Farmers’ Response to Economic Benefits of Integrated Farming

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Abstract. The availability of abundant cattle waste in a village is an important factor for implementing organic paddy farming practice. The utilization of cattle waste in SRI practice, biogas and worm cultivation increase farmers’ income but this issue is not informed well to farmers because traditionally agricultural extention agent focused on delivering cropping techniques than economic advantages. The objective of this study is to assess farmers’ response to the possibility of inserting the information about the economic benefits of integrating SRI, biogas, and worm cultivation in the SRI extension program. The respondents were conventional farmers in Boyolali District and using added value and farmers’ response concept. There are three activities in this research namely obtaining added value throughout biogas value chain, presenting the added value to farmers, and receiving farmers’ response. The results shows in three parts of biogas value chain increase farmers’ economic benefits from 974.000 IDR/year to 5.18 million IDR/year. Conventional farmers give high positive response to the integration of implementing SRI and following biogas project and receiving added value from installing biogas digester. However, farmers give low response to cultivate worm due to unstable demand and its price volatilization.

Keywords: paddy, organic, cattle waste, biogas, worm, farmers’ response, extension

1. Introduction
Potential of organic farming expansion in Indonesia is enormous because available land for organic agriculture in Indonesia is very wide [1], organic products have a good market prospect, and the implementation of organic farming increase land quality, water and air that impact on increasing production and human life quality [1,7]. Besides its massive potential, the performance of an organic farming area expansion tends to stagnate. During the period of 2008-2011, the organic farming area only grew 2.81 percent per year [1,7]. The low growth of SRI area expansion as one of organic practices, showed that there were some problems related to the organic farming area expansion. Besides some classical problems such as certification process, limited market for organic products, low price, and the extension of SRI [4].

The availability of cattle manure become an important reason for farmers why they wanted to reduce the use of chemical fertilizers and implement the SRI practice, although not all SRI technique guides are implemented. This occurred because most of farmers are growing cattle, including conventional farmers, and the amount of cattle manure is abundant [6]. Nevertheless, conventional
farmers in this village still did not want to shift their farming practice to SRI, even though agricultural extension agents strive to inform SRI farming techniques through their extension materials. To deal with extension problem, other new extension materials are necessary to be added in an extension process which are performed by agricultural extension agents. Inserting economic benefits knowledge of implementing SRI instead of convincing conventional farmers by technical substances can be considered as a potential substance.

The objective of the study is to assess farmers’ response to the possibility of inserting the information about the economic benefits of integrating SRI, biogas, and worm cultivation in the SRI extension program. Within the context of the research objective, the following research questions are formulated to obtain a farmers’ response to the new extension material. The central question of this research is: how much the value-added of integrating SRI, biogas and worm cultivation and farmers’ response to economic benefit substances disseminated by a researcher. Specifically, this research is carried out to answer the following sub research questions: (1) How much the value-added of implementing biogas and worm cultivation in each part of a biogas value chain?; (2) How does farmers’ response to the economic benefit of SRI, biogas and worm cultivation extension materials disseminated in this research?

2. Methodology
The net private benefit of the conventional system is higher than SRI. However, in a condition when all labor is calculated as the cost, SRI’s net private benefit and also net social benefit are higher than conventional system. SRI’s net private benefit when all labor is calculated as costs is 15.23 million IDR/ha and for conventional system is 13.60 million IDR/ha or 13% lower than SRI. Meanwhile, the net social benefit when all labor is calculated as costs, for SRI and conventional system are 14.96 million IDR/ha and 12.55 million IDR/ha respectively. When all labor and cattle waste are calculated as costs, the net social benefit of SRI (11.97 million IDR/ha) is also more than conventional system (11.89 million IDR/ha) [6].

The economic benefit that comes from reducing externalities of implementing SRI is less known by the farmers due to the lack of extension about social benefits. According to manual book of implementing SRI released by Ministry of Agriculture of Indonesia, agriculture extension agents have an obligation to counsel information stated in manual book which is the technical matters of implementing SRI, but not include the economic benefits. If agriculture extension agents do not want to increase their knowledge by themselves, economic benefit will not be delivered to farmers.

