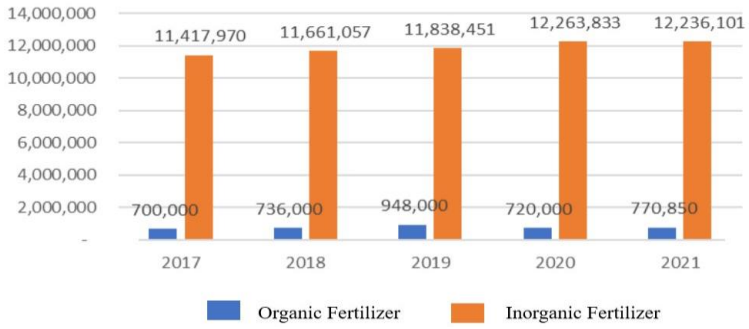

Fig. 2. PT. Indonesian fertilizer organic and inorganic fertilizer production 2017-2021

2 Research methods and results

The conceptual framework of this research can be described as follow:

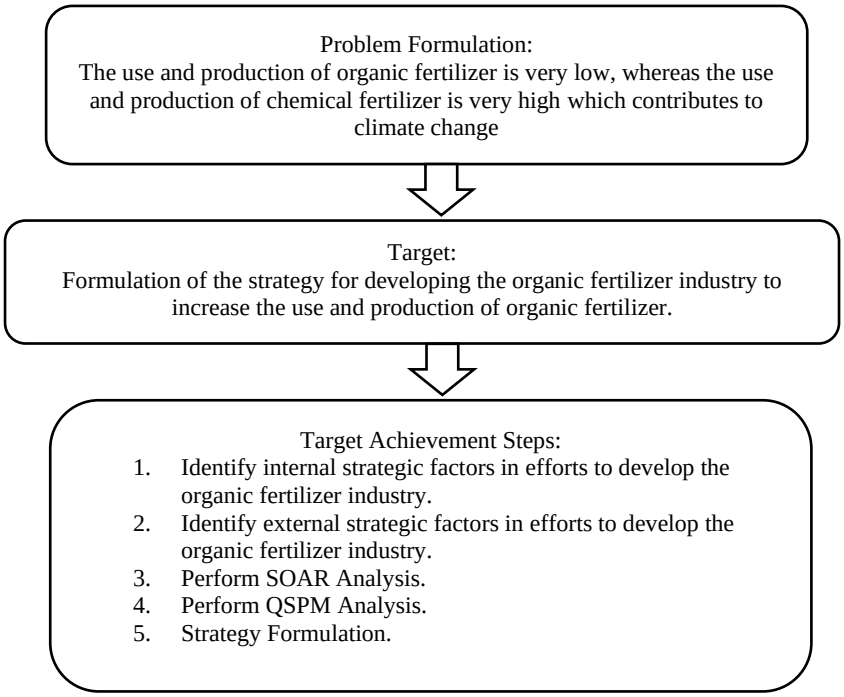

Fig. 3. The conceptual framework of the research

The method used in this research was a combination of literature study, SOAR (Strength, Opportunities, Aspirations, Results) analysis, QSPM (Quantitative Strategic Planning Matrix) analysis, surveys, and a series of discussions in Focus Group Discussions (FGD).

SOAR is a strategic planning tool that focuses on current strengths and future vision to develop strategic goals [6]. SOAR consists of four elements, namely: 1) Strengths (S), that are internal strengths and abilities which are able to support to achieve the goals. 2) Opportunities (O), that are part of the external environment that must be analyzed so that it is easy to understand what must be done so that they can be utilized. 3) Aspirations (A) that are the hopes, vision and mission of the internal environment that to be achieved. 4) Results (R), that are the results to be achieved in strategic planning in order to determine the extent to which the agreed goals have been achieved. Meanwhile, the QSPM is a method for evaluating strategic alternatives objectively based on internal and external factors to obtain a priority sequence of the strategic alternatives.

Based on the results of identifying the internal and external strategic factors, the alternative strategies for the Development of the Organic Fertilizer Industry in Indonesia were formulated using the SOAR Analysis Matrix as shown in Table 1.

Table 1. SOAR analysis matrix for the development of the organic fertilizer industry.

