Prototype of Sliding Type Rice Transplanter for "Tapak Macan" Cropping Pattern

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Abstract. The "tapak macan" planting system is one of the technologies that has been proven to be successful in increasing rice productivity in the Special Region of Yogyakarta to 16–17 tons/ha. The "tapak macan" is a planting system that uses three stems planted with a triangular symmetrical pattern, with the distance on each planting point on one clump 5–7 cm. Although it can increase rice productivity well, the implementation of the system is still done manually. Based on these constraints, a Rice transplanter prototype for "tapak macan" was created by the Department of Agricultural and Biosystems Engineering Universitas Gadjah Mada to solve that problem. From the laboratory's performance testing, the best result was 3.68 rice seeds taken for A1, 5.82 for A2, and 3.88 for A3. Based on these results, it can also be seen that the performance of testing the prototype in the laboratory is still far from the planting requirements of the "tapak macan." Hence, improving the prototype's performance is necessary before the public can accept it. In addition, rice seeds with a ribbon shape are also needed for using the prototype. Therefore, a new prototype was made from a transplanter that used seeds in a square shape. That seed's shape is usually used by transplanters already on the market. The development base was chosen so that the community can more accept the prototype that will be made. In the end, the wider community can apply the "tapak macan" planting system with excellent potential. Based on this research, a prototype has successfully taken 2,5 seeds at each planting point. This prototype also has advantages that can use to plant with another planting pattern. With this prototipe hoped that later with this tool, it will be able to overcome general agricultural problems, namely related to planting power. Specifically, it can help implement the "tapak macan" system. Indirectly, with this prototype, it is also hoped that it can increase rice productivity in Indonesia.

Keywords: Technology · Agriculture · "tapak macan" · Rice Planting System · Rice Transplanter

1 Introduction

The "tapak macan" planting system is one of the technologies in rice cultivation that has been proven successful in increasing rice productivity. The "tapak macan" planting

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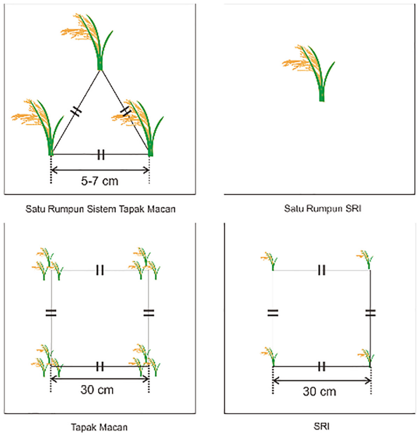

Fig. 1. The different between "tapak macan" and SRI rice cropping pattern

system in the Special Region of Yogyakarta has increased rice productivity to 16–17 tons/ha [1]. These results are better than average because the national rice productivity in Indonesia, based on data from the Badan Pusat Statistik, is only in the range of 5.3 tons/ha. From these results, it can also be seen that the potential of implementing the tiger tread planting system is enormous in increasing the cultivation value of rice plants.

The "tapak macan" rice planting system is a modification of the SRI (System of Rice Intensification) [5]. SRI is a rice planting system that recommends the planting pattern with the number of seedlings as one stem per clump, with a distance on each clump of 30 cm [6]. Modifications on the SRI planting system to make it a "tapak macan" are on the planting pattern. If SRI used one stem per clump, the "tapak macan" planting system uses three stems planted with a triangular symmetrical pattern, with the distance on each planting point on one clump being 5–7 cm.

Although it can increase rice productivity well, the implementation of the system is still done manually. Based on these constraints, a Rice transplanter prototype for "tapak macan" was created by Agricultural and Biosystems Engineering Universitas Gadjah Mada to solve that problem [1]. The rice transplanter is a semi-mechanical transplanter driven by human power [azmi]. Furthermore, when the prototype has tested the performance of the planter unit in the laboratory, the best results were obtained the average number of seeds taken was 6.4 rice stalks for the A1 fork, 8.0 rice sticks for the A2 fork, and 6.2 rice stalks for the A3 fork [2]. The prototype was then tested on the feeding unit and obtained the average yield of rice seeds for each point of 5.4 stems per clump [4]. Then the best settings were combined and obtained from the two tests, resulting in 3.68 rice seeds taken for A1, 5.82 for A2, and 3.88 for A3 [3] (Fig. 2).

Based on these results, it can also be seen that the performance of testing the prototype in the laboratory is still far from the planting requirements of the "tapak macan." Hence, it is necessary to improve the work performance of the prototype before the public can accept it. In addition, rice seeds with a ribbon shape are also needed for using the prototype. The shape of the seeds is also an obstacle to the public's acceptance of this prototype because a specially shaped tray is needed to make it.