Agricultural extension agents’ role is very important to realize agricultural development based on people’s needs. He added that agricultural extension agent’s role is as a researcher who searching for mutual advices and recommendations related to knowledge and technologies, as an educator who improves farmers’ knowledge, delivering information to farmers and increasing farmers’ working spirit, and as an agricultural extension agent who raises farmers’ attitude of openness and not compulsion [5].

Agricultural extension agents should be able to diagnose obstacles faced by farmers, building and maintaining a good relationship with farmers, strengthen technology adoption, and prevent the decreasing adoption of technologies. Mosher (1997) mentioned that agricultural extension agents’ roles are: (1) educator; (2) analyzer; (3) adviser; (4) organizer; (5) needs changing developer; (6) a driver of change; and (7) builder for agricultural extension agents and farmer relationships [7]. To support those of roles, agricultural extension agents have to master and utilize information of technology, communication and education [4].

The researcher has an idea that the most important factor for farmers to shift from conventional farming practices to SRI is the availability of cattle manure. It means that the farmers have to raise cattle or buy cattle manure from other farmers or sellers. In order to accelerate the adoption of SRI by farmers, the extension about the social benefits of practicing SRI, the chances of obtaining government support for providing cattle for farmers, improving farmers’ knowledge to raise cattle, the value-added
of raising cattle, the use of cattle manure, affiliating biogas project, and the possibility of cultivating worm, in terms of increasing economic benefit, should be performed.

The first step carried out in this research is to calculate the value-added could be obtained by the farmers along the value chain of raising 2 cattle and implementing household biogas. The value-added of each part of a biogas value chain is used as the extension materials in the study site. The extension by researchers to farmers’ representative at study site is performed in order to increase farmers’ knowledge and behavior of SRI.

The second step is to obtain data and information about farmers’ self-awareness about SRI practice and raising cattle, and farmers’ response of extension materials that the researcher had already counseled. The positive response of the farmers showed the focus of extension on how to raise cattle and how to utilize cattle manure to earn economic benefit through its value-added, which is performed by an agriculture extension agent, is the main factor if the Ministry of Agriculture intends to accelerate the SRI area expansion.

For answering sub research question 1 (How much the value-added of implementing biogas and worm cultivation in each part of a biogas value chain?), focus group discussion (FGD) with a farmer group in Cibodas village at Lembang sub district, West Java province, is performed. For sub question 2 (How does farmers’ response to economic benefit of SRI, biogas and worm cultivation extension materials disseminated in this research?), This study collected data from the representation of 5 farmer groups and 1 female farmer group by using a questionnaire that was distributed after extension.

To answer sub question 3 (What policy recommendations should be offered to the Ministry of Agriculture of Republic of Indonesia in terms of accelerating System of Rice Intensification (SRI) area expansion?), interview was performed by the officials of local government and extension workers in order to discuss about the new idea of focusing extension about adopting SRI, raising cattle extension and the biogas project compared to focus only on technical implementation of SRI.

The study site was in the Cibodas village in the Lembang sub district, West Java Province. This village is chosen in order to obtain data and information about the cost of building biogas installation, and economic benefit of implementing biogas.

The profitability of implementing biogas is calculated by using formula explained below [2] [9]:

\[ \pi = TR - TC, \quad \pi = \text{profit}, \quad TR = \text{total revenue}, \quad TC = \text{total costs}. \]

Criteria will follow: if \( \pi > 0 \): implementing biogas is profitable, if \( \pi < 0 \): implementing biogas is not profitable. Farmers’ self-awareness about their knowledge of SRI practices and their response to the extension of the possibility of receiving value-added by implementing SRI and household biogas is measured by using a Likert Scale [3,4].

Each representative from 5 farmer groups is asked to fill the questionnaire. Farmers answered the questions by giving check sign (✓) in each statement in questionnaire according to their self-awareness about their knowledge of SRI practices and raising cattle. There are 12 statements and on SRI practice part and 8 statements in raising cattle part. After researcher gave a presentation and discussion accompanied by experts, officials and NGO members, about SRI to farmers, then a response questionnaire is used to each farmer to be filled with the same filling method. The second questionnaire asked about farmers’ response to extension material delivered by researcher and their willingness to implement biogas and SRI.

