The study of technology adoption on integrated crop management (ICM) of paddy rice in Aceh Province

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Abstract. The aim of these activities was to provide input/recommendations to policymakers about the issues and problems of agricultural development from the study of technology adoption on integrated crop management (ICM) of rice. The event was held from March - November 2015 in four districts namely Pidie, Aceh Utara, Aceh Barat, and Aceh Barat Daya. The activities implemented through field studies with respondents are farmers who received the SLICM program (purposive sampling). Each district was selected one district and each district will be selected two villages. In-depth interview respondents as much as 10-20 farmers per village. Respondents were selected randomly from members of rice SLICM. Data collected consists of primary data and secondary data and processed by descriptive analysis. The results showed that the level of technology adoption on integrated crop management (ICM) of rice in Pidie, Aceh Utara, Aceh Barat, and Aceh Barat Daya districts is not influenced by the characteristics of the respondent, such as age, education, and experience of farmers in cropping rice. Technology adoption on integrated crop management (ICM) of rice is still limited to the use of the technology components of new varieties and seed labeled. The various components of the basic technology and the integrated crop management selection of paddy rice, which have not adopted by respondents include intermittent irrigation, organic fertilizer utilization, weeding with *grok* While legowo cropping system is still limited. The adoption rate on integrated crop management (ICM) of rice is influenced by several factors, among others: the implemented technology is easy, uncomplicated. The technology is also cheap but in accordance with the conditions of society and new technologies can provide more benefit to them (increased yield).

1. Introduction
Agribusiness rice in Aceh are generally not optimally applying technological innovation, so that the productivity is still relatively low. On the other hand, the productivity of rice vary by location, either because of differences in agro-ecosystem, social condition, farmers cultural and farmer's response to the innovation. Rice productivity comparing two production systems: traditional paddy (Paddy) and GCRPS combined with two nitrogen fertilizer regime has a positive effect on the development of rice roots and that the improved root development is of vital importance for higher yields. Furthermore, the
improved root development in innovative water-saving ground cover rice production system (GCRPS) may avoid potential lodging phenomena and increase soil organic carbon stocks, thus improving key soil functions [1].

The agricultural sector is expected to play an important role in food provision and employment for the community. Therefore, the proper agricultural development policy in Aceh province becomes very important in reducing poverty and accelerating economic growth. The innovation Technology can quickly be used by the farmer/community with juxtapose, harmonize and integrating the research/study activities with the interests of stakeholders user. Institutional role in efforts to create site-specific adaptive technology through a participatory approach is a strategic point to increase communication access to farmers as users of technology. The implementation program of Integrated Crop Management (ICM) for paddy is a one government effort to enhance production and productivity of paddy to reach a sustainable self-sufficient. The research results show that [2] ICM components with high levels of adoption are superior varieties, harvest and post-harvest handling, planting seeds and land use according to the season factors that significantly influence the technical inefficiency of integrated crop management are the age of the farmer, agricultural experience, level of education and area of land ownership [3].

Aceh has significant potential in agriculture, especially food crops. Extensive irrigated land in Aceh 214 939 ha with a productivity of 4.2 tons/ha, while the upland rice productivity of 3.74 tonnes/ha. Various attempts have been made to increase the productivity of rice crops, one of them through the approach of Integrated Crop Technology (ICM), which has been introduced to farmers in Aceh since 2004. In an effort to achieve a surplus of 10 million tonnes of rice in 2014, Aceh Province in 2012 conducting SL-ICM of rice on 2,922 units with 29.300 ha of total area [4]. The implementation of rice SL-ICM intend among others to accelerate the adoption of technology components of rice ICM with the adopted target from various alternative technology components of rice by farmers so that can increase knowledge and skills in managing their farming, for increased the productivity.

The utilization of agricultural resources is the key to improving agricultural productivity, so that limited resources should be allocated as efficiently as possible. Agricultural resources consisting of land, labor, water, including the elements contained in it is the primary resource for human survival. The unwise management and does not refer to in the future will result in decreased quality of the resource itself, which ultimately affect the agriculture productivity.

