ISBN 978-602-344-252-2

# Contribution of agricultural mechanization in rice production system to support sustainable agriculture in Klaten Regency, Central Java

*Uning Budiarti*, dan Reni Yuliana*
*Jl. Sinarmas Boulevard, Pagedangan, Tangerang, Banten 15338. Telp. 08119936787*
**Coressponding author: Email : bbpmektan@litbang.deptan.go.id, bbpmektan@yahoo.co.id*

***ABSTRACT***

*Development of agricultural mechanization can not stand alone, because it is a sub system in the production process. Many studies shows, that agricultural machinery have a very close relationship with the socio-economic dynamics of agricultural production system that requires a good management for agriculture machineries management which is known as UPJA as custom hiring. Implementation of agricultural mechanization in the concept of modern agriculture can increase work capacity in agricultural production process in every stage of production process, reduce production cost by increasing efficiency and productivity, decrease losses, and improving product quality. Hand tractor, paddy transplanter, power thresher and combine harvester has been used in paddy farming system in Klaten district, Central Java. The contribution of the use of agricultural machineries to sustainable agriculture is as follows; increase the work capacity so that it can overcome the delay of planting time, therefore simultaneous planting can be realized. With simultaneous planting, pest control will be easier, because the life cycle of pest can be cut off. The management of agricultural machineries that is part of the agricultural corporation is realized in Gapoktan, so that rice production system is integrated in a collaboration of rice production activities through grain processing into rice, increasing the profit margin to reach about Rp. 2.500.000-3.739.000/ha. Increasing this profit becomes one of the impetus for farmers to produce and participate in sustainable agriculture.*

Keywords: rice, agricultural mechanization, sustainable agriculture

## INTRODUCTION

Sidowayah is one of the villages in Klaten which is one of the centers of rice production, its fertile soil and the availability of water throughout the year causes farmers to grow rice throughout the year or in other words not simultaneously. This condition causes production to be available throughout the year, but on the other hand this also makes it difficult to break the life cycle of plant disturbing organisms.

The optimal utilization of alsintan allows simultaneous planting. However, the trend of employment interest in agriculture has decreased as a

ISBN 978-602-344-252-2

result of the power to manage the farm has decreased from year to year. The symptoms of aging farmer are very clear, where those involved in agriculture are the elderly who are dominated by the age range of 50 to over 60 years. The management of farmer organizations, both UPJA and farmer groups, is also dominated by the elderly. On the other hand, the assistance of alsin can overcome this problem, but alsintan assistance has not been used optimally so that it has not contributed significantly to the optimal production process as expected. Cultivation and cropping patterns follow a limited pattern of labor and at will so that the growing season is not simultaneously resulting in the development of plant-disturbing organisms which can break the sustainability of rice production. Cahyati et al. 2015, shows that the use of agricultural machinery is common in Sidowayah village. The use of alsintan in rice farming systems is more efficient than manual. Judging from the aspect of time can increase efficiency by 46.93% - 47.61%, whereas from the aspect of the number of people working can increase efficiency by 72.34%. Based on the results of the analysis of the cost of rice farming, it is known that the cost of farming using alsintan is lower when compared to the manual method. From the results of the analysis it is known that the total labor cost of manual rice farming is Rp. 13,161,000 / ha, whereas if using alsintan in full (except weeding) is Rp. 12,279,000 / ha or can increase cost efficiency by 6.70%.

The real contribution of agricultural mechanization to the sustainable rice production system is very much determined by the institutional role to optimize the use of agricultural machinery. Institutional strengthening is needed so that the Alsintan manager, the Agricultural Machine Tool Service Unit, can be independent and economically profitable. In fact, it is expected that the Agricultural Machine Tool Services Unit (UPJA) can complete the needs of agricultural machinery independently by buying from the proceeds obtained to support production and simultaneous cropping patterns. The three main farmer institutions involved are the farmer group, Gapoktan and UPJA. Agricultural Machinery Equipment Service Unit is one of the divisions in Gapoktan. This is in accordance with the 2015 Modern Agricultural Pilot Implementation Guidelines issued by the Directorate General of Agricultural Infrastructure and Facilities of the Ministry of Agriculture in 2015. The organizational configuration of farmers is expected to change the crop selling system that has been using a slash system. farmers are "entangled" to sell rice in a slash to middlemen with a weak bargaining position in determining the amount and price. This has become an obstacle and root of problems that indirectly causes the low motivation of farmers (who are mostly sharecroppers) to adopt agricultural innovations offered, including the innovation of agricultural machinery.

