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**Factors Shaping the Operation of Machinery Hire Services:
Case Studies on the Implementation of the Institution for Rental
Service of Agricultural Machinery (IRSAM) Programme in
the Special Region of Yogyakarta, the Republic of Indonesia**

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ABSTRACT

As part of the government initiative to improve the production of agricultural commodities, particularly the five major staples – rice, maize, soybeans, sugar and beef, the Ministry of Agriculture (MoA) of the Republic of Indonesia launched the implementation of the Institution for Rental Service of Agricultural Machinery (IRSAM) programme in 1998. The programme aims to encourage the use of farm machinery at the farm level to improve agricultural production, and to promote farmers to develop a rural business unit by providing agricultural machinery services to other farmers.

The IRSAM programme has been rolled out for more than 18 years. From this programme, many farmers have received machinery and started to provide services to other farmers. Nevertheless, the implementation of the IRSAM programme has been applied to different areas of the Republic of Indonesia, and showed various levels of success. Some IRSAMs have successfully developed the units into profitable businesses. However, the majority of the IRSAMs are still underdeveloped. This research is interested in gaining a deeper understanding of the factors that are shaping the operation of IRSAMs, especially in the Special Region of Yogyakarta and how they are working on those factors. By understanding the various factors, there would be a possibility for this research to provide recommendations on how the MoA will be able to improve the implementation of the IRSAM programme.

A multiple case studies approach was used to explore factors and circumstances, which influence the operation of the IRSAM. Two cases were selected in the Special Region of Yogyakarta. One IRSAM was chosen in each of Gunungkidul Regency and Bantul Regency, respectively. This research applied purposive and snowballed sampling to select participants. Sixteen groups of participants were interviewed. This research analysed the data using qualitative data analysis method.

The results revealed four significant factors influenced the operation of both IRSAMs. These were: 1) managers with good administrative and finance skills, 2) the availability of capable machinery operators, 3) the demand for machinery services from farmers (farmer group members and non-members), and 4) the availability of institutional support

from the public and private sectors that enable the IRSAM to flourish, such as access to financial aid, the availability of spare parts, access to agricultural extension services, training for IRSAM employees, and rural infrastructure (rural road networks and irrigation networks).

Although most of these factors have been identified in other literature, significantly, this research highlighted one factor that has previously not been identified. This factor was the availability of alternative private providers/other IRSAMs around the selected IRSAMs. Additionally, it was revealed that the formal organisation structure of the IRSAM seemed only to exist in the Republic of Indonesia. The formal structure has made the roles of manager and operators a significantly important factor in affecting the operation and success of the IRSAM.

This research illustrates the complexity of the dynamic factors that affect the operation of small-scale machinery service providers. The local circumstances and different characteristics of situations are going to mean that the specific factors and settings that are shaping the performance of the machinery hiring group will vary. This research shows how the delivery process of the IRSAM programme using a blanket policy does allow the IRSAMs to perform well across different situations. This study highlights the value that could be had for the IRSAMs to perform better if the government better targets types of machinery to match specific needs of farmers in different areas. Besides, the research suggests that the government could develop a database management system of public and private machinery hire services to obtain information on the actual supply and demand of machinery services.

Keywords: farm machinery hire services, small-scale farmers, agricultural mechanisation, IRSAM, custom hiring, the Special Region of Yogyakarta,

Title: Factors Shaping the Operation of Machinery Hire Services, Case Studies on the Implementation of the Institution for Rental Service of Agricultural Machinery (IRSAM) Programme in the Special Region of Yogyakarta, the Republic of Indonesia