Future condition		Present condition	
Aspiration.	*Result*.	*Strength*.	*Opportunity*.
1) Fulfilling the need for organic fertilizer in Indonesia. 2) All stakeholders are involved in developing the organic fertilizer industry. 3) The use of organic fertilizer will encourage a sustainable agricultural system. 4) Development of the Organic Fertilizer Industry. 5) Encourage the increasement of organic food products. 6) Local sources of raw materials for making organic fertilizer are utilized. 7) The Ministry of Industry's support for strengthening the development of the organic fertilizer industry would be continued. 8) Education and dissemination regarding organic fertilizer among farmers is carried out continuously. 9) The role of local government in encouraging the use of organic fertilizer is running well.	1) The implementation of a sustainable agricultural system can be achieved. 2) A reduction in the contribution of greenhouse gas emissions from the agricultural sector of 0.32% in 2030 can be achieved. 3) Increase in the organic fertilizer industry within 5 years. 4) The issuance of a Ministry of Industry policy that supports strengthening the development of the organic fertilizer industry.	1) Law Number 22 of 2019 concerning Sustainable Agricultural Cultivation Systems. 2) Minister of Agriculture Decree No. 261/KPTS/ SR.310/M /4/2019 regarding technical requirements for organic fertilizers, biological fertilizers and soil amendments. 3) Decree of the Director General of Food Crops No. 70/HK.301/C/7/2018 concerning instructions for implementing Organic Fertilizer Processing Unit. 4) The potential of research institutions and universities to support the development of the organic fertilizer industry. 5) The potential of industry/small and medium enterprises that support organic fertilizer production. 6) The potential sources of organic fertilizer raw materials in Indonesia are very abundant.	1) Agricultural land in Indonesia generally lacks organic elements. 2) There is a government target to reduce CO_2 emissions. 3) The market opportunity for organic fertilizer is quite large. 4) The availability of inorganic fertilizers is decreasing due to limited raw materials. 5) Several inorganic fertilizer manufacturers have produced organic fertilizer. 6) There are potential number of MSMEs producing organic fertilizer.

S – A Strategy:	*S – R Strategy:*	*O – A Strategy:*	*O – R Strategy:*
1) Develop an organic fertilizer industry based on local raw materials in accordance with the required standards (S2, S5, S6, A1, A4, A5, A6). 2) Conduct education, dissemination and socialization to regional officials and farmers about organic fertilizer. (S1, S2, S3, S6, A4, A5, A6, A8, A9). 3) Encourage participation research institutions, universities, industry and stakeholders in developing the organic fertilizer industry by utilizing local raw materials to support sustainable agriculture. (S1, S2, S4, S5, S6, A2, A3, A4, A7, A8, A9).	1) Encourage synergy between research institutions, universities, industry, local governments and other stakeholders to develop an organic fertilizer industry based on local raw materials in order to contribute to reducing Green House Gases and implementing sustainable agricultural systems. (S5,S6,R1,R2,R4) 2) Encourage the issuance of Government Regulations regarding the Implementation of Law no. 22 of 2019 concerning Sustainable Agricultural Cultivation Systems. (S1, R1). 3) Increase the commitment of farmer groups and local governments that obtain Organic Fertilizer Processing Units so that organic fertilizer produc-ton continues (S3, R3)	1) Encourage farmer awareness to use organic fertilizer by utilizing local raw material sources to improve soil quality and reduce CO2. (O1, O2, O3, A3, A6, A8, A9) 2) Encourage MSMEs and fertilizer producers to produce organic fertilizer by utilizing sources local raw materials. (O4, O5, O6, A1, A4, A6, A7) 3) Encourage the use of organic fertilizer to produce organic products. (O1, O2, A5)	1) Encourage the use of organic fertilizer to reduce GHG emissions. (O1, O2, R2). 2) Promote a campaign to increase land fertility by using organic fertilizer to achieve sustainable agriculture. (O1, O2, R1, R2, R4). 3) Accelerate organic fertilizer production to overcome the limited amount of inorganic fertilizer. (O4, R3).

Notes:
S – A Strategy: Strategy of using strengths to achieve aspirations.
O – A Strategy: Strategy to take advantage of opportunities to achieve aspirations.
S – R Strategy: Strategy of using strengths to achieve results.
O – R Strategy: Strategy to take advantage of opportunities to achieve results

To determine the priority order for each Alternative Strategy that has been formulated, the QSPM (Quantitative Strategic Planning Matrix) method is used with the following steps:

Determine the weight and Attractiveness Score (AS) of internal and external strategic factors. Weight is the level of importance of each strategic factor, while Attractiveness Score is the attractiveness value of each strategic factor. In this study, the weight is calculated by inviting 8 experts to each give a score of 1 if the strategic factor is considered weak, 2 if it is considered somewhat weak, 3 if it is considered somewhat strong, and 4 if it is considered strong. Then these values are averaged. The weight is equal to the average value of each strategic factor divided by the sum of the average values of all strategic factors. Meanwhile, the Attractiveness Score is obtained from respondents who give a value of 1 for strategic factors that are considered unattractive, a value of 2 for those that are considered somewhat attractive, a value of 3 for those that are considered attractive, and a value of 4 for those that are considered very attractive. Then take the average value from each respondent. In this study there were 54 respondents from research institutions, universities, industry and local government who returned questionnaires. The results are shown in Table 2 and Table 3.

