The role of mechanization in agricultural development on border areas

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Abstract. The application of mechanization in agriculture is aimed to increase productivity. In the last five years, the Government - specifically Ministry of Agriculture - has rapidly and widely distributed assistance in the form of agricultural machinery and equipment to fulfil these ideals. Nevertheless, the reality has not given satisfactory results especially for border areas. Border areas are far from the center of government and it becomes the obstacle in distributing the machines. This study aims to determine the extent of the application and role of mechanization in agricultural development in border areas with case study in Kapuas Hulu Regency, West Kalimantan Province. The study was conducted in 25 villages located directly adjacent to Malaysia. The primary data obtained from interview with heads of farmer group (gapoktan) and the secondary data obtained from authorized institutions. It can be concluded that the agricultural machinery and equipment as a result of government assistance are still not optimally utilized and it causes the slow growth of production rate. It occurs because the tractors were given without improving farmers capacity such as the ability to operate and maintain the machine. Therefore, there is a need to increase non-physical aspects in order to improve the success of the program.

1. Introduction
Productivity and efficiency in cultivation are needed to be increased in order to boost agricultural development. It can be achieved by increasing the role of agricultural mechanization. The term 'mechanization' is usually used to describe the general application of agricultural tools and machinery in agriculture. Mechanization is a management tool that can be used by farmers to increase production and profits [1]. The application of agricultural mechanization needs to be done in order to increase efficiency especially for labors in the production process. The aim is to improve the efficiency of human labor because currently the number of workers in agriculture tends to decrease, namely 36.96 million in 2017 to 35.87 million in 2018 [2]. In addition, the application of agricultural mechanization is expected to improve the degree and standard of living of farmers, the quantity and quality of agricultural production, as well as the growth of farming types from subsistence types to corporate agriculture.

Border areas are geopolitically important because they act as the 'front page' of Republic of Indonesia. Therefore, border areas can give a good impression to the outside world. Geopolitics of border areas are characterized by land and sea borders [3]. There are two definitions of the term border according to [4] namely boundaries and frontiers. The context boundary means the dividing line between regions. Whereas based on the context of frontiers, border means the path (zones) that stretches and separates the two regions of the country. Furthermore, according to [4] the border line is a vertical plane through the soil surface, underground layers and air and limits the activities that take
place within it. Right and left areas on the border are called border areas. Most of the population occupying land and sea border areas work in the agricultural sector (95%) and the remaining 5% work in mining, industrial, trade, transportation, services, and other sectors. The role of the agricultural sector as a source of income for the population is higher than in non-border areas and this indicates that efforts to improve the welfare of the population in the border region need to be approached through the development of the agricultural sector [3].

One of the border areas that has considerable potential in agriculture is the border region in West Kalimantan Province, namely in Kapuas Hulu Regency which directly adjacent to Sarawak (Malaysia). The land border area with Malaysia is dominated by hilly topography to mountains with an altitude of 250-450 m. There are 6 districts directly bordering with Malaysia consists of 65 villages and 4 sub-districts. Concrete problems that take place in the border region in Kapuas Hulu Regency related to the fields of economy, infrastructure and natural resources. The condition of communities throughout the border region is still largely poor with low welfare levels, the characteristic of community which are still lagging behind, and inadequate use of technology [3].

As the efforts to increase the role of agricultural mechanization in agricultural development, up to 2018 the Ministry of Agriculture has successfully distributed assistance in the form of agricultural equipment and machinery of 370,378 units or increase of 4.752% compared to 2013 of 7,633 units [2]. The increase in agricultural equipment and machinery assistance was also conducted in Kapuas Hulu District, with the provision of machineries reaching 260 units or 293 percent from 2015. However, the increase in the assistance has not been able to increase productivity. The natural disaster such as floods have reduced agricultural productivity, from 25.21 quintal/ha in 2015 to 22.35 quintal/ha in 2018. Nevertheless, in the four years there was an increase in rice production by 22.18 percent or around 43,042 tons in 2015 to 52,588 tons in 2018 due to an increase in planting area from year to year [6].

According to the factors mentioned above, the research on the role of agricultural mechanization in border areas, especially in Kapuas Hulu Regency, needs to be done. The objective was to examine the effectiveness of Government assistance to agricultural development in border areas. This research was carried out based on a case study from the Field Work Practice of Bogor Agricultural Development Polytechnic (Polbangtan Bogor) in Kapuas Hulu Regency. Students who went to Kapuas Hulu Regency are deployed directly to help increase production and eventually to help optimizing agricultural tool and machinery assistance from the Government.

