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To cite this article: F Y Adriyani and K K Rangga 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1027** 012036

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The impact of transplants machine on acceleration of innovations adoption in rice cultivation in Lampung Province

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Abstract. The use of machinery in agriculture is mainly to solve the problem with the scarcity of labor. In fact, this innovation is not automatically accepted by farmers, especially in areas with large labor force. This study aims to determine the impact of transplants machines on rice cultivation. This paper was written as literature study and based on the author's experience since 2014-2020 as extension worker in rice cultivation assessment in Lampung province. The result shows that the use of rice transplants machine has a particularly positive impact on increasing the application of innovation such as improved nursery techniques, use of young seedlings, and use of legowo planting systems. In addition, the use of transplants machines also causes changes in society and has a negative impact such as the emergence of competition between farm workers and transplants machine service providers.

Keywords: Technology; Transplanter; Paddy; Legowo; Adoption.

1. Introduction

The agricultural sector in general and in particular the conventional management of plant cultivation requires a large workforce, starting from land processing to harvesting and post-harvesting. Even there is increasing in population, seems that it will not cause problems in employment. Agricultural sector always faces problems with the need for labor. The amount of labor in land preparation and planting activity in rice cultivation is higher (370.7 hours) than plant protection (194.8 hours) and harvesting (109.2 hours) activity [1]. This fact could impact to the time for planting in rice cultivation that is mainly depend on planting workers.

The problem of labor scarcity in the agricultural sector is likely to increase with the development of science and changes in mindset. It is undeniable that the interest of the younger generation to work as farmers is decreasing and there is a tendency to choose to work as factory workers or private companies.

To overcome this, the use of machines is an alternative solution to the problem. Machine could replace human labor. However, even farmers know that the use of machine could decrease amount of labor but farmers doesn't directly move to machine in order to replace human labor, for example only a few farmers use transplanting machine in rice cultivation [1]. Furthermore, technology does not necessarily solve all problems in the community. In fact, the existence of technology might be the cause of some problems for example is the use of rice planting machines (transplanters). The use of transplanter has a positive impact, especially in increasing the application of innovation and productivity



which ends in increasing welfare. In addition, the use of transplanter can also bring about changes in society that can have a negative impact if they are not wise to respond.

The following is a discussion of how the application of an innovation has an impact on the pattern of people's lives.

2. Materials and methods

This paper was written as literature study and based on the author's experience since 2014-2020 as extension worker in rice cultivation assessment in Central Lampung Regency (Seputih Raman, Seputih Banyak and Seputih Agung District), East Lampung Regency (Raman Utara and Purbolingo district), South Lampung Regency (Candipuro District), Tanggamus Regency (Gisting District) and Pringsewu Regency (Gading Rejo and Ambarawa District) Lampung province.

3. The impact of rice transplanting machine (Transplanter)

3.1. Increase the adoption of other innovation.

Innovation has some characteristics that influence someone to adopt it and one of characteristics is complexity [2]. Reduction in production cost is encouraging the adoption of innovation in rice cultivation meanwhile complexity and compatibility is obstructed factor in adoption [3]. Complexity is related to difficulty. Farmers usually avoid innovation that is difficult to use and understand. However, there are some innovation that could make user easier to use the other innovation.

3.1.1. Nursery. Nursery is main activity for most farmers in rice cultivation. However, many farmers don't pay attention for how doing good nursery. Many research showed that density and age of seed in nursery are influenced the growth and yield. Low density nursery could give a good place for seed with low competition for nutrient and light so it will be vigorous [4]. Productive tillers are increasing when we use vigorous seed and wider nursery area (low density seedling nursery) through lower competition among seed [5]. However, farmers are reluctant to carry out nursery with low density. Low density in nursery means more area for nursery. Based on the results of interviews with farmers, farmers' hesitancy is as a result of their observations and experiences that the rice that is planting in ex field nursery will be grow poorly. So, the wider the nursery, the more land that is not good for planting. In addition, another cause is the cost of making wider nursery will be increase (increasing production costs). Through the use of a transplanter, farmers could solve their problems in nursery width. The use of a transplanter requires a special nursery model that is using a tray called the dapog system. In this nursery, the nursery can be done in the yard and doesn't decrease quality of rice field.