Table 2. Weight and AS of internal strategic factors

Internal strategic factors	Weight	AS
Strength		
Law Number 22 of 2019 concerning Sustainable Agricultural Cultivation Systems.	0.064	3
Minister of Agriculture Decree No. 261/KPTS/ SR.310/M /4/2019 regarding technical requirements for organic fertilizers, biological fertilizers and soil amendments.	0.064	3
Decree of the Director General of Food Crops No. 70/HK.301/C/7/2018 concerning instructions for implementing Organic Fertilizer Processing Unit.	0.069	3
The potential of research institutions and universities to support the development of the organic fertilizer industry. The potential of research institutions and universities to support the development of the organic fertilizer industry.	0.069	3
The potential of industry/small and medium enterprises that support organic fertilizer production.	0.056	3
The potential sources of organic fertilizer raw materials in Indonesia are very abundant.	0.061	3
Aspiration		
Fulfilling the need for organic fertilizer in Indonesia.	0.064	3
All stakeholders are involved in developing the organic fertilizer industry.	0.064	3
The use of organic fertilizer will encourage a sustainable agricultural system.	0.074	4
Development of the Organic Fertilizer Industry.	0.069	3
Encourage the increasement of organic food products.	0.069	3
Local sources of raw materials for making organic fertilizer are utilized.	0.069	3
The Ministry of Industry's support for strengthening the development of the organic fertilizer industry would be continued.	0.064	3
Education and dissemination regarding organic fertilizer among farmers is carried out continuously.	0.074	3
The role of local government in encouraging the use of organic fertilizer is running well.	0.074	3

Table 3. Weight and AS of external strategic factors.

External strategic factors	Weight	AS
Opportunity		
Agricultural land in Indonesia generally lacks organic elements.	0.105	3
There is a government target to reduce CO2 emissions.	0.100	3
The market opportunity for organic fertilizer is quite large.	0.100	3
The availability of inorganic fertilizers is decreasing due to limited raw materials.	0.088	3
Several inorganic fertilizer manufacturers have produced organic fertilizer.	0.096	3
There are potential number of MSMEs producing organic fertilizer.	0.084	3
Result		
The implementation of a sustainable agricultural system can be achieved.	0.117	3
A reduction in the contribution of greenhouse gas emissions from the agricultural sector of 0.32% in 2030 can be achieved.	0.105	3
Increase in the organic fertilizer industry within 5 years.	0.100	3
The issuance of a Ministry of Industry policy that supports strengthening the development of the organic fertilizer industry.	0.105	3

Calculate the amount of TAS for each alternative strategy. Amount of TAS is the amount of TAS for each strategic factor that determines strategic alternatives. TAS is Total Attractiveness Score which is equal to Weight multiply by Attractiveness Score. The result of the calculation, the amount of TAS for each alternative strategy for the Development of Organic Fertilizer Industry in Indonesia is shown in Table 4.

Table 4. The amount of TAS for each alternative strategy

No.	Alternative strategy	Amount of TAS
1	S – A 1: Develop an organic fertilizer industry based on local raw materials in accordance with the required standards.	1.356
2	S – A 2: Conduct education, dissemination and socialization to regional officials and farmers about organic fertilizer.	1.839
3	S – A 3: Encourage participation research institutions, universities, industry and stakeholders in developing the organic fertilizer industry by utilizing local raw materials to support sustainable agriculture.	2.273
4	S – R 1: Encourage synergy between research institutions, universities, industry, local governments and other stakeholders to develop an organic fertilizer industry based on local raw materials in order to contribute to reducing Green House Gases (GHG) and implementing sustainable agricultural systems.	1.017
5	S – R 2: Encourage the issuance of Government Regulations regarding the Implementation of Law no. 22 of 2019 concerning Sustainable Agricultural Cultivation Systems.	0.543
6	S – R 3: Increase the commitment of farmer groups and local governments that obtain Organic Fertilizer Processing Units so that organic fertilizer production continues.	0.507
7	O – A 1: Encourage farmer awareness to use organic fertilizer by utilizing local raw material sources to improve soil quality and reduce CO_2 emissions.	1.862

8	O – A 2: Encourage MSMEs and fertilizer producers to produce organic fertilizer by utilizing sources local raw materials.	1.602
9	O – A 3: Encourage the use of organic fertilizer to produce organic products.	0.822
10	O – R 1: Encourage the use of organic fertilizer to reduce GHG emissions.	0.930
11	O – R 2: Promote a campaign to increase land fertility by using organic fertilizer to achieve sustainable agriculture.	1.281
12	O – R3: Accelerate organic fertilizer production to overcome the limited amount of inorganic fertilizer.	0.564

Determine the priority order of alternative strategies. From the results of calculating the amount of TAS for each alternative strategy, the priority order of alternative strategies is shown in Table 5.