(a)

(b)

Fig. 2. (a) Rice transplanter prototype for "tapak macan" rice cropping pattern (b) Planting forks

Therefore, a new prototype was made with a transplanter that used seeds in square shapes. The square shape is a seed used by transplanters already on the market. This development base was chosen so that the community could accept the prototype that would be made. In the end, the tiger tread planting system that has the great potential can be applied by the wider community.

2 Materials and Methods

The research method used is direct observation. Furthermore, the research stage is divided into six stages.

The first stage is the literature study and continues with direct observation of the previous prototype, including seedlings on the customized trays. When the data was obtained, then the design concept was created. And then, the design got evaluated when

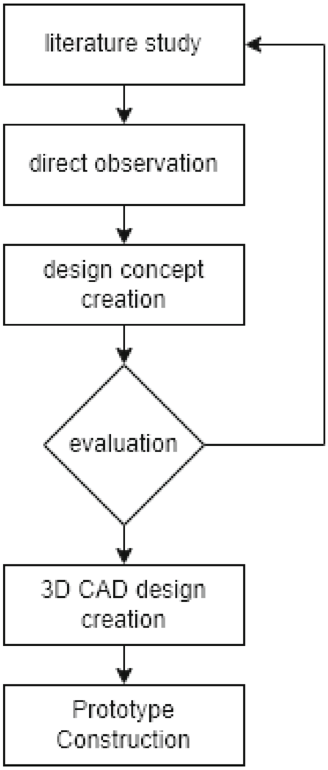

Fig. 3. The steps of "tapak macan" rice transplanter research

design was possible to create. Then the process continued to the 3D CAD design creation step and ended with the prototype construction. Based on the results of literature studies and direct observations that have been carried out, it was decided to carry out reverse engineering. This reverse engineering activity is based on a semi-mechanical rice planting tool of the "jajar legowo" type, which farmers have widely used. Furthermore, from the tool, a concept design was made that contained an overview of the prototype that would later be made (Figs. 3 and 4).

After that, the concept drawing was evaluated, and decided to make a prototype of a rice planting tool capable of planting rice with a "tapak macan," Then, the prototype was named ATP TM G-1. The rice transplanter originally planted with a planting distance of 20-25cm was then changed to 30 cm. In the slider mechanism, it will serve to shift the top by 120º, which is intended to be able to form an equilateral triangle-shaped planting pattern. The ATP TM G-1 prototype is a transplanter composed of three parts: the upper part (planter unit, feeding unit, and frame), the slider mechanism part, and the bottom (surfing). Two partners carried out the prototype's construction process, for the upper part was constructed in the "badoel" workshop in Jenangan District, Ponorogo Regency, East Java Province. For the slider, the bottom, overall assembly, and finishing

Fig. 4. The steps of "tapak macan" rice transplanter research

Fig. 5. ATP TM G-1

were carried out in the mechanical engineering department workshop, SMKN 2 Depok, Sleman Regency, Special Region of Yogyakarta (Fig. 5).

After the prototype was created, then continued with the functional testing to occur the seeds picking performance was. Primarily to know whether the prototipe's seeds picking performance can surpass the requirement of tapak macan to pick one seed for one planting point or not.

3 Result and Discussion

From the laboratory's performance testing, the result of seed picking performance is an average of 2,5 seeds. After getting that result, the sliding mechanism was equipped to give the ability for planting tapak macan pattern and then got the result shown in Table 1.

Table 1. The result of Seeds Picking Performance

	A1	A2	A3
Seeds Picked	2.5	2.4	2.6

From the result, we knew that the sliding type prototype has enhancement compared to the prototype before. The previous prototype only resulted in 3.68 rice seeds taken for A1, 5.82 for A2, and 3.88 for A3. We knew that the sliding type had a significant improvement. The sliding type can take 2.5 seeds and is closer to one stem for one planting point. Using that mechanism also made the difference between each planting point closer. The rising performance made by the sliding type makes it possible as an actual mechanism product for the tapak macan transplanter.

The prototype is designed modularly to be carried easily. It also could plant the seeds with various patterns, are "tapak macan," "jajar legowo," SRI, and "tegel" planting patterns. For planting "tapak macan" patterns, use the slider part as a pattern-making mechanism and adjust the number of seedlings taken. For "jajar legowo" use, only the top and bottom parts are used, and adjustments of planting distances are required. For planting "tegel" models, only using top and bottom parts also adjusting the marker for space between rows is required. Moreover, only use the top and bottom parts for the SRI planting pattern and adjust the picking angle.

4 Conclusion

Based on this research, we knew that the prototype with a rectangular seed shape had a performance on seeds taken was 2.5 seeds on average for each planting point. The prototype also can plant various rice planting patterns, including tiger tread, legowo jajar, tegel, and SRI. It is hoped that later with this tool, it will be able to overcome general agricultural problems, namely related to planting power. Specifically, it can help implement the "tapak macan" system. Indirectly, with this prototype, it is also hoped that it can increase rice productivity in Indonesia.

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