Farmers’ answers to each statement in the farmers’ self-awareness questionnaire are grouped into: (1) their knowledge of SRI practices and (2) raising cattle. Meanwhile, for farmers’ response questionnaire, farmers’ answer are categorized into (1) farmers’ response to the possibility of increasing their knowledge in SRI practice; (2) farmers’ response to the possibility of improving their knowledge in raising cattle; and (3) farmers’ willingness to obtain biogas value-added.

**Farmers’ answer for all statements in each group is accounted and categorized as follows:**

- If farmers gave 1-3 check signs (✓) among all statements in a group, their answers are categorized as “1”
- If farmers gave 4-6 check signs (✓) among all statements in a group, their answers are categorized as “2”
- If farmers gave 7-9 check signs (✓) among all statements in a group, their answers are categorized as “3”
If farmers gave 10-12 check signs (✓) among all statements in a group, their answers are categorized as “4”

For group of statement which only has 8 statements:
If farmers gave 1-2 check signs (✓) among all statements in a group, their answers are categorized as “1”
If farmers gave 3-4 check signs (✓) among all statements in a group, their answers are categorized as “2”
If farmers gave 5-6 check signs (✓) among all statements in a group, their answers are categorized as “3”
If farmers gave 7-8 check signs (✓) among all statements in a group, their answers are categorized as “4”

For group of statement which only has 4 statements:
If farmers gave 1 check signs (✓) among all statements in a group, their answers are categorized as “1”
If farmers gave 2 check signs (✓) among all statements in a group, their answers are categorized as “2”
If farmers gave 3 check signs (✓) among all statements in a group, their answers are categorized as “3”
If farmers gave 4 check signs (✓) among all statements in a group, their answers are categorized as “4”

The average of all categories for each farmer is averaged. Subsequently, it is then grouped into three score groups, i.e. 1 (if the average score of all farmers is 1.00 – 2.00); 2 (if the average score of all farmers is 2.01 – 3.00), 3 (if the average score of all farmers is 3.01 – 4.00). The interpretation of score 1 is farmers’ self-awareness and farmers’ response is low, score 2 is median, and score 3 is high.

3. Result and Discussion
The first part of calculating farmer’s cost and benefit on each part of a biogas value chain starts with the assumption that the farmer only raising 2 cattle, but not installing biogas, the farmer’s added benefit is only from cattle manure. Farmer’s benefit is 15 tones/year x 66,667 IDR/tones = 973,333 IDR/year (Table 1).

The second part of biogas value-added assuming that the farmer affiliates with a project and installing biogas reactor. Farmer’s revenue in this second part is obtained from bio-slurry value and methane gas value calculated from LPG value which replaced by methane gas use for turning on 2 stoves, 1 lamp and 1 time cooking rice by using a specific rice cooker for a year. Farmer’s benefit in the second part is 2.10 million/year. Benefit per cost ratio (B/C) is 1.43 or farmer gains 43% benefit over the cost.

The third part is to enhance the biogas value chain by adding growing worm effort in order to increase farmer’s benefit. Farmer’s benefit is 5.18 million IDR/year. The B/C ratio in this third part of a biogas value chain is 4.12 or 2.88 times higher than the second part.

The explanation above exhibited that there were a huge cattle manure surplus, which is 39.21 kg/day/farmer that can be used as raw material of biogas digester. The cost of building 6 m$^3$ biogas digester is 9.46 million IDR and can be used until 15 years. The three possible benefits in three biogas value chain are showed as follows: (1) farmer only utilizes cattle manure as organic fertilizer or sold, the benefit is 973 thousand IDR/year; (2) farmers install biogas digester and received benefit from energy produced and bio-slurry production, the benefit is 2.1 million IDR/year; (3) farmers add cultivating worm business by using bio-slurry instead of energy benefit and selling bio-slurry, the benefit is 5.18 million IDR/year.