Table 5. The priority order of alternative strategies.

Code	Amount of TAS	Strategy	Ranking
S-A 3	2.273	Encourage participation research institutions, universities, industry and stakeholders in developing the organic fertilizer industry by utilizing local raw materials to support sustainable agriculture.	1
O-A 1	1.862	Encourage farmer awareness to use organic fertilizer by utilizing local raw material sources to improve soil quality and reduce CO_2 emissions.	2
S-A 2	1.839	Conduct education, dissemination and socialization to regional officials and farmers about organic fertilizer.	3
O-A 2	1.602	Encourage MSMEs and fertilizer producers to produce organic fertilizer by utilizing sources local raw materials.	4
O-R 2	1.596	Promote a campaign to increase land fertility by using organic fertilizer to achieve sustainable agriculture.	5
S-A 1	1.356	Develop an organic fertilizer industry based on local raw materials in accordance with the standards.	6
S-R 1	1.332	Encourage synergy stakeholders to develop an organic fertilizer industry based on local raw materials in order to contribute to reducing GHG and implementing sustainable agricultural systems.	7
O-R 1	0.930	Encourage the use of organic fertilizer to reduce GHG emissions.	8
O-A 3	0.822	Encourage the use of organic fertilizer to produce organic products.	9
O-R 3	0.564	Accelerate organic fertilizer production to overcome the limited amount of inorganic fertilizer.	10
S-R 2	0.543	Encourage the issuance of Government Regulations regarding the Implementation of Law No. 22 of 2019	11
S-R 3	0.507	Increase the commitment of farmer groups and local governments that obtain Organic Fertilizer Processing Units so that organic fertilizer production continues.	12

3 Conclusions and recommendations

3.1 Conclusions

In agricultural cultivation, organic fertilizer plays a role as a soil improver which has an important function to maintain and improve the quality of soil fertility. In the long term, the use of organic fertilizer can support sustainable agricultural programs. Therefore, to be able to meet the need for organic fertilizer, it is necessary to develop the organic fertilizer industry.

Based on the analysis, the development of the organic fertilizer industry in Indonesia can be achieved through 3 (three) main strategies. The first strategy is to encourage the participation of research institutions, universities, industry and stakeholders in developing the organic fertilizer industry by utilizing local raw materials to support sustainable agriculture and strengthening monitoring of organic fertilizer quality standards. The second strategy is to encourage farmer awareness to use organic fertilizer by utilizing local raw material sources to improve soil quality and reduce CO_2 emissions. The third strategy is to provide education, dissemination and socialization to regional officials and farmers about organic fertilizer.

3.2 Recommendations

In an effort to develop an organic fertilizer industry based on local raw materials, the following recommendations are presented:

1) Encourage the participation of research institutions, universities, industry and stakeholders in developing the organic fertilizer industry by utilizing local raw materials to support sustainable agriculture.

   Policies and programs that need to be taken are:

   (1) Increasing the role of research institutions, universities, industry and stakeholders in developing the organic fertilizer industry which is operationalized in the program of Application of technology resulting from research and development of the organic fertilizer industry.

   (2) Utilization of local raw materials for making organic fertilizer in the framework of sustainable agriculture which is operationalized in the program of Development of an organic fertilizer industry close to local sources of raw materials; and Providing incentives by the Government to organic fertilizer businesses made from local raw materials.

   (3) Strengthening supervision of organic fertilizer quality standards which is operationalized in the program of Monitoring the quality of organic fertilizer products in accordance with existing standards.

2) Encourage farmer awareness to use organic fertilizer by utilizing local raw material sources to improve soil quality and reduce CO_2 emissions.

   Policies and programs that need to be taken are:

(1) Use of local raw materials to make organic fertilizer which is operationalized in the program of Campaign for farmers to use organic fertilizer made from local raw materials.

(2) Improving soil quality by using organic fertilizer which is operationalized in the program of Campaign to use organic fertilizer for farmers to improve soil quality; and Providing incentives to farmers who use organic fertilizer to improve soil quality.

3) Conduct education, dissemination and socialization to regional officials and farmers about organic fertilizer.

Policies and programs that need to be taken are:

(1) Education, dissemination and socialization about organic fertilizers to officials and farmers in region which is operationalized in the program of Regular farmer group talks about organic fertilizers; Training on making and using organic fertilizer; and Internships in industry for assistants and farmers in the regions in order to increase capacity and capability.

The strategies, policies and programs recommended above need to be consolidated between related parties (Coordinating Ministry for the Economy, Ministry of Agriculture, Ministry of Industry, Ministry of BUMN, Ministry of Villages and BRIN) coordinated by the Coordinating Ministry for the Economy.

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