The Institute for Agricultural Technology (BPTP) of Aceh has produced a number of specific technological innovations of rice that have been disseminated through BPTP, BAPELUH, BPP and farmer groups networks. The primary purpose of network development, among others: (1) accelerate the process of technology transfer and agricultural information: (2) collect feedback of the study and preference results of technology user needs. Among these technologies is the Integrated Crop Management (PPT) of rice. The aim of the activities was to identify and analyse the affecting factors on technology adoption on integrated crop management (ICM) of rice in Aceh province [5].

2. Materials and methods

2.1. Time and Place
The activities begin in March - November of 2015, placed in rice production areas namely Pidie, Aceh Utara, Aceh Barat and Aceh Barat Daya.

2.2. Study Design
The activities implemented through field studies with respondents are farmers who received SLICM program (purposive sampling). Each district was selected one districts and each district will be selected two villages Indepth interview respondents as much as 10-20 farmers per village. Respondents were selected randomly from members of rice SLICM.
2.3. Observation and Data Analysis
The data used as a source of discussion consists of primary data and secondary data. Primary data collected from respondents consisting of the officials from scope of agriculture agencies in the district and sub-district level and the farmers and their family in the field.

The primary data collection will be done through several approaches namely: Indepth interviews (depth interview) to farmers, their families and other relevant officials at the district/sub-district level, and Focus Group Discussion (FGD).

Secondary data was collected through searches of relevant documents and publications to the topic of study in BBP2TP, related research center, BPTP Aceh, and surfing the website.

The types of primary data collected, are as follows:

a) Characteristics of respondents, including age, education, farming experience and others.

b) Performance of technology adoption on integrated crop management (ICM) of rice.

c) The flow of technology adoption.

The analytical method used in this research is descriptive analysis. This method is the analyzed data to illustrate and interpret the objects according to what is or explain the phenomena that occur around the study object with the intention of find a way of determining the study.

3. Results and Discussion
3.1. Study Sites
This study was done in two zones of the region, Pidie and Aceh Utara represent the eastern region and Aceh Barat and Aceh Barat Daya representing the western region. All the chosen sites were the center of rice production in Aceh Province. Each district has rice area reached 29,391 ha distributed in 23 districts in Pidie, 45,493 ha, spread in 27 sub-districts in Aceh Utaradistrict, Aceh Barat district 16,426 ha in 12 districts and 11,426 ha in Aceh Barat Daya district spread in 9 districts. For Pidie district, the chosen site is Mutiara sub district namely Balee Busu and Lingkok Busus villages.

Aceh Utaradistrict held in Muara Batu subdistrict, namely Panigah and PalohAwee villages. In Aceh Barat the study was held in Suak Timah and Cot Darat villages of Samatiga sub district. In Aceh Barat Daya was held in Blang Dalam and Cot Mancang Villages of Susoh sub district.

3.2. Characteristics of Respondents
The farmers who were respondents in this study a 100% male. 77.5% of respondents involved between 40-54 years old, an age which is productive in rice farming experience between 10-20 years. Respondents have gained a wide range of technologies to increase the productivity of rice cultivation, although it only had education level of secondary school (31.25%), but have the ability to assess a feasible or not the innovation for adoption. The majority of farmers have arable land between 0.5 - 0.75 ha. The characteristics of respondents involved in this study are presented in Table 1.