Figure 1. Nursery system in implementation of rice transplanting machine

3.1.2. Young seedlings. The age of rice seedlings at transplanting has a direct effect to plant growth and yield [5]. More productive tillers and higher yield unit⁻¹ area will be obtained by planting healthy and vigorous seedlings, because mortality rate after transplanting will be decreased [6]. Furthermore, based on several studies that have been carried out, the advantages of planting young seedlings are that plants can grow better with the number of tillers tend to be more. Other study showed interaction between seedling density in nursery, transplanting age of seed, and variety. High seedling density should not transplant at older age because the yield will be reduced drastically and the higher yield could be reached if farmers transplanted young seedling from low seedling density nursery [7]. The effect of seedlings age will be different by varieties. In planting Dendang varieties, 14 DAS seedlings tended to show better in shoot dry weight [8]. Other result showed that in planting local varieties, higher productivity will be obtained when use 21 DAS seedlings [9]. However, the advantages of using these innovations are not necessarily able to increase the application of young seedlings by farmers. Problems encountered in the use of young seedlings include (1) limited availability of planting labor, (2) most planting labor reject young seedling because its size is smaller than old seedling, (3) some area is not suitable for young seedling because the presence of snail pests and rainfed with uncertainty rainfall [7]. The use of a transplanter can anticipate obstacles in the application of young seedlings because the transplanter can substitute and reduce the amount of labor. Farmers won't be depending on planting labor and could use young seedlings. Additionally, the use of transplanter need some requirement for seed such as seed height so that will be force farmers to use young seedling.

3.1.3. Implementation of Jajar Legowo Planting System. The jajar legowo planting system is one of the technological engineering that has become a government program to be developed in order to increase rice productivity to support the P2BN Program. The jajar legowo 2:1 and 4:1 rice planting systems have been introduced in Central Lampung Regency since 2000 and have been shown to increase rice productivity and income by 15-20% compared to the conventional planting system. However, until now the development of the adoption of the row legowo planting system every year is still less than 10% of the total existing planting area. Some research showed that farmers are doubtful in applying jajar legowo planting system [10], the knowledge about jajar legowo doesn't associated with implementation of this innovation [11]. Based on the interview with farmers, the obstructing factor in adoption of Jajar legowo planting system is the jajar legowo planting system still used human labor. The population in jajar legowo planting system increase about 30% and as a consequence of that, labor need extra time and energy to planting with this system. Moreover, even though the planting costs are increased, the planting labor tends to still choose the conventional planting system. The adoption rate for jajar legowo planting system is slow, farmers has difficulty to implement this innovation because of a few labor want and able to use this planting system and planting legowo jajar could spend higher costs [10]. In addition, the jajar legowo planting system is influenced by the complexity [12]. The scarcity of planting labor is main influence the implementation of jejer legowo planting system. With these considerations in mind, the Agency for Agricultural Research and Development has introduced a jajar legowo rice planting machine, named Indo Jarwo Transplanter 2:1. The operation of the transplanter is relatively easy and simple and could be operated by 2 - 3 people with the division of tasks for one person as an operator, one provider and transporter of seeds and one embroiderer for empty clumps moreover it can be completed within 5-6 hours ha⁻¹ with an operational cost of Rp.500,000 [13].



Figure 2. The using of rice transplanting machine and “jajar legowo” implementation

3.2. Farmers Income

The presence of the rice planting system with the jajar legowo planting system is a solution from the labor aspect, reducing work costs, and accelerating the work process. This planting machine is very prospective to be socialized in order to increase the planting area of jajar legowo rice which is an innovation that could increase rice productivity.