ISBN 978-602-344-252-2

**Objectives**

- Application of modern agriculture with optimal application of agricultural machinery
- Simultaneous planting breaks the food chain for plant disturbing organisms and preventing pest attacks
- Remember production efficiency and reduce costs, increase farmer income

## MATERIALS AND METHODS

### Model Concept

The application of mechanization is done through institutional approach with the rationale of corporation development in developing integrated agricultural area which by applying the Economies of scale principle, the broader the business management the more efficient the cost which includes the crop management, the cost of production facilities, the transportation cost and the marketing cost of the farming product. With the corporation will also be obtained ease in terms of access to information, access to capital, bergaining poistion in the market. By developing a corporate system means consolidation efforts farming activities conducted by farmers with the application of management principles as a company owned farmers needed to achieve effectiveness, efficiency and sustainability.

The essence of the corporate concept is to build cooperation through a single management system, by merging small farms into a large scale business that meets economies of scale to become more efficient, high productivity, homogeneous products, and higher production quality that are prerequisites for improving competitiveness, added value and improve production quality. Small farming enterprises that are joined in a landscape are managed with good agricultural management systems, such as mechanization menagement, planting same variety, same technology treatment, good harvesting system and good post harvest management.

In this corporate model, the market determine the quantity and quality of the supply of raw materials sourced from producers (Association of Farmer Groups / Farmers 'Association) through Farmers' Economic Enterprises (KEP / Koperasi / BUMP / BUMDES / BUMR). Farmers Economic Enterprises (KEP / Koperasi / BUMP / BUMDES / BUMR) through partnerships with agro input institutions provide services of production facilities to the Association of Farmer Groups / Farmers' Association to produce the necessary raw materials of a Trading Business Group or Industrial Business Group. Farmers' Enterprises (KEP / Koperasi / BUMP / BUMDES / BUMR) also built partnerships with financing institutions to serve the various needs of the Joint Farmer Groups in