3.3. Performance of Technology Application
Integrated crop management (ICM) is an approach in the management of land, water, crops, crop pests (OPT), and an integrated, sustainable climate in order to increase productivity, incomes of farmers and environmental sustainability. Integrated crop management (ICM) principle includes four elements, namely integration, interaction, dynamic and participatory. Technology components in integrated crop management (ICM) was divided into two, namely the basic technology components consist of: (1) the use of new varieties (VUB), (2) seed quality and labeled, (3) efficient fertilization, and (4) pest and disease control suitable with pest target, (5) organic materials utilization, and (6) regulation of crop populations and the chosen technology component consists of: (1) perfect cultivation, (2) young seedlings, (3) the number of seedlings per clump, (4) intermittent irrigation, (5 ) weeding with gasrok, and (6) harvest and post-harvest handling (Department of Agriculture, 2008). The performance of technology adoption on integrated crop management of rice that have been implemented by involved respondents in the study are presented in Table 2.
Table 1. The characteristics of respondents on technology adoption of integrated crop management of rice in Aceh Province (2015).

| Respondent Characteristics | Districts | Amount | Percentage |
|----------------------------|-----------|--------|------------|
| Age                        |           |        |            |
| ≤ 39                       | Pidie     | 5      | 3          | 4          | 2          | 14         | 17,5       |
|                           | Aceh Utara| 3      | 4          | 4          | 18         | 62         | 77,5       |
|                           | West Aceh | 4      | 2          | 0          | 4          | 5          |            |
|                           | Aceh Barat| 2      | 2          | 0          | 4          | 5          |            |
|                           | Daya      | 1      | 2          | 0          | 4          | 5          |            |
|                           | Amount    | 20     | 20         | 20         | 20         | 80         | 100        |
| Formal Education           |           |        |            |
| Primary School (≤ 6 th)    | Pidie     | 5      | 9          | 5          | 4          | 23         | 28,75      |
|                           | Aceh Utara| 9      | 5          | 8          | 5          | 25         | 31,25      |
|                           | West Aceh | 5      | 7          | 8          | 5          | 25         | 31,25      |
|                           | Aceh Barat| 4      | 7          | 7          | 11         | 32         | 40         |
|                           | Daya      | 10     | 4          | 7          | 11         | 32         | 40         |
|                           | Amount    | 20     | 20         | 20         | 20         | 80         | 100        |
| Rice Farming Experience (years) |           |        |            |
| ≤ 10                       | Pidie     | 4      | 3          | 4          | 5          | 16         | 20         |
|                           | Aceh Utara| 3      | 4          | 3          | 4          | 16         | 20         |
|                           | West Aceh | 3      | 4          | 3          | 4          | 16         | 20         |
|                           | Aceh Barat| 4      | 1          | 2          | 5          | 20         | 20         |
|                           | Daya      | 1      | 2          | 0          | 4          | 5          |            |
|                           | Amount    | 20     | 20         | 20         | 20         | 80         | 100        |
| Number of Family Members (soul) |           |        |            |
| ≤ 4                        | Pidie     | 13     | 15         | 14         | 16         | 58         | 72,5       |
|                           | Aceh Utara| 15     | 14         | 13         | 13         | 55         | 68,75      |
|                           | West Aceh | 5      | 3          | 5          | 3          | 16         | 20         |
|                           | Aceh Barat| 2      | 2          | 1          | 1          | 6          | 7,5        |
|                           | Daya      | 5      | 4          | 0          | 2          | 7          | 8,75       |
|                           | Amount    | 20     | 20         | 20         | 20         | 80         | 100        |
| Rice Farming Land Area (ha) |           |        |            |
| < 0,5                      | Pidie     | 4      | 2          | 7          | 5          | 18         | 22,5       |
|                           | Aceh Utara| 2      | 2          | 13         | 13         | 55         | 68,75      |
|                           | West Aceh | 15     | 14         | 13         | 13         | 55         | 68,75      |
|                           | Aceh Barat| 1      | 4          | 0          | 2          | 7          | 8,75       |
|                           | Daya      | 1      | 4          | 0          | 2          | 7          | 8,75       |
|                           | Amount    | 20     | 20         | 20         | 20         | 80         | 100        |

Table 2 shows the total of 91.20% of respondents have used qualify seed and 77.50% labeled. Dose of fertilizer used was based on the availability of working capital owned. Farmers do not have information about the Leaf Color Chart (LCC), paddy Soil Test Kit (PUTS) or Map of phosphate and potassium nutrient status which can be used to determine the nutrient needs of crops. Organic matter has not been accustomed to do, especially the use of manure even though farmers have cattle, goats and poultry, but 13.75% of respondents are already using organic fertilizers although not suitable with the recommendation.

