Technologies required to improve agricultural issues of Indonesia

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Abstract. Acceleration of mechanization is one of the effective methods to increase farming productivity. Mechanization status in Indonesian agriculture is not sufficient yet and the current objectives of mechanization is in the stage of intensification of production and relocation of manual labor from farming activities. However, mechanization should also support farm management to become industrialized to increase farm household welfare. By use of ICT technologies equipped on the advanced machinery can also contribute to optimize the effect of using machinery and maximize productivity in their activities as well as proper maintenance of the machine.

Keywords: agriculture, machinery, Indonesia, SMARTASSIST

1. Introduction

Indonesia is known as the most populated country in ASEAN countries and it is one of the most important policy to increase productivity of agricultural production especially of staple food products. Mechanization would improve the production, however, mechanization status in Indonesia is still not sufficient. This paper would like to suggest some of the technologies which will be required to improve farm management by utilizing machineries.

2. Method

This paper was written based on authors’ knowledge about the condition in the field of agricultural machineries application gathered in our research survey in 2015 and 2016.

3. Result

3.1. The existing status of agricultural mechanization development in Indonesia

The first stage of farm mechanization is called as subsistence farming where no machineries are involved in this stage. Then through industry revolution marked with the invention of machines and development of the world’s first compact diesel engines by Yamaoka (1933), agriculture entered to the next stage of developing diesel-powered, labor-saving, reduced-manpower machinery and to opening new markets around the world for agricultural, marine, construction and industrial uses [1].

In Indonesia, small farm mechanization system development is started with material transfer in the year of 1950, followed by design transfer in 1970 and the capacity transfer beginning in 1980 [2]. The objectives of mechanization in Indonesia are to increase productivity through intensification, reduce
post harvest losses, increase added value and maintain the quality of farm product [3]. In addition to those multiple objectives, the ultimate goals are to increase farm household welfare and create employment opportunity in the rural area [3].

The evidence of agriculture machineries contributes to increasing of production is by measuring the production of rice as staple food for Indonesia. With assumption of two-wheels tractor can increase cropping index by 34% to 41%, it contributes to rice production of about 19.47% to 20.81% during year of 2011 to 2015 [4]. Realizing this opportunity and responsibility to feed 319 million people in 2045 [5] MoA started in 2014 sets optimist goal to bring Indonesia as a world food barn in 2045. Thus, government distributed more budget for agricultural machineries grant as shown in Table 1.

**Table 1.** Selected agricultural machineries grant from MoA in 2015-2017 [6].

| Selected agricultural machineries grant | Unit 2015 | Unit 2016 | Unit 2017 |
|----------------------------------------|-----------|-----------|-----------|
| Two-wheels tractor                     | 27,812    | 31,734    | 14,615    |
| Four-wheels tractor                    | 1,472     | 2,250     | 1,572     |
| Transplanter                           | 5,879     | 5,854     | 1,730     |
| Harvester                              | 3,246     | 12,893    | * 4,631   |

Note: *: including power thresher; small, medium and large combine harvester; vertical dryer and building

3.2. *Agricultural machineries utilization level in Indonesia*

In order to understand the application of agricultural machineries by farmers in Indonesia, Yanmar CO., LTD collaborated with Bogor Agricultural University (IPB) through Yanmar Agricultural Research Institute-IPB (YARI-IPB) to conduct research survey in strategic food crops i.e. rice, maize and soybean. This research was conducted in production center of the crops in 2015 for rice and 2016 for maize and soybean. The result is shown in Table 2 and 3.

In term of rice production, it can be seen that land preparation is already fully mechanized with two-wheels tractor but farmers haven’t applied four-wheels tractor yet. Rice transplanter is still not commonly used by almost areas of survey, which only 6% of farmers in Cilacap, Central Java Province) uses rice transplanter. Special condition is for rice harvester where this machines are already used by all farmers in Pinrang, South Sulawesi Province where only 3% and 32% of farmers used rice combine harvester in other survey areas.

**Table 2.** Level of agricultural mechanization in rice production activity (Unit in %) [9].

| Activity and machines                 | Cilacap, Central Java Province | Location of survey | Pinrang, South Sulawesi Province |
|---------------------------------------|-------------------------------|--------------------|---------------------------------|
| Land preparation by:                 |                               |                    |                                 |
| • Two-wheels tractor                  | 100                           | 100                | 100                             |
| • Four-wheels tractor                 | 0                             | 0                  | 0                               |
| Rice transplanting by four-rows transplanter | 6                          | 0                  | 0                               |
| Rice harvesting by combine harvester | 3                             | 32                 | 100                             |