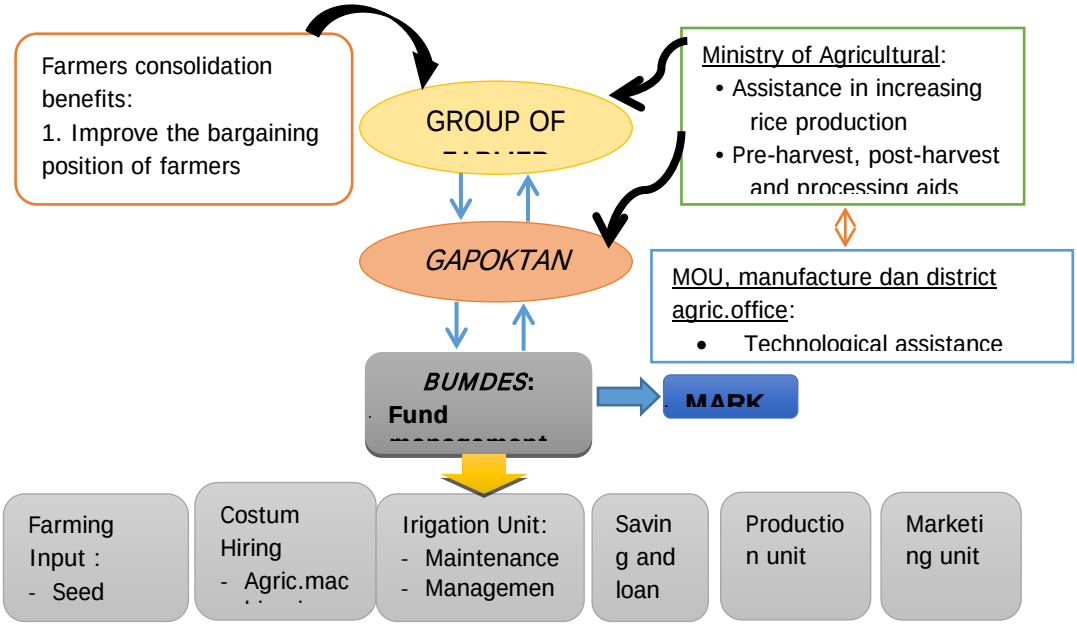
ISBN 978-602-344-252-2

the production process of farming through developed business units (Figure 2). The stages in the development of a corporation are: (1) Preparatory stage which includes diagnostic studies to get an overview of the characteristics of the region, designing models for establishing corporate rules and organizations in which the rights and obligations of farmers are included; (2) The model development stage that includes the design of consolidated production management to seek the benefits of the on-farm management unit and seek alternative off farm and non-farm alternatives and the consolidation design of the marketing and marketing management ; (3) Stages of land management, where farmers are expected to entrust business management to corporations; and (4) the model stabilization stage, where the farmer has fully consolidated the manjamen and there has been an expansion of employment opportunities (inside or outside the corporation). In the context of the development of integrated corporate-based agricultural areas, each stage of growth of KEP / Koperasi / BUMP / BUMDES / BUMR, the role of Agricultural Extension is required. The role of agricultural extension as a facilitator, motivator, companion and supporter of farmers' business movement is the central point in growing cooperatives / BUMDES that meet 7 criteria requirements, namely; (1) Has engaged in market-oriented group activities; (2) The organizational structure of the farmer's organization has a management that conducts business activities or agribusiness unit; (3) Have a business plan developed in a participatory manner within a certain time or business cycle; (4) Having recording and bookkeeping of business; (5) Has built network in business development with other farmer institution; (6) Has established business partnerships with entrepreneurs or other peasant economic institutions; and (7) Requires formal legal support to strengthen business development. The mechanization model that will be developed is covering one Gapoktan area with wetland agro-ecosystem, with an area of about 100 ha which is done simultaneously planting.

**Activity Implementation Steps**

The methodology of this research consists of desk study and FGD, field survey, modification and improvement of agricultural machineries configuration if necessary, socialization and mentoring of *Gapoktan / UPJA* (costum hiring), *UPJA* performance evaluation, data analysis and reporting. Briefly the stages of activity in this study are shown in the diagram as shown in Table 1.

ISBN 978-602-344-252-2




Figurer 1. Concept of corporation in developing farming area

Tabel 1. Research activity steps

| Steps | Methods | Output |
|---|---|---|
| Model Designing | Desk study | Questionaire |
| Qusionere listing<br>Identify area<br>- Agroecosystem<br>- Existing technology<br>- Farmer Institutional | Survey<br>FGD<br>Evaluation of institutional performance | Configuration of existing technology components<br>Existing institutional performance data |
| Model Implementation<br>Farmer Institutional strengthen | Coordination, socialization, advocating, Modification, repair and maintenance of agric.mach | Implemented model |
| Improving skill of operator | Evaluation of institution performance | Implemented model |

## RESULTS AND DISCUSSION

### Technical and Management Assistance

Technical assistance is carried out through training in the manufacture of breeders for breeding, training on the use and maintenance of planting and harvesting machines (paddy transplanter and combine harvester). The training

ISBN 978-602-344-252-2

was conducted by ICAERD for young farmers as operators and technicians. Management assistance is carried out to strengthen institutional management of farmers including UPJA institution; such as bookkeeping improvements, regular meetings, comparative studies, reorganization to revitalize gapoktan.

The meeting with the farmer group committee was conducted to find out the progress of activities and obstacles faced in the field. Based on data obtained in the field, from 100 ha the location of the application of the model has been done rice planting using transplanter as much as 71,617 hectares. In general, farmers acknowledge the use of transplants can increase production. In the provision of seeds, the group helps make a nursery in a dapok. After the seeds grow about 3 cm, then the seeds are distributed to all members of the group and placed in their respective fields.

For UPJA bookkeeping, has been done orderly administration that each machine has its own records so that it can be known machine performance and record for maintenance. It is expected that UPJA in determining the renting price of machineries, not only based on the needs of operational costs alsintan only but can be to buy new machinery if severe damage. So far, the majority of farmers' crops are sold by slaughter. The difference between the selling price of grain and the way weighed can reach the range of 1.5 - 2 million rupiah per hectare, higher that weighed. In the future, Bumdes is expected to be able to accommodate / buy grain farmers with the price of rice with reduced processing costs so that farmers will get higher yield than usual. Seeing the size of the price difference received by farmers, Bumdes hopes to buy grain farmers with a higher price that is bought at a reduced price of rice processing. Currently Bumdes only manages 7 hectares of land which is a village land, while other businesses are managing Bumdes Nature tourism and cooperation with BNI and Bulog.