The farmers are already using the legowo row cropping system (Jurong) although not suitable with the recommendations. A total of 30.77% of respondents already implementing jurong system 2:1 and 4: 1. Pest control in paddy rice with an integrated approach to pest management (IPM), a 13.75% of respondents have implemented.

The Technology Package on integrated crop management of paddy rice, in addition to having six main technological components (base) also has six selected technology components. The use of selected technology components by respondents is still limited. All respondents (100%) have done a perfect tillage. Young seedlings utilization under the age of 21 days was carried out by 95% of respondents, as well as cropping 1-3 trees per cropping hole has been adopted by 90% of respondents. Intermittent irrigation have not done by all farmers. This is due to the availability of irrigation water remains a major constraint in all regions.
Table 2. The performance of technology implementation on integrated crop management (ICM) of rice on study sites.

| Technology Components on ICM of paddy rice | Districts          | Districts          | Districts          | Amount | Percentage |
|------------------------------------------|--------------------|--------------------|--------------------|--------|------------|
|                                          | Pidie              | Aceh Utara         | Aceh Barat         |        |            |
| The basic components:                    |                    |                    |                    |        |            |
| 1. VUB utilization                       |                    |                    |                    |        |            |
| a. Suitable                             | 20                 | 17                 | 16                 | 20     | 73         | 91.25     |
| b. Less suitable                        | 0                  | 3                  | 4                  | 0      | 7          | 8.75      |
| c. Not suitable                         | 0                  | 0                  | 0                  | 0      | 0          | 0.00      |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| 2. Qualify seeds and labeled             |                    |                    |                    |        |            |
| a. Suitable                             | 16                 | 14                 | 14                 | 18     | 62         | 77.50     |
| b. Less suitable                        | 4                  | 6                  | 4                  | 2      | 16         | 20.00     |
| c. Not suitable                         | 0                  | 0                  | 2                  | 0      | 2          | 2.50      |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| 3. Organic matter utilization           |                    |                    |                    |        |            |
| a. Suitable                             | 0                  | 0                  | 0                  | 0      | 0          | 0.00      |
| b. Less suitable                        | 3                  | 2                  | 2                  | 4      | 11         | 13.75     |
| c. Not suitable                         | 17                 | 18                 | 18                 | 16     | 69         | 86.25     |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| 4. Legowo cropping system               |                    |                    |                    |        |            |
| a. Suitable                             | 5                  | 3                  | 3                  | 13     | 24         | 30.77     |
| b. Less suitable                        | 12                 | 12                 | 11                 | 4      | 39         | 50.00     |
| c. Not suitable                         | 4                  | 5                  | 6                  | 0      | 15         | 19.23     |
| Amount                                   | 21                 | 20                 | 20                 | 17     | 78         | 100.00    |
| 5. Specific fertilization               |                    |                    |                    |        |            |
| a. Suitable                             | 2                  | 2                  | 2                  | 4      | 10         | 12.50     |
| b. Less suitable                        | 18                 | 18                 | 17                 | 16     | 69         | 86.25     |
| c. Not suitable                         | 0                  | 0                  | 1                  | 0      | 1          | 1.25      |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| 6. Pest control                         |                    |                    |                    |        |            |
| a. Suitable                             | 3                  | 2                  | 2                  | 4      | 11         | 13.75     |
| b. Less suitable                        | 15                 | 13                 | 14                 | 12     | 54         | 67.50     |
| c. Not suitable                         | 2                  | 5                  | 4                  | 4      | 15         | 18.75     |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| Selected components:                    |                    |                    |                    |        |            |
| 7. Perfect Tillage                      |                    |                    |                    |        |            |
| a. Suitable                             | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| b. Less suitable                        | 0                  | 0                  | 0                  | 0      | 0          | 0.00      |
| c. Not suitable                         | 0                  | 0                  | 0                  | 0      | 0          | 0.00      |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| 8. Young seedlings utilization (age <21 days) |                    |                    |                    |        |            |
| a. Suitable                             | 20                 | 18                 | 18                 | 20     | 76         | 95.00     |
| b. Less suitable                        | 0                  | 2                  | 2                  | 0      | 4          | 5.00      |
| c. Not suitable                         | 0                  | 0                  | 0                  | 0      | 0          | 0.00      |
| Amount                                   | 20                 | 20                 | 20                 | 20     | 80         | 100.00    |
| 9. 1-3 seedlings per clump              |                    |                    |                    |        |            |
| a. Suitable                             | 20                 | 18                 | 14                 | 20     | 72         | 90.00     |
| b. Less suitable                        | 0                  | 2                  | 6                  | 0      | 8          | 10.00     |
All farmers (100%) do not use a gastrok to weed paddy field. Generally they do manually, revoke, weeding and remove existing weeds in paddy field. The use of gastrok not yet entrenched. The lack of information about gastrok causing farmers in the study sites is not aware of any such tool. Harvest and post-harvest management have been completed by farmers as much as 83.75%, while the other 16.25% did not disclose the true post-harvest but the constraints are limited and grain threshing machine (thresher) so had to wait 1-2 days after it had a turn for threshing.