The results showed that the conventional farmers’ knowledge about SRI practice (the score is 2.1875) and raising cattle (2.1250) are categorized in medium level (Table 2). After new extension materials are delivered, farmers’ showed positive response. Their knowledge about SRI practices is increasing and are grouped into high category. Meanwhile, farmers’ response to raising cattle increases but categorized into medium level. Furthermore, farmers’ willingness to obtain biogas value-added received high positive response except for their willingness to cultivate worm that showed medium level.
Table 1. Costs and benefits of implementing 6 m$^3$ biogas digester and cultivating worm, 2015.

| No. | Type of costs, revenue and benefit | Unit | Volume | Price/Unit | Value |
|-----|----------------------------------|------|--------|------------|-------|
| I Costs: | Building a digester: | | |
| 1 | Digester's size | m$^3$ | 6 | | |
| 2 | Digester's lifespan | Years | 15 | | |
| 3 | Cost | IDR | 9,490,500 | | |
| 4 | Depreciation (5%/year) | IDR/year | 474,525 | | |
| 5 | Building 2 racks for cultivating worm | | |
| 6 | Rack's size | m$^2$ | 7 | | |
| 7 | Rack's lifespan | Years | 6 | | |
| 8 | Cost | IDR | 1,150,000 | | |
| 9 | Depreciation (5%/year) | IDR | 57,500 | | |
| 10 | Land size for building a digester and a rack | | |
| 11 | Land size | m$^2$ | 21 | | |
| 12 | Opportunity cost of land | IDR/year | 17,500 | | |
| 13 | Cattle manure | | |
| 14 | Volume | 15 | 66,667 | | |
| 15 | Worm seeds | Kg | 4 | 35,000 | 140,000 |

**TOTAL COST**

1,662,858

1,465,358

II Revenue:

| No. | Type of costs, revenue and benefit | Unit | Volume | Price/Unit | Value |
|-----|----------------------------------|------|--------|------------|-------|
| 1 | Casting | kg | 3,780 | 714 | 2,700,000 |
| 2 | Worm | kg | 72 | 27,750 | 1,998,000 |
| 3 | Liquefied Petroleum Gas (LPG)'s | cylinder | 48 | 25,000 | 1,200,000 |
| 4 | Slurry for organic fertilizer | kg | 2,520 | 375 | 945,000 |

**Slurry for organic fertilizer (2)**

2,362,500

**TOTAL REVENUE**

6,843,000

III Benefit:

| Type of costs, revenue and benefit | Value |
|-----------------------------------|-------|
| Casting + Worm + LPGs + Slurry | IDR/year | 5,180,142 |
| Slurry + LPGs | IDR/year | 2,097,142 |

IV R/C ratio

| Type of costs, revenue and benefit | R/C ratio |
|-----------------------------------|----------|
| Casting + Worm + LPGs + Slurry | 4.12 |
| Slurry + LPGs | 1.43 |

Source: primary data, computed, 2015.
Farmer’s Self-Awareness and Response to Economic Benefits of Implementing SRI and Biogas
Table 2. Farmers’ self-awareness about their knowledge on SRI practice and raising cattle, and farmers’ response to the extension of SRI, raising cattle and biogas, 2014.

| No | Items | Average score and percentage farmers answer “yes” on statements |
|----|-------|---------------------------------------------------------------|
| **Before counseling:** | | |
| **I** | Conventional farmer's knowledge about SRI practices (score) | 2.1875 |
| 1 | Tillage techniques (%) | 25.00 |
| 2 | Selecting good seeds (%) | 31.25 |
| 3 | Seedling (%) | 37.50 |
| 4 | Planting method and spacing (%) | 25.00 |
| 5 | Fertilizer application (%) | 68.75 |
| 6 | Weeding (%) | 50.00 |
| 7 | Eradicating pest and disease (%) | 12.50 |
| 8 | Harvesting techniques (%) | 93.75 |
| 9 | Grading techniques (%) | 68.75 |
| 10 | Post-harvest handling (%) | 56.25 |
| 11 | Packaging (%) | 31.25 |
| 12 | Water management (%) | 25.00 |
| **II** | Conventional farmer's knowledge about raising cattle (score) | 2.1250 |
| 1 | Selecting cattle seeds (%) | 56.25 |
| 2 | Ration techniques (%) | 18.75 |
| 3 | Cattle disease treatment techniques (%) | 12.50 |
| 4 | Cattle estrus period (%) | 56.25 |
| 5 | Natural and artificial insemination techniques (%) | 37.50 |
| 6 | Cage sanitation and hygiene techniques (%) | 87.50 |
| 7 | Cattle health (%) | 62.50 |
| 8 | Cattle products processing techniques (%) | 25.00 |
| **After counseling:** | | |
| **III** | Increasing conventional farmer's knowledge about SRI practices (score) | 3.0625 |
| 1 | In respect of cultivation techniques (%) | 100.00 |
| 2 | Post-harvest handling (%) | 75.00 |
| 3 | Product processing (%) | 56.25 |
| 4 | Product selling (%) | 75.00 |
| **IV** | Increasing conventional farmer's knowledge about cattle breeding (score) | 2.3750 |
| 1 | In respect of breeding techniques (%) | 87.50 |
| 2 | Utilization of cattle manure (%) | 100.00 |
| 3 | Product processing (%) | 31.25 |
| 4 | Product selling (%) | 18.75 |
| **V** | Conventional farmer's willingness to obtain biogas value-added (score) | 3.060 |
| 1 | The farmer wants to raise cows (%) | 93.75 |
| 2 | The farmer wants to utilize cattle manure (%) | 87.50 |
| 3 | The farmer wants to install the biogas digester (%) | 87.50 |
| 4 | The farmer wants to cultivate worm (%) | 31.25 |