2. Methods
The research activities were carried out from July 1st to August 16th 2019 which took place in 5 districts in Kapuas Hulu Regency, which are:

1. Puring Kencana District with an area of 296 km², six villages and 2,398 inhabitants.
2. Badau District consists of 9 villages with an area of 574 km² and 6,185 inhabitants.
3. Batang Lupar District consists of 9 villages with an area of 1,577 km² and 5,531 inhabitants.
4. Embaloh Hulu District consists of 10 villages with an area of 3,562 km² and 5,328 inhabitants.
5. North Putussibau District consists of 17 villages, 2 sub-districts with an area of 4,521 km² and 23,824 inhabitants.
6. South Putussibau District consists of 17 villages, 2 sub-districts with an area of 6,352 km² and 18,502 inhabitants.

The research was conducted by doing field observation, distributing questionnaires to farmer groups in 25 villages, in-depth interviews with agricultural extension workers, head of farmer groups and local government officials (regent and district chiefs), and literature studies.

3. Results and Discussion
3.1 The Significance of Border Areas
Border areas are very strategic areas for security, social and economic stability, both for those who live near the border and all citizens in a country. Indonesia's vast border region requires effective and accountable management policies from social, economic, defence and security aspects. From the point
of view of defence and security, the border area is the gate in and out of Republic of Indonesia. The border area is very vulnerable to smuggling of illegal goods, weapons, narcotics, and illegal drugs. Despite the crucial position of the border area, conditions on the field indicate that the border management system in Indonesia tends to be less effective and accountable.

Land border areas such as Kalimantan have specific geopolitical conditions. The pull and push factors for economic growth and social development greatly affect the development status of the area. From an economic standpoint, for example, regions in Kalimantan directly adjacent to Malaysia have lower development compared to their neighbours. It makes citizens in these border areas conduct economic transactions with neighbouring countries. Management of the border region is essentially an integral part of national development. The strategic values possessed by border areas include:

a. Border areas have an important influence on national sovereignty;
b. The border area is a driving factor for improving the socioeconomic welfare of the surrounding community;
c. Border areas have interrelations that affect each other with activities carried out in other areas that border, both with regions and between countries; and
d. Border areas affect defence and security conditions, both regional and national scale.

3.2 Geographical Condition of Kapuas Hulu Regency
Geographically, Kapuas Hulu Regency in West Kalimantan Province is located between 0.50 °N - 1.40 °S and between 111.400 °E - 114.100 °E with Putussibau as regency capital. The boundaries of the Kapuas Hulu region are as follows:

1. North: directly adjacent to Serawak (East Malaysia)
2. West: directly adjacent to Sintang Regency
3. East: directly adjacent to East Kalimantan and Central Kalimantan Province
4. South: directly adjacent to Sintang Regency and Central Kalimantan Province

In general, Kapuas Hulu Regency extends from west to east with the longest distance of about 240 km and extends from north to south around 126.70 km and is the easternmost district in West Kalimantan Province (as attached in Figure 1). The distance from the Capital of the Province is approximately 657 km by road, about 842 km via Kapuas River and approximately 1.5 hours of air flight. Kapuas Hulu Regency was founded on January 13th 1953 based on Emergency Law number 3 of 1953 concerning the Establishment of Level II Regions in Kalimantan with the capital Putussibau. The first regent who served was JC. Oevang Oeray (1951-1955), followed by Anang Adrak (1955-1956).
Kapuas Hulu Regency which has an area of 29,842 km$^2$ consists of 23 districts. This area is 20.33% of the total area of West Kalimantan. The largest sub-district is South Putussibau sub-district which has an area of 6,352 km$^2$ with its capital is Kedamin.

Kapuas Hulu Regency Region, in terms of its physiographic aspects, is generally divided into three physiographic regions, namely Kapuas Watershed Basin Area, Kapuas Hulu Mountains Region and Muller Mountains Region. This physiographic region has characteristics which are not found elsewhere. Kapuas watershed is mainly a shallow lake and swamp and very broad, peaty low terraces, surrounded by narrow edges that encompass scattered and hilly terrain. The mountain range with an altitude of 500-1800 meters located on Mount Lawit in the north surrounds an area of 10,780 km$^2$, almost all sides. The ravines in the mountains are to the Southwest and to the Northwest. The plains around the border watersheds are considered as coal and petroleum source zones, so that rather sedentary agricultural activities are carried out intensively on narrow river plains. Swampy physical conditions and the many lakes make transportation between the main villages very difficult. The Kapuas Hulu Mountains Region, a total area of approximately 10,000 km$^2$, covers the border with Kapuas Hulu, East and Central Kalimantan Province, which appears to be up to 2,000 meters high. Almost all these areas, including the Betung Kerihun National Park, are continuing to develop. In addition, this region is classified as a coal source area but not for petroleum and others. The Muller Mountains Region with an area of 18,370 km$^2$ (including the mountainous part of Muller in Sintang District) is characterized by rather high sedimentary mountains in the form of elongated platforms, quasquas and hills at the foot of the mountain and bordering inland flow areas the remote. This area is drained by the Silat Hulu River Kapuas Hulu Regency and the Kapuas Tengah River and Melawi River Sintang Regency.