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ABBREVIATIONS

2WT	Two Wheeled Tractors
4WT	Four Wheeled Tractors
AFGA	The Argorejo Farmer Group Association
AMMOTRAC	The Agricultural Mechanics and Operators' Training Centre
AMSEC	The Agricultural Mechanisation Service Enterprise Centres of Ghana
BAPPEDA	Badan Perencanaan Pembangunan Daerah Kabupaten Bantul / Regional Development Planning Agency of Bantul
CIA	Central Intelligence Agency
CSAM	Centre for Sustainable Agricultural Mechanisation
DPPKA	Dinas Pendapatan Pengelolaan Keuangan dan Aset Provinsi Daerah Istimewa Yogyakarta / Provincial Agency for Revenues, Financial and Asset Management
FAO	Food and Agriculture Organisation of the United Nations
FGD	Focus Group Discussion
GA	General Assembly
GAPOKTAN	Gabungan Kelompok Tani / Farmer Group Association
GDP	Gross Domestic Product
GOI	The Government of the Republic of Indonesia
GRDP	The Gross Regional Domestic Product
IAARD	The Indonesian Agency for Agricultural Research and Development
IRRI	International Rice Research Institute
JICA	The Japan International Cooperation Agency
MOA	The Ministry of Agriculture of the Republic of Indonesia
MUHEC	The Massey University Human Ethic Committee
NAERLS	National Agricultural Extension Research Liaison Services of Nigeria
NGO	Non-Governmental Organisation
NPFS	National Programme for Food Security of Nigeria
OECD	The Organisation for Economic Co-operation and Development
PNG	Papua New Guinea
POKTAN	Kelompok Tani / Farmer Group
PTOS	Power Tiller Operated Seeder in Bangladesh
QDA	Qualitative Data Analysis
SMEDC	The Small and Medium Enterprise Development Centre
TSFG	The Tirto Sari Farmer Group
UPJA /	Usaha Pelayanan Jasa Alat Mesin Pertanian / The Institution for
IRSAM	Rental Service of Agricultural Machinery

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CHAPTER ONE: INTRODUCTION

1.1 Background

Agriculture has a major role in promoting economic growth in the Republic of Indonesia. According to the Ministry of Agriculture (MoA) of the Republic of Indonesia, the role of the agriculture sector is not only to provide food and raw materials for many industries in the country, but it is also a source of income for many households, particularly in rural areas (MoA, 2015c). In 2014, this sector contributed 10% to the country's total Gross Domestic Product (GDP), with the average growth from 2010 to 2014 of 3.9% (MoA, 2014a). In 2014, the agricultural sector was able to create employment opportunities for more than 35 million people, which was 30% of the total workforce in the country (MoA, 2015c). Therefore, the development of agriculture sector has been the main concern of the Government of the Republic of Indonesia (GOI).

In developing the agricultural sector, the GOI has implemented agricultural mechanisation since the 1950s (Handaka & Winoto, 2013). Farm mechanisation plays a major role in the country, especially in improving yield, production, quality, added value, and reducing losses of agricultural commodities (Unadi, n.d). In addition, agricultural mechanisation reduces the cost of production and increases farmers' incomes (Unadi, n.d). Along with the intention of the GOI to enhance the production of the strategic commodities, such as rice, the role of agricultural mechanisation has increased significantly (Handaka & Winoto, 2013). However, the recent development of mechanisation in agriculture is facing a more complex and competitive environment, such as the growing population and the decline of the farm family and labour (Unadi, Alihamsyah, & Budiarti, 2014).

To face these challenges, in 1998 the MoA introduced "The Institution for Rental Service of Agricultural Machinery" (IRSAM), as part of the national agricultural mechanisation policy (CSAM, 2014; MoA, 2008). The IRSAM programme was intended to popularise the use of farm machinery among farmers (Unadi et al., 2014). The programme encourages farmers to become entrepreneurs by establishing an IRSAM unit. This unit,

which will be referred to as "IRSAM" in this research, is a rural business unit under a farmer group administration, designed to manage farm machinery distributed by the government. Furthermore, an IRSAM delivers commercial agricultural machinery services, such as tilling, transplanting, threshing, and milling, to the members of a farmer group and non-members, to earn profits for the IRSAM's management (MoA, 2008). The MoA views that the IRSAM programme suits the characteristics of smallholders in the country, where smallholders own small land holdings (0.4 - 0.9 ha/farmer household) and have limited access to capital (Unadi, 2014).

In 1998, the MoA introduced the IRSAM programme in 13 Provinces (Aceh, North Sumatra, Riau, Jambi, Lampung, West Java, Central Java, East Java, the Special Region of Yogyakarta, West Kalimantan, South Kalimantan, South Sulawesi, and West Nusa Tenggara) (MoA, 2008). The MoA expanded the programme across the country to promote more farmers to establish IRSAMs (Mayrowani & Pranadji, 2012). According to Paman, Inaba, and Uchida (2016), machinery hire services, such as the IRSAMs, have become rural economic institutions in small-scale farmer communities, which have an operational objective to generate profit.