3.4. The Increasing Adoption Factors
The increasing technology adoption on integrated crop management of rice on study sites is not affected by the characteristics of the respondent, such as; age, education and experience of farmers in rice cropping. This is showed by the same adoption level even though the characteristics of the different farmers.

The study showed the rate of adoption is influenced by several factors, among others: the implemented technology is easy, uncomplicated. The technology is also cheap but in accordance with the conditions of society and new technologies can provide more benefit to them (increase yield). Technology on integrated crop management of paddy fields that are mentioned above are more likely to be adopted by farmers.

From the various components of the basic technology and the selection of integrated crop management of paddy fields, which have not been adopted by the respondents were: intermittent irrigation, organic fertilizer utilization, weeding with gastrok. While the limited technology adopted by some farmers is legowo row cropping system.

The Result of research Mariano et., al [6] In the Philippines, the government must consider short-term strategies that offset environmental difficulties such as drought and immersion. government intervention to improve the education status of farm households, address the effects of small farm sizes and encourage more profit-oriented behaviour by farmers is needed to increase technology adoption in rice production in the long run

4. Conclusions
The technology adoption rate on integrated crop management of rice in Pidie, North Aceh, Aceh Barat and Aceh Barat Daya Districts is not influenced by the characteristics of the respondent, such as; age, education and experience of farmers in rice cropping. The technology adoption rate on integrated crop management of rice is still limited to the use of the technology components of new varieties and seed
labeled. From the various components of the basic technology and the selected of technology adoption rate on integrated crop management of rice, which have not been adopted by the respondents were: intermittent irrigation, organic fertilizer utilization, weeding with gasrok. While legowo row cropping system is still limited. The adoption rate on integrated crop management of rice is influenced by several factors, among others: the implemented technology is easy, uncomplicated. The technology is also cheap but suitable with the conditions of society and new technologies can provide more benefit to them (increase yield).

5. Recommendation
To increase the adoption in order to increase of rice productivity in Aceh Province, some steps can be taken, namely: (1) conduct internalization, socialization, advocacy and promotion, (2) achieve institutional support, (3) build a partnership, (4) provide guidance and (5) accelerate the flow of dissemination by utilizing a variety of channels to produce a broader spectrum. Improved knowledge and skills of agricultural extension as an information carrier agent of innovation through increased intensity of training and demonstrations for agricultural extension on integrated crop management of paddy rice.

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