Most of the Kapuas Hulu area located between 25-500 meters above sea level. While areas with elevations above 500 meters are found in the Kapuas Hulu mountains to the north and the easternmost part of the Kapuas Hulu Regency which runs up to the Muller Mountains near the border with Central Kalimantan. A small portion of the hilly area of the cluster to the north and east of Lake Luar in Batang Lupar District also has an altitude of between 100 - 500 meters above sea level [6].

**Figure 1.** Administrative region of Kapuas Hulu Regency
3.3 Demographics
The population of Kapuas Hulu Regency based on data from the Statistics (BPS) of Kapuas Hulu Regency in 2018 consists of 258,984 people located in 23 districts with a population density of around 7-8 people/km². This shows that there is quite a lot of vacant land that has not been used properly, especially for the agricultural sector. The districts that have the largest population are North Putussibau, South Putussibau and Silat Hilir, each of which has a population of 31,684; 23,311; and 18,808 inhabitants. Population distribution in Kapuas Hulu Regency began to be evenly distributed, especially with the construction of the South Cross Road connecting Putussibau-Sintang City and North Cross connecting Putussibau City with the northernmost area, namely Puring Kencana and Lubok Antu Districts, East Malaysia Serawak District [4].

The population who aged 15 years and older is 185,835 inhabitants. A total of 13,245 people are open unemployment and 32,246 people are included in the non-labour force category. The rest, which is 140,164, includes the work force. Of these, as many as 43,892 people were elementary school graduates, 30,325 people were high school graduates, and 26,616 people were junior high school graduates. This shows that the education level of the workforce in the Kapuas Hulu District is quite low [1].

Most of the Kapuas Hulu residents work in three sectors, namely agriculture, services and trade. The number of residents who work in the agricultural sector, including forestry, plantations, and fisheries as many as 84,415 people or 60.22% of the total population. In addition to agriculture, the number of people working in the trade sector is 20,527, and in services is 17,347. This shows that more than half the population in Kapuas Hulu District works in the agricultural sector [4].

3.4 Natural Resources
Kapuas Hulu Regency which has a large enough area is very potential to be developed as an agricultural area. But until 2018, the area of land used for paddy fields is only 35,997 hectares, equivalent to 1.21% of the total area of Kapuas Hulu Regency. The most extensive types of rice fields based on irrigation sources are rain-fed rice fields, which are 21,720 hectares, and the largest rainfed rice fields are in North Putussibau, Seberuang and South Putussibau Districts. Development of food crop agriculture continues to be increased to achieve regional food self-sufficiency, increasing income and improve community nutrition through diversification of food types, increasing productivity and increasing land use. The target of increasing agricultural production in Kapuas Hulu is directed at intensification, extensification, diversification, and rehabilitation efforts where these efforts need to be continued and scaled up in an integrated manner in accordance with the conditions and potential of the region while taking into account environmental sustainability and natural resources. Rice harvested area in Kapuas Hulu Regency from the results of the Agriculture Statistics report in 2018 showed an increase from the previous year of 26,751 ha in 2018 [1]. The increase in agricultural productivity in lowland rice can be seen in table 1.
Table 1. The increase of area and productivity of paddy in 2012-2018

| Year | Area (ha) | Harvested Area (ha) | Productivity (quintal/ha) | Production (ton) |
|------|-----------|---------------------|---------------------------|------------------|
| 2012 | 21,554    | 22,169              | 23.23                     | 51,495           |
| 2013 | 21,090    | 22,609              | 24.87                     | 56,235           |
| 2014 | 21,093    | 21,430              | 24.40                     | 52,289           |
| 2015 | 22,546    | 17.283              | 25.21                     | 43,042           |
| 2016 | 23,853    | 23,111              | 24.33                     | 56,238           |
| 2017 | 25,333    | 23,147              | 25.93                     | 60,510           |
| 2018 | 28,828    | 23,529              | 22.35                     | 52,588           |

From table 1 above, there is an increase in planting area and rice harvest area. This has a direct effect on increasing rice productivity and production. Even so, in 2018 there has been a decrease in yield productivity to 22.35 quintal/ha from 25.93 quintal/ha (in 2017). The cause is a natural disaster that is flooding along the banks of the Kapuas River, causing farmers to experience crop failure.