1.2 Problem statement

Currently, the IRSAM programme has been delivered for more than 18 years. The MoA has been able to promote the establishment of the IRSAMs at the farm level in several Provinces in the Republic of Indonesia. In 2012, the total number of the IRSAMs reached more than 12,000 (Unadi et al., 2014). However, the implementation of the IRSAM programme across different areas in the Republic of Indonesia resulted in various outputs regarding the operation of the IRSAMs. Despite the IRSAMs having been successfully established in several Provinces, the way the units operate in terms of servicing farmers and generating income, differ across the country. Most of the IRSAMs (more than 78% of the total number of the IRSAMs) are servicing farmers in limited conditions, because the units are still in the early stage of development, marked by a small number of farm machines owned by the IRSAMs (MoA, 2008). On the other hand, compared to the majority of the IRSAMs, there are some IRSAMs (22%), which have expanded the business and have more diverse farm machinery (MoA, 2008; Unadi et al., 2014).

Looking at the different results on the implementation of the IRSAM programme, several studies in the Republic of Indonesia have attempted to shed light on the circumstances that shape different outputs of the programme delivery across the country (Ariningsing & Tarigan, 2005; Hamidah & Soedarto, 2006; Mayrowani & Pranadji, 2012; Nasution, Jumin, & Ismail, 2012; Paman et al., 2016; Unadi et al., 2014). From these studies, it was found that, mostly, the authors paid attention to the performance of the IRSAMs, which were shaped by several factors. These factors include the capability of the manager and the operators, the quality of service from the IRSAMs, and the institutional support, such as the availability of extension services, access to credit and the condition of the infrastructure around the IRSAMs. While these factors have provided insights into the operation of the IRSAMs, the dynamics, which affect those factors over time, remain unclear. There has been little discussion on how those factors interlinked in shaping the operation of an IRSAM.

Therefore, this research is interested in understanding, more specifically, how the IRSAM programme that is applied across different areas of the Republic of Indonesia is being implemented to highlight various factors that are shaping the outcome of programme implementation. This research is focused on learning various factors that may have changed over time in shaping the particular IRSAMs and how IRSAMs are working on those factors. Understanding these different circumstances is, therefore, essential in improving the IRSAM programme. The aim of this research, therefore, is to provide recommendations and some insight as to how the MoA may be able to improve the IRSAM programme. In this study, particular attention is focused on the Special Region of Yogyakarta, as one of the first pilot sites of the IRSAM programme in 1998, which has a long history in developing the IRSAMs.

1.3 Research questions

“What factors shape the operation of the IRSAMs and how these factors influence the operation of the IRSAMs?”

1.4 Objectives

There are three specific objectives in this research:

1. To identify and describe the functioning of the IRSAMs in the Special Region of Yogyakarta.

2. To identify factors which shape the operation of the IRSAMs in the Special Region of Yogyakarta.
3. To explore the influence of these factors on the activities of the IRSAMs.

1.5 Significance of the study

There is a large body of research on understanding various factors, which affect the operation of machinery hire services. However, little discussion has been given to understanding how machinery service providers, such as the IRSAMs, are working within the dynamic changing of these factors. In this regard, the information generated from this research would be useful and essential for related stakeholders, both public and private organisations, as follows:

1. The Central Government, the MoA: By understanding various factors, which influence the operation of the IRSAMs, the MoA may be able to improve the IRSAM programme delivery by paying more attention to different aspects of local circumstances.
2. The Local Government of the Special Region of Yogyakarta: this research could provide insight on how the IRSAMs are interacting with the identified factors so that the Local Government may be able to justify their public interventions in improving the effectiveness of the IRSAM programme implementation.
3. The IRSAM managers and management: this research could support the IRSAMs to improve their operation by suggesting to them how to be more efficient in serving farmers.
4. Similar public or private machinery hire providers: the information generated from this research could be useful for other machinery service providers operating under similar conditions by adding knowledge on how these factors shape the operation of machinery service providers.

In addition, this study will add to the body of literature in the context of agricultural mechanisation, particularly in machinery hire services.