Slightly similar result of figures is shown in maize and soybean production. All farmers respondent in Nganjuk of East Java Province used two-wheels tractor for land preparation. However, only 32% and
27% of farmers uses two-wheels tractor for land preparation in Pohuwato of Gorontalo Province but as much as 26% and 40% of farmers uses four-wheels tractor.

| Activity and machines | Location of survey |
|-----------------------|--------------------|
|                       | Nganjuk, East Java Province | Pohuwato, Gorontalo Province |
| Land preparation by:  | Maize | Soybean | Maize | Soybean |
| • Two-wheels tractor | 100 | 100 | 32 | 27 |
| • Four-wheels tractor | 0 | 0 | 26 | 40 |
| Harvester             | 0 | 0 | 3 | 0 |

Based on our study on the application of rice transplanter, it is found that it is difficult to run rice transplanter machine on the wet paddy field area especially in Bogor, West Java Province due to alluvial soil type, soft and deep hard pan [11].

3.3. Future trend of agricultural machineries technology

As mentioned in the previous chapter, agriculture is started in a form of subsistence farming. Affected by industrialization technology, economic growth of the country and lifestyle change, agriculture machineries gradually steps forward to industry 3.0 and 4.0 where the application of sensor and automation, robot technology as well as ICT embedded on the machine.

3.3.1. Needs of IoT technologies to improve productivity. Utilization of agricultural machinery can relocate manual labor force from farming activities dramatically, however, to improve farm management by use of machinery, machines should be maintained properly and various information from daily work should be recorded and utilized in the convenient way to improve the operation. This requirements leads to the necessity of Smart Machinery system using ICT technologies.

3.3.2. Introduction of Smart Machinery system. To improve utilization and expect effective work performance of agricultural machine, data collection during the operation besides proper use of machine is required. To maintain agricultural business by using machine, machine should be under proper maintenance and the usage of machine should also be well managed to improve productivity of their business. To perform these objectives, several services based on IoT technology has already been introduce in this business field. One of those service which can support advanced farming management will be Yanmar SMARTASSIST system.

Yanmar SMARTASSIST system consists of various functions which can improve daily farm work efficiency such as machine information monitoring equipped with GPS, Field information system, Work log management, and analysing functions to suggest improvement as well as antitheft monitoring function.

3.3.2.1. Proper maintenance of machine. To maintain advanced farming business and prevent unexpected interval by machine service, it is very important for machine owners to monitor their machine condition every day and hour to realize advance warning from the machine in case of trouble before machine down. To monitor and make warning to the machine owners, various information should be collected from their machine.

3.3.2.2. Daily work management. Managing daily machine usage under control of machine owner is one of the important process to improve their business. By recording operational information (Figure 1) from the machine, owner can evaluate their machine and their worker’s performance and result for daily tasks. Not only to evaluate the performance, they can use their record to continuously improve process which causing loss in their process by visualization of each tasks.
3.3.2.3. **Field and work log information.** Information about the field (Figure 2) where machines work largely affects their work efficiency. Information such as the field location, actual area, crop variety, and condition of the field need to be stored and reviewed before the next season’s business.

![Figure 2](image)

**Figure 2.** Field information can be visualized for easy review.

Work log and plants growing status in the field also need to be recorded to determine the schedule of next work. Daily recording can be done through smartphone application which can be analysed by using computer. This can also support to fulfil GAP requirement.

3.3.2.4. **Importance of support from machine suppliers.** Besides monitoring machine condition all the time by machine owners, Yanmar Remote Support Center also support monitoring the machine condition every hour and inform the owners in case of any machine trouble. This can decrease machine down time and unexpected theft cases.

3.4. **Do Indonesia can apply this technology?**

In 2010, Indonesia enters bonus demography where the dependancy ratio getting smaller in the history of a country. When bonus demography ended in Japan in 1970, Japan became the third world largest economy after USA and Uni Soviet. This is the starting and critical point for Indonesia to be stronger in economy.

In this era, Indonesia is a country where internet utilization is very huge. In 2017, the internet users grow by 8% to 143.26 million people or 55.68% of total population in Indonesia [12]. From this number, 49.52% is those who ages 19-34 yo, 29.55% is 35-54 yo, 16.68% is 13-18 yo and 4.24% is over than 54 yo. This figures shows that ICT is all-well accepted by young generation means that we are sure that agricultural machineries with ICT will be accepted by young generation.

4. **Conclusion**

To improve productivity of farming activities is needed to bring Indonesia as a world food barn in 2045. In this stand point, more mechanization accelerated by technological improvement of suppliers to adapt farm condition in Indonesia also supported by government subsidy would be the most important factor to achieve improvement. However, to improve farming productivity by use of machinery, farm management should also be industrialized to maximize the effect of using machinery in their business.
By use of ICT technologies in the future machines should also support their management by suggesting maximum productivity in their activities as well as proper maintenance of the machine.

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