3. 5 The Assistance of Agricultural Machinery and Tool from Ministry of Agriculture

Agricultural development continues to be promoted to achieve Indonesia's target as a world food barn by 2045. The target will be obtained if Indonesia has a food sovereignty [8]. Food sovereignty is said to be successful if it meets the parameters, which are: 1. Fulfilment of domestic food production needs, 2. Food policy can be regulated independently, 3. farmers as the main actors of agricultural business are protected and their welfare is guaranteed. This was realized through several programs aimed at increasing the production of several agricultural commodities which were supported by the government's policy alignments with the farming community.

With the various activities to increase agricultural production, the Ministry of Agriculture through the Directorate of Agricultural Tools and Machines, the Directorate General of Agricultural Infrastructure and Facilities is obliged to support the availability of agricultural facilities, especially agricultural tools and machinery, as well as the guidance and development of the management of agricultural tools and machinery. The management of agricultural equipment and machinery is expected to involve young people to get their involvement in agriculture as well as to reduce the problem of labor availability.

The Ministry of Agriculture allocates the APBN budget for the provision of pre-harvest machinery to accelerate land management in the form of hand tractors, tractors, transplanters, excavators, cultivators, water pumps, and other machinery and their accessories. Provision of water pumps to support the availability of irrigation water. While the supply of excavators as a means of optimizing the management of swamps and opening of new land and normalizing irrigation networks. Provision of agricultural machinery to support the cultivation of horticultural commodities in the form of cultivator. Agricultural machinery and tool assistance from the Government is given to farmer groups who are active and have been able to manage their groups and activities well. Farmer groups in Kapuas Hulu Regency have also received agricultural assistance from the government. The data of assistance are presented in Table 2.
### Table 2. The Agricultural Machinery and Tool from Government Assistance for Kapuas Hulu Regency

| No. | Category                        | Year | Total |
|-----|---------------------------------|------|-------|
| 1.  | Hand tractor                    | 31   | 54    | 13   | 20 | 118 |
| 2.  | Tractor                         | 1    | 1     | 0    | 2  | 4  |
| 3.  | Corn cultivator                 | 0    | 0     | 0    | 67 | 6  |
| 4.  | Water pump                      | 11   | 30    | 11   | 0  | 119 |
| 5.  | Rice trans-planter              | 24   | 4     | 0    | 0  | 28 |
| 6.  | Mini excavator                  | 0    | 0     | 1    | 0  | 1  |
| 7.  | Small combine harvester         | 0    | 0     | 1    | 0  | 1  |
| 8.  | Medium combine harvester        | 0    | 3     | 1    | 0  | 4  |
| 9.  | Power thresher                  | 0    | 7     | 7    | 5  | 19 |
| 10. | Hand sprayer                    | 0    | 101   | 23   | 70 | 194 |

Based on the data in table 2, the Ministry of Agriculture has aided with 10 types of agricultural machinery and tools for Kapuas Hulu Regency. This assistance was distributed to six farmer groups in Kapuas Hulu Regency. According to the interview with heads of farmer groups, the machines were used once a year because the growing season was only once a year.

### 3. 6 Farmers’ Perception of the Assistance

Agricultural land in Kapuas Hulu Regency consists of large tracts of land with an area of more than two hectares. The dominant agriculture is agricultural fields and corn as the mainstay commodity. Because of the large size of the land and not all of them are utilized by the population, the farmers rely on the shifting cultivation system. It means that the farmers open new land, plant with selected commodities, then after the planting period is over, the farmers look for other land to plant. Such system is considered easier and cheaper because there are less costs incurred by farmers to do land maintenance. In the long run this will lead to a lot of land that is not utilized and cause a minimum increase in productivity of agricultural products. Therefore, over the past five years the use of agricultural machinery and tool in Kapuas Hulu Regency has been more intensively introduced so that farmers find it easier to cultivate land and take care of plants. It is expected that this will reduce their tendency to shift agricultural land. However, the facts on the field showed that the expectation was not yet fulfilled. For example, total harvested area in Kapuas Hulu Regency was 23,529 ha of total area 28,828 ha in 2018. Tractors from government’s assistance until 2018 were 118 units. Thus, a hand tractor oversaw an area about 199 ha. It was still beyond working capacity of tractor. The government should provide another solution to it. The use of tractor for soil tillage can be seen in Figure 2 below.