ISBN 978-602-344-252-2

Figure 1. Field activities

**Farmer Institution in Sidowayah Village**

One of the activities in this study, which is classified as action research, is carried out by institutional strengthening consisting of strengthening management, organizing costum hiring, and workshops. Institutional strengthening is intended for UPJA manager to be independent and economically profitable in their business. Furthermore, it is expected that UPJA can purchase other machinery from their profit. UPJA as a part of gapoktan can not be separated from the progress of the parent organization (Gapoktan), existing conditions that occur in the village Sidowayah is still weak institutional, there has been no routine activities conducted both social and economic activities. So that the economic benefits of the rice production system in this village are mostly enjoyed only by traders.

To improve the knowledge and knowledge of Sidowayah farmers among others through a comparative study to the gapoktan that has advanced management, namely Gapoktan Sari Rejeki in the village of Pulosari, Karanganyar. The follow-up of the comparative study was started again at the regular meeting of selapanan (35 days) once by Gapoktan followed by 4 (four) farmer groups namely : *Tani Makmur, Sumber Agung, Agung Rejeki and Gemah Ripah*. Reorganized the management of Gapoktan Sidowayah with administrators and members who are interested in grouping for dynamic groups.

ISBN 978-602-344-252-2


Figure 2. Comparative study to more advance *Gapoktan*

With this new marketing, which is separated from pengijon, it will get a huge increase in added value that can be achieved by farmers and Gapoktan. The added value referred to is the difference in sales with weighed. During this time the sale without weighed and believed to only be valued at about Rp 3,000 an kg. Yet when this famine for example the price of grain GKP in the market between Rp 4,500 to 5,000 per kg.

Each plot of rice fields has the potential to add value of Rp 1.5 to 2 million, or equal to approximately Rp 5 million per ha. So the total value per planting season is Rp 5 million x 174.5 ha or more than Rp 850 million per season. If the index of crops 2.5, then at least can be obtained value added more than Rp 2 billion. Although the profit-sharing pattern is still fixed, but the farmers' income will increase as well.

ISBN 978-602-344-252-2

Table 2. Existing condition, design, and development of rice agribusiness institution in Sidowayah village

| Activities | Existing condition | Progress | Next Planning |
|---|---|---|---|
| Supply of seed, fertilizser, pesticide | In 2017 there is a seed grant from BPTP, while fertilizer subsidies, as well as pesticides and herbicides are purchased from kiosks | *Gapoktan/BUMDES* will provide all the seeds of need in Sidowayah village, and the rest will be marketed through BPTP. *Bumdes* is producing 7 ha of seeds by renting village land. | Seed production by a trained group of breeders in this village. |
| Land preparation | Using TR2 | Using TR2 | Combination TR4 with TR2 due to faster TR4 usage and better result |
| Planting | Less than 30 ha already use transplanter at MT III 2017 | There are 100 ha that already use transplanter, the rest still manual | Targeted all land (183 ha) using transplanter managed by *UPJA* |
| Harvesting | Already 50 percent use combine harvester, but belonging to *penebas* (middle man) | for MT II harvest in November 2017 will use CH optimally, as long as it is technically feasible | 100 percent using CH managed by *UPJA* |
| Rice milling Unit (RMU) | There are 2 private mills in this village, one of which is Mr. Wardoyo a wholesaler | There is an offer of using small size RMU Japanese production, but is able to produce premium rice. | *UPJA* has its own RMU |
| Paddy trading | Almost entirely purchased by large traders (Mr. Wardoyo). Other traders are difficult to get in, because of sosial approach | Agreed all the paddy bought by *Gapoktan* and marketed directly to alternative paddy traders | Purchased by other traders with weighed, with potential revenue increase of Rp3-4.5 million per ha. Or, bought by *BUMDES* |
| Rice marketing | Sold and packing by merchants | Some will be marketed by *BUMDES* | *Gapoktan* buy the paddy then milled, and the rice is marketed by *Bumdes* to the commercial market. |
| Cropping index | 1 to 3<br>By planting not simultaneously, wreng pest has the potential | 2 to 3<br>With simultaneous planting, pest control will be easier | 3<br>pest control will be easier,because the life cycle of pest can be cut off |