Source: primary data, computed, 2015.
4. Conclusion

There are three parts in the biogas value chain to show the increase of economic benefits. In the first part, conventional farmers only utilize cattle manure to receive added benefit. The farmer only receives 974,000 IDR/year or approximately 325,000 IDR/paddy season. In the second part, farmers affiliates with BIRU project and receives the added value from implementing biogas. Farmers obtain 2.1 million IDR/year or 700,000 IDR/paddy season. In third part, farmers install biogas digester and cultivating worm. Farmers benefit is 5.18 million IDR/year or 1.73 million/paddy season.

Conventional farmers give high positive response to the integration of implementing SRI and following biogas project and receiving value-added from installing biogas digester. However, farmers give low response to cultivate worm due to unstable demand and its price volatilization. It showed that government support on the procurement of cattle for conventional farmers and intensive extension about raising cattle at the same time implementing biogas will attract conventional farmers to shift their farming practice from conventional to SRI.

To accelerate SRI area expansion by attracting conventional farmers to shift their farming practice from conventional to SRI, government is recommended to use information about economic benefit of raising cattle and implementing biogas in the extension material of agricultural extension agents, because traditionally agricultural extension agents focused on delivering cropping techniques. Therefore, agricultural extension agents’ capability in counseling about raising cattle must be improved.

References

[1] Food and Agriculture Organization (FAO). 2002. Organic agriculture, environment and food security. *Environment and Natural Resources Series No. 4*.

[2] J. P. Gittinger. 1986. Analisa ekonomi proyek-proyek pertanian (Economic analysis of agricultural projects). UI Press – John Hopkins.

[3] K. S. Indraningsih. 2010. Penyuluhan pada lahan margjinal: kasus adopsi inovasi usahatani terpadu lahan kering di Kabupaten Cianjur dan Kabupaten Garut, Provinsi Jawa Barat.(Counseling on marginal land: a case of adoption of integrated dryland agricultural innovations in Cianjur Regency and Garut Regency, West Java Province). Disertasi. Post Graduate IPB. Bogor.

[4] K. S. Indraningsih, Syahyuti, A.M. Sunarsih, Ar-Rozi, S. Suharyono, and Sugiarito. 2013. Peran penyuluh swadaya dalam implementasi undang-undang system penyuluhan pertanian (The role of self-help extension agents in the application of the agricultural extension system la). Laporan akhir penelitian di Pusat Sosial Ekonomi dan Kebijakan Pertanian, Badan Litbang Pertanian.

[5] A. G. Kartasaputra. 1994. Technologi penyuluhan pertanian (Agricultural extension technology). Bumi Aksara. Jakarta

[6] M. Maulana. 2015. Social costs of System of Rice Intensification (SRI) and conventional rice production system in Indonesia. Master of Science thesis in Environmental Sciences of Wageningen University and Research Centre. The Netherlands.

[7] A. T. Mosher. 1997. Menggerakkan dan membangun pertanian (Moving and building agriculture). Yasa Guna. Jakarta.

[8] H. Mayrowani. 2012. Pengembangan pertanian organic di Indonesia (Development of organic agriculture in Indonesia). *Forum Penelitian Agro Ekonomi, Volume 30 No.2, Desember 2012*: p91-108.

[9] Soekartawi. 1995. Analisis Usahatani (Farm Analysis). Penerbit Universitas Indonesia. Jakarta.