CHAPTER TWO: THE AGRICULTURAL MECHANISATION STRATEGY IN THE REPUBLIC OF INDONESIA

2.1 Introduction

This chapter outlines general information about the Republic of Indonesia and the agricultural mechanisation strategies to promote the application of farm machinery by farmers. Section 2.2 gives the geographical location and population of the country, and the policy arrangements, and the role of the agriculture sector to support the economic growth of the Republic of Indonesia. The agricultural sector, in general, is described in Section 2.3, which covers information about climate, annual rainfall, and land utilisation. Furthermore, this section outlines main agricultural production and the characteristics of smallholder farmers in the country. Following this section is the agricultural mechanisation strategy of the Republic of Indonesia, which outlines the development of IRSAM programme as part of the national strategy in fostering the use of farm machinery at the farm level (Section 2.4). Section 2.5 summarises the chapter.

2.2 The Republic of Indonesia in general

2.2.1 Geographical location

The Republic of Indonesia, as the world's largest archipelago of 17,508 islands, is located in Southeastern Asia, lying between the Indian Ocean and the Pacific Ocean with geographic coordinates 6.1750° S, 106.8283° E (see Figure 1) (CIA, n.d). The Republic of Indonesia has a total area of 1,904,569 square kilometres (Statistics Indonesia, 2015b). It borders Malaysia to the north and Timor Leste and Papua New Guinea (PNG) to the east. The country's major islands are Sumatra, Java, Bali - East Nusa Tenggara - West Nusa Tenggara, Sulawesi, Kalimantan, and Papua.



Figure 1. Map of the Republic of Indonesia

Source: CIA (n.d)

2.2.2 Population

The population of the Republic of Indonesia in 2016 reached 260 million, which made the country the fourth most populous country in the world after China, India, and the United States, with an annual increase of 1.17% (Worldmeters, 2016). The majority of the population (57%) resides in Java Island. In 2015, out of the total population, 28.6 million Indonesians lived below the national poverty line, of Rp. 330,776 (NZ \$ 36.7)¹ per person per month (World Bank, 2015).

2.2.3 Policy and institutional arrangement

In the Republic of Indonesia, the central government at the national level has been implementing a decentralisation process in managing the country's policy since 1999. Decentralisation started to take effect in 2004, at which time local governments were given the opportunity to manage their respective governments, based on the principles of transparent government (Ministries of Agriculture Marine Affairs and Fisheries and Forestry & FAO, 2007). In 2014, the GOI strengthened the implementation of decentralisation by emphasising the improvement of the governance system of the local governments by launching Law No. 23 Year 2014 (Ministry of Home Affairs, 2014). Through decentralisation, the central government, as part of their authority, delivers development programmes at the national level to the provincial and regional levels after

¹ NZ \$1 = Rp. 9,000 on 28 March 2016

the central government have formulated the standards, norms, and policies of the programmes. Meanwhile, the regional governments followed the national development programmes by creating implementation guidelines. Supported by the national and the provincial government, regional governments have responsibilities for planning and implementing development programmes, according to the circumstances of the regional governments (Ministries of Agriculture Marine Affairs and Fisheries and Forestry & FAO, 2007).

2.2.4 The role of the agriculture sector

Over the past 15 years, the performance of the Republic of Indonesia's economy has achieved significant progress, with an impressive reduction in poverty and a stable growth of household incomes (OECD, 2015). In 2014, the GDP of the country reached US \$ 888.5 billion, with 5.0% growth in the same year (World Bank, 2014). One of the significant contributors to the country's GDP is the agriculture sector. In 2014, this sector contributed 10% to total GDP, with an average growth from 2010 to 2014 of 3.9% (MoA, 2014a). In 2014, the agricultural sector was able to provide employment for more than 35 million people, which was 30% of the total workforce in the country. However, when it is compared to 2010, there was a decrease of nearly 3 million (5%) people working in this sector (MoA, 2015c).

2.3 Overview of agricultural sector

2.3.1 Climate, annual rainfall and agricultural land area

Located on the equator, the climate of the Republic of Indonesia is tropical, with the average temperature in the coastal plains of 28⁰C, the mountain regions 26⁰C, and the higher mountain regions 23⁰C. The humidity in most of the areas in the country ranges between 70 and 90 percent. Winds blow from the south and east in June until September, which is known as the dry season, and from the north-west in December until March, which is known as the wet season. The transition from the dry season to the rainy season occurs from October to November. Meanwhile, from the rainy season to the dry season, the transition occurs from April to May. Annual rainfall in the country ranges from 1000 mm to 3500 mm with annual days of rain of between 67 to 200 days (Nitis, 1999).