![Figure 2. The use of tractor for soil tillage in Kapuas Hulu Regency](image-url)
Farmers' perceptions of agricultural machinery and tool assistance from Ministry of Agriculture were obtained through questionnaires, direct interviews with the heads of farmer groups, and agricultural extension workers in Kapuas Hulu District. The machines are obtained by renting to business of agricultural machinery and tool services (UPJA) around the land to be cultivated. Based on the results of the questionnaire, there were no significant obstacles in processing land using agricultural machines because even though the area of Kapuas Hulu District tends to be hilly, but due to the vast agricultural land and the flat topography, it is not difficult for farmers to use agricultural machines. Likewise, the ability of farmers to operate hand tractor and four-wheeled tractors. Farmers who have been operators of “Alsintan” have received prior training.

Nevertheless, there is still a reluctance of farmers to use agricultural machines in their agricultural cultivation activities. Farmers who become operators of agricultural machines during training are only equipped with expertise to operate the machines but are not equipped with the ability to carry out maintenance and repair activities. In fact, agricultural machines must get regular maintenance so that machines are not easily damaged. Improper routine maintenance will speed up the damage and require repair activities that ultimately cost a fortune. Good maintenance requires the discipline of the operator, technical knowledge about these machinery, simple repair tools and tools, and the availability of suitable spare parts [1]. In addition to maintenance activities, repair activities are also needed which include repairing and replacing damaged or worn components so that the waste products that were previously unusable can be operated again. This activity really requires the existence of a workshop that is equipped with adequate tools, technicians with good technical skills and knowledge, easily accessible by farmers, and good spare parts are available [1]. One of the supporting facilities is the agricultural machine’s workshop which is not yet available in Kapuas Hulu Regency, so farmers have difficulty in improving agricultural machines at an affordable price.

Based on these results, the authors conducted a SWOT analysis related to agricultural mechanization in Kapuas Hulu Regency. The authors see the strength possessed by Kapuas Hulu Regency, which is the vast land that can be utilized for agriculture, it occupies around 1.21% of the total land area. Contoured land conditions but still a lot of topography that tends to be flat also allows for optimum use of agricultural machines in Kapuas Hulu Regency. The weakness that the authors encountered was that the business of agricultural machinery and tool services (UPJA) was not yet optimum in Kapuas Hulu Regency. This causes agricultural machines assistance from Ministry of Agriculture has not been utilized to the optimum. Of all 25 villages, the agricultural machinery was used only once a year as well as the planting season. The use of agricultural machinery was still limited due to lack of human resource and topography in Kapuas Hulu Regency. In addition, there is still a lack of knowledge transfer from agricultural extension workers to farmers so that knowledge related to maintenance and repair of agricultural machinery is not yet received by farmers in their entirety. Around 80% farmers able to operate the machine. On the contrary, their ability to maintain the machine was only 50% of the farmers. The opportunity to develop agricultural mechanization in Kapuas Hulu Regency is because Government under the leadership of President Joko Widodo is focusing on developing border and remote areas in Indonesia. This also encourages local governments, especially those directly bordering with other countries to advance their border areas. The border area is also not well known for its economic potential and other potentials so that it makes it attractive for research and field studies for students. This is the reason for the last two years Polbangtan Bogor sent its best students to go to the field in Kapuas Hulu Regency. The threat that may be faced is that agricultural extension workers who do not have a background in agricultural mechanization become less familiar with agricultural machines, both in terms of operation, maintenance, and repair. This is what hinders the spread of knowledge related to agricultural machines. In addition, the younger generation is more interested in working in other sectors such as the industrial sector and services that are more promising and provide a more secure guarantee of income than in the agricultural sector.
4. Conclusions
Since 2014, the Government through Ministry of Agriculture has distributed agricultural machinery and tool assistance to border areas, one of which is Kapuas Hulu Regency. The number of machinery available in Kapuas Hulu Regency consists of machinery for land management such as tractors, transplaters, water pumps, excavators, rice harvesters, paddy threshers, and sprayers. However, the implementation in the field is still limited due to the lack of knowledge of farmers in maintenance and repair activities of agricultural machines (50% of farmers). The increase in agricultural productivity was apparently caused by an increase in land area despite a decline in 2018 due to natural disasters caused by floods in Kapuas river basin. Therefore, the use of agricultural machinery must be increased so that assistance from the Government reaches its target in helping to increase agricultural productivity in border areas.

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