Source: analysis of primary qualitative information

ISBN 978-602-344-252-2

Table 3. Comparison of farming analysis per hectare of existing cultivation with Mechanization of Sidowayah village, Polanharjo, Klaten

| Number | Cultivate | Transplanting | | Weeding | | Harvesting | | | Drying | | Rice Milling unit | | Benefit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | cost | conventional | Transplanter | conventional | P.weeder | by midle man* | by farmer** | | | | (RMU) | Total cost | Bruto | Netto |
| | | | | | | | P. Thresher | Combine Harvester | Conventional | Dryer | | | | |
| | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) | (Rp) |
| 1. | 300,000 | 550,000 | - | 40,000 | - | 1,000,000 | - | - | - | - | - | 1,990,300 | 9,000,000 | 7,009,700 |
| 2. | 300,000 | - | 315,000 | 40,000 | - | 1,000,000 | - | - | - | - | - | 1,755,300 | 9,000,000 | 7,244,700 |
| 3. | 300,000 | - | 315,000 | 40,000 | - | - | 1,000,000 | - | - | - | - | 1,755,300 | 11,500,000 | 9,744,700 |
| 4. | 300,000 | - | 315,000 | 40,000 | - | - | - | 800,000 | - | - | - | 1,555,300 | 11,500,000 | 9,944,700 |
| 5. | 300,000 | - | 315,000 | - | 250,000 | - | - | 800,000 | - | - | - | 1,365,300 | 11,500,000 | 10,134,700 |
| 6. | 300,000 | - | 315,000 | - | 250,000 | - | - | 800,000 | 80,000 | - | 157,900 | 1,603,200 | 12,632,000 | 11,028,800 |
| 7. | 300,000 | - | 315,000 | - | 250,000 | - | - | 800,000 | - | 125,000 | 157,900 | 1,648,200 | 12,632,000 | 10,983,800 |

Notes:
The land per plot is called *patok*
One *patok* is 1/3 hectare
Cost and value above is in *patok*
Paddy productivity is around 2500 kg/*patok*
Rice milling cost is 100 Rp/kg
Dryer cost is 100 Rp/kg
Dry paddy harvesting 4.600 Rp/kg; rice 8.000 Rp/kg
Transplanter hiring 275.00 Rp/plot; paddy nursery 40.000 Rp/plot
* middle man purchase paddy from field by predicting price (without weighing)
** farmer harvest their paddy, weighing and sell their paddy

Strengthening *gapoktan* institutions in synergy with *BumDes* empowering *gapoktan* to handle rice production system from providing input cultivation to harvesting, increase farmer income approximately Rp. 2.5 – 3.7 million per ha. The benefits of applying rice mechanization goes directly to farmers and changing harvest habits to be weighed by increasing farmers' income for sustainable rice production in Sidowayah village.

## CONCLUSIONS

1. Application of mechanization model in rice production systems improve technical, institutional and human resources.
2. The model of the implementation of mechanization Klaten Regency has followed by 4 farmer groups, including Farmers Makmur, Sumber Agung, Agung Rezeki and Gemah Ripah.
3. The implementation of the mechanization model increases the intensity of rice planting from 2.5 to 3.
4. Institutional strengthening through technical and management assistance at *UPJA* improve the skills of engineering operators.
5. The mechanization model optimizes the use of machinery so that simultaneous cropping patterns can be made, breaking the life cycle of pests so as to reduce the risk of crop failure and changing harvest habits to be weighed by increasing farmers' income for sustainable rice production.

ISBN 978-602-344-252-2

## REFERENCES

Ananto E., Handaka and Sutrisno. 2007. Economic of Rice in Indonesia. Edited by E. Pasandaran, F. Kasryno. Agency of Agricultural Research and development.

Indonesian Agency for Agricultural Research and Development (IAARD). 2016. Grand Design World Food warehouse. Paper Roadmap Development of Agricultural Mechanization Supports Strategic Commodities 2016 - 2045. Ministry of Agriculture. Jakarta.

Bambang Purwanta. 2011. Study of Rice Cultivation Input Method of System of Rice Intensification. *Journal of Agritech*, Vol.31, No.1, February 2011. Universitas Gajah Mada, Yogyakarta

Cahyati S, D Sahara, T Prasetyo. 2015. Application of Mechanization of Agriculture Towards Modern Agriculture System on Wetland, Central Java. In: Sahara D. et al. 2015. Innovation of Agricultural Mechanization for Rice Self-Sufficiency: Implementation and Dissemination. Indonesian Agency For Agricultural Research And Development (Iaard) Press Jakarta (pp 31)

Teguh P and C Setiyani. 2015. Innovation in agricultural mechanization to support increased rice production in Central Java. In: Sahara D. et al. 2015. Innovation of Agricultural Mechanization for Rice Self-Sufficiency: Implementation and Dissemination. Indonesian Agency For Agricultural Research And Development (Iaard) Press Jakarta (pp 17)