With regard to the utilisation of the agricultural land in the Republic of Indonesia, the MoA divides the country into four categories as follows:

1. Wetland, with irrigation and non-irrigation systems, is a type of farmland which is separated by small dykes to save water and usually used as a rice field;
2. Dry field/garden is dry land (unirrigated land), which is planted with seasonal or annual crops, and its location is separated from the yard around the house. Additionally, the utilisation of this agricultural land remains in its initial location;
3. Shifting cultivation land is dry agricultural land (unirrigated land), which is cultivated with seasonal crops, and is used only for one or two seasons, then it will be left by the peasant if it is no longer fertile; and
4. Temporary unused land is regularly used, but only between one and two years, and includes wetland that is not irrigated for more than two years.

In detail, the utilisation of agricultural land in The Republic of Indonesia from 2009 to 2014 is shown in Figure 2 (MoA, 2014b).

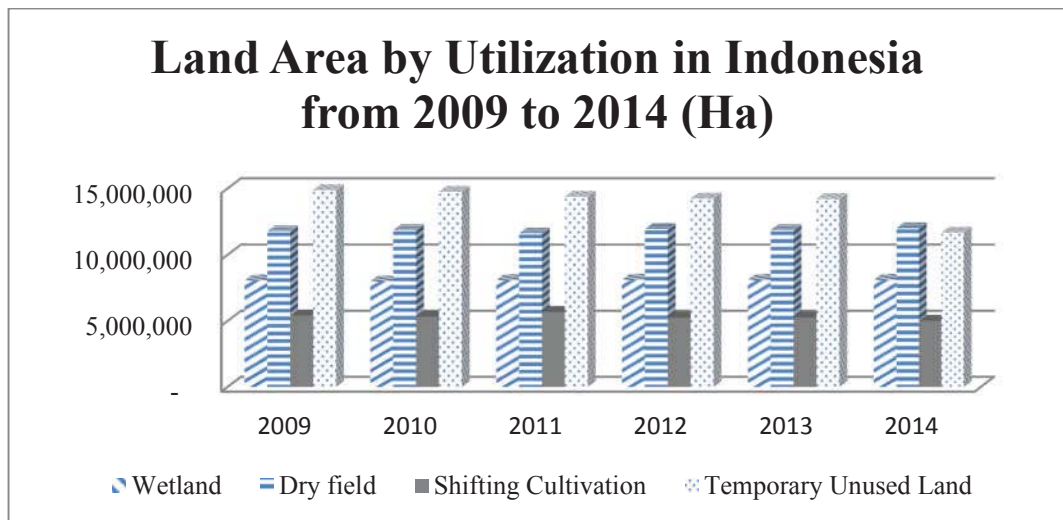


Figure 2. Land area by utilisation in the Republic of Indonesia from 2009 to 2014 (Ha)

Source: Statistics Indonesia (2014)

In 2014, the total area of wetland was 8.12 million hectares, with 40 percent of this area located on Java Island, 27 percent on Sumatra Island, and the rest of the wetland areas located across the country (Statistics Indonesia, 2014). With the majority of wetland located on Java, this island has an extensive irrigation system. In 2014, there were 2.44 million hectares of wetland irrigated on Java (more than 51% of the total wetland areas in the Republic of Indonesia) (Statistics Indonesia, 2014).

2.3.2 Agricultural production

The Republic of Indonesia has several major commodities, as shown in Table 1. From this table, it can be seen that in the estate crops group, palm oil is the leading commodity. This commodity has made the Republic of Indonesia the world's largest palm oil producing country, with total production in 2015 of more than 30 million tonnes. Estate crops group remain the major contributor to the country's GDP from agriculture, because the majority of the estate crops are exported with export growth reaching 7.4% in 2014 (MoA, 2015c). The majority of these commodities are experiencing an upwards trend in terms of production. Similarly, an increase in production of agricultural commodities has occurred in the food crops and livestock groups. These groups are now under serious attention from the MoA. As part of the effort of the MoA to achieve food sovereignty and food self-reliance, the MoA is increasing the domestic production of staples, particularly the five key staples – rice, maize, soybeans, sugar and beef (IAARD, 2013).