In areas with limited manpower, especially planting workers, the presence of rice planting machines (transplanters) is welcomed by farmers and other technology users, with the hope of solving the problem of scarcity of planting labor. Transplanters in Jarwo Super cultivation only require 2 - 3 workers with a planting time of 5 - 6 hours /ha (Kiswanto, 2014) it means a transplanter could reach 1 ha planting area per day this is much more efficient in terms the amount of labor needed in conventional planting. Although the planting cost by using a transplanter is the same as conventional (human labor) that is around Rp. 600,000-800,000, but for planting with human labor there is an additional labor cost to make lines and divide the seeds which is around Rp. 200,000 and an additional cost for removing the seeds from nursery bed which is around Rp. 400,000. These additional costs showed that using a transplanter has lower cost production for planting that is about Rp, 600,000. The study showed that the application of Jarwo Transplanter as a rice-planting machine could increase 23.64% of productivity and 39.40% of farmers' income comparing with the conventional method of planting. Moreover, the application of Jarwo Transplanter as rice planting machine more efficient with the R/C ratio of 2.71 and BEP Rp.1.550/kg, meanwhile the conventional planting has the R/C Ratio 2.27 and BEP 1,850/kg. The Marginal B/C Ratio 14.90 indicated the rice planting by using Jarwo Transplanter machine had opportunities to be developed in a wider area [14].

4. Strengths and weaknesses in using transplanting machines

Another study showed that the efficiency of the use of labor with the jarwo transplanter machine in tidal land was 73.63% by reducing planting costs by Rp. 1,472,500 due to manual labor savings of 37 HOK/ha [15]. Rice productivity with the use of a transplanter is higher than the manual method, which is 6.80 tons/ha compared to 6.41 tons/ha because the distance and depth of planting using a transplanter machine can be more uniform so that plant growth can be more optimal [16].



Figure 3. Comparison labor in conventional rice planting and using rice transplanting machine

In addition to advantages, there are weaknesses in the use of transplanters that is related to its adoption. The adoption of rice transplanter in Lampung Province is still low (17,07%) [17]. The reason they are reluctant to use transplanter planting tools is because it could change the existing cultural system (shifting the planting force). The use of transplanters in areas with an adequate planting labor can create new problems. The problem is mainly because of the competition between planting workers and the use of transplanters which in turn has an impact on the income of the farming family from planting workers. Actually, the income of the farming family is not decrease. This is based on the fact that the planting labor come from farming families. The reduction in family income from planting labor can be substituted by an increase in farm income margins on account of the reduction in planting costs. In addition, planting workers who lose their jobs can be transferred to workers for making nurseries for the dapog system. In this case, the planting laborers, who are mostly women, still have other income with jobs that are physically easier.

Another problem face to adoption of transplanter is the price of transplanter is relatively expensive so it is not affordable for individual farmers furthermore an analysis showed that benefit reduction or increase in cost of transplanters can be a reason for entrepreneur to be away from adopting transplanters because its profit is not as their expectation [18]. Rice transplanter machine technology also need some suitable requirement both a technical side or land area as well as socio-cultural or customs [19]. The innovation which has high compatibility will be adopt faster by farmers [20].

The rice planting machine (transplanter) is an innovative technology, in its application it must pay attention to the social, economic and cultural conditions of local farmers, to avoid the eviction of farmer workers. Therefore, the development of the Indo Jarwo Transplanter machine is currently concentrated in areas where the workforce is limited.

5. Conclusion

In conclusion, the use of rice transplants machine has a particularly positive impact on increasing the application of innovation such as improved nursery techniques, use of young seedlings, and use of legowo planting systems. The advantages of the transplanter include (1) it can speed up planting time, reduce planting costs, (2) overcome the scarcity of planting labor, (3) use only 2 workers, (4) reduce production costs and be more efficient, (5) easy to operate, (6) uniform spacing and depth of planting so that plant growth can be optimal and uniform. In addition, the use of transplants machines also causes changes in society and has a negative impact such as the emergence of competition between farm workers and transplants machine service providers.

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