Table 1. Selected agricultural production of the Republic of Indonesia from 2010 to 2015

No	Commodity	Production (Ton)					
		2010	2011	2012	2013	2014*	2015**
	Estate Crops						
1	Crude Palm Oil	21,958,120	23,096,541	26,015,518	27,782,004	29,344,479	30,948,931
2	Natural Rubber	2,734,854	2,990,184	3,012,254	3,237,433	3,153,186	3,231,825
3	Coconut	3,166,666	3,174,379	3,189,897	3,051,585	3,031,310	3,025,011
4	Sugar cane	2,290,116	2,267,887	2,591,687	2,551,026	2,632,242	2,728,393
5	Coffee	686,921	638,647	691,163	675,881	685,089	739,005
6	Cocoa	837,918	712,231	740,513	720,862	709,331	701,229
7	Tea	156,604	150,776	145,575	145,460	143,751	143,001
	Food Crops	2010	2011	2012	2013	2014*	2015**
1	Rice	66,469,394	65,756,904	69,056,126	71,279,709	70,846,465	75,361,248
2	Maize	18,327,636	17,643,250	19,387,022	18,511,853	19,008,426	19,611,704
3	Soybeans	907,031	851,286	843,153	779,992	954,997	963,099
	Livestock	2010	2011	2012	2013	2014*	2015**
1	Beef	436,450	485,335	508,905	504,819	497,669	523,926

*) preliminary figures

**) estimated figures

Source: MoA (2015a) and Statistics Indonesia (2015a)

2.3.3 The characteristics of the Indonesian farmers

Farmers in the Republic of Indonesia are characterised by smallholders who have small land holdings, where 46.82% of 26.14 million farm households own less than 0.5 hectares or 5000 m² of land (Statistics Indonesia, 2013). Furthermore, the majority of smallholder farmers in the country have fragmented agricultural production, where the agricultural production is small due to small land holding and unable to meet scale economies, particularly for long-distance transportation and processing (Hayami & Kawagoe, 1992). According to the Agricultural Census in 2013, of the total 26.14 million farm households in the country, the majority of farm households reside in Java (13.4 million) (Statistics Indonesia, 2013). From the total farm households, 17 million households work in the food crops subsector, such as rice, maize, and soybeans (Statistics Indonesia, 2013).

Looking at the majority of farm households that work in the food crops sub-sector, the farm system in the Republic of Indonesia is categorised as part-commercial small independent specialised family farms (McConnell & Dillon, 1997). The operating objective of this kind of farm system, is growing particular crops continuously, or near-continuously, such as paddy with the orientation of farming being family sustenance through selling some part of their production (McConnell & Dillon, 1997).

2.4 Agricultural mechanisation strategy

2.4.1 Agricultural mechanisation development

Agricultural mechanisation development in the Republic of Indonesia can be divided into three stages based on the technology transfer as follows: material transfer stage (the 1950s), design transfer stage (1960 – 1980), and capacity transfer stage (1980 – present) (Handaka & Winoto, 2013). The material transfer stage of the 1950s was marked by the utilisation of farm machinery, formerly used by the Dutch during their occupancy of the country. During this period, some tractor workshops were established in Java Island and other parts of the country. By using tractors, the government started to open farm areas. However, at this stage, these tractors were designed for use in the home country of the tractor producers, and were unsuitable for Indonesian terrain. As a result, the application of these tractors was not successful, and the government was unable to improve production and productivity of agricultural commodities, particularly rice (Handaka & Winoto, 2013).

The government made adjustments on the imported farm machinery at the design transfer stage, after learning from the previous failure (from 1960 to 1980) (Handaka & Winoto, 2013). In 1966, there was a massive importation of farm machinery by the government to support the development of agricultural mechanisation in the country. This initiative was closely related to the intention of the government, at that time, to implement a policy of increased rice production (Herianto et al., 2010). The private sector was also starting to produce farm machines, such as rice hullers, rice polishers and rice milling, by imitating the technology from overseas producers (Handaka & Winoto, 2013). At this stage, many farmers progressively gained knowledge and started to use farm machinery in their farming practices. As a result, there was a shift of agricultural machinery ownership from the government to farmers (Handaka & Winoto, 2013). In 1970, the country reached an agricultural development milestone, where a transition from traditional to modern agriculture system occurred (Lubis, n.d). As a result, with the support of technology, combined with infrastructure and institutional development, the implementation of the farm credit scheme, and an input-output price subsidy policy, the Republic of Indonesia was able to achieve rice self-sufficiency in 1984 (Herianto et al., 2010; Mardianto et al., 2014).

From this point forward, the development of mechanisation entered the capacity transfer stage, which started in 1980. At this stage, the application of farm machinery was growing because the achievement of a significant increase in rice production during 1980-1989 involving the use of farm machinery (Mardianto et al., 2014). As reported by Handaka (2009), at least 97% of the total rice production in 1980 was processed using farm machinery, which included small, medium, and large rice milling machines. The domestic industry was increasing production of agricultural machinery during 1988 – 1997, after realising the growing demand for farm machinery from farmers, as shown in Table 2. From then on, the application of farm machinery grew rapidly, marked by the increased utilisation of farm machinery by farmers from 1998 to 2002, particularly hand tractors and irrigation pumps (see Table 3) (Handaka, 2009). Handaka (2009) points out that the next phase of the agricultural mechanisation development in the country would be more complex and competitive. It is because of the global changes in information technology and economy, which would have an impact on national capacity in generating, adopting, adapting and delivering the best-suited technology for the benefits of farmers (Handaka, 2009).

Table 2. Agricultural machinery industry development in the Republic of Indonesia from 1988 to 1997 (in unit)

No	Name of Farm Machinery	1988/1989	1990/1991	1992/1993	1994/1995	1996/1997
1	Two-wheel tractor	2,490	6,330	9,350	9,818	11,860
2	Four-wheel tractor (small)	14	20	36	38	50
3	Four-wheel tractor (Big)	188	200	360	540	632
4	Thresher	500	909	1,431	1,503	1,845
5	Rice Polisher	150	665	1,050	1,213	1,560
6	Rice Milling Unit (RMU)	400	468	11,300	1,638	2,010
7	Water pump	10,800	7,973	55,714	70,200	95,875

Source: Handaka and Winoto (2013)

Table 3. The utilisation of selected farm machinery in the Republic of Indonesia from 1998 to 2002

Machinery	1998	1999	2000	2001	2002	Ann.growth (per cent)
Hand tractor	84,178	86,944	99,304	86,644	103,446	6
Pesticide applicator	1,642,686	1,760,543	n.a.	1562217	n.a	3.4 (b)
Irrigation pump	117,340	166,030	190,013	215,774	216,643	17.5
Thresher (a)	370,426	375,299	388,609	340,654	347,658	-1.68
Dryer	5,778	5,798	6,238	7,117	5,045	-1.8
Rice mills	43,071	42,816	45,402	39,996	46,123	2.2
a. Estimated number consist of 30 per cent power thresher and 70 per cent manual thresher including pedal						
b. Data of the period 1997 - 2001						

Source: Central Bureau of Statistics 1999 – 2004 as cited in Handaka (2009).

2.4.2 The development of IRSAM programme

Since it was introduced in 1998 in 13 provinces, the development of the IRSAM programme has experienced several progressions. The IRSAM programme development is intended to support the national policy on agricultural mechanisation in the Republic of Indonesia (MoA, 2011). It is essential in fostering the use of farm machinery among farmers, by considering the nature of agricultural operation of the majority of farmers in the country (MoA, 2011). The programme is also essential for increasing food production and substituting for agricultural labour due to migration to other sectors (Unadi et al., 2014). Furthermore, it is beneficial for increasing the utilisation of farm machinery among farmers who have poor purchasing capacity. Farmers' low purchasing capacity has been due to their limited capital, small land holdings, limited technical skills and low level of education (Unadi et al., 2014). Therefore, by providing farm machinery to farmer groups and encouraging them to share the use of the machines through IRSAMs, the government

was able to promote the IRSAMs in several provinces (Mayrowani & Pranadji, 2012). The government views that under the administration of a farmer group, or a farmer group association, an IRSAM will be able to manage farm machinery provided by the government and use the machines to deliver machinery hire services to member farmers and non-members (Mayrowani & Pranadji, 2012).

In 2008, to accelerate the utilisation of farm machinery at the farm level, the MoA strengthened the IRSAM programme by imposing regulation number 25/Permentan/PL.130/5/2008. The regulation encourages farmer groups to establish IRSAMs, particularly in areas where no IRSAMs exist. Additionally, the regulation promotes the existing IRSAMs to extend their services to farmers and generate profits (MoA, 2008). Through this programme, the government was able to promote more farmer groups to establish IRSAMs across the country. As shown in Table 4, there were a growing number of the IRSAMs from 2006 to 2012. To measure the progress of the programme implementation, the MoA classifies the level of the IRSAM development into three classes: beginner, improved and professional, as shown in Table 5 (MoA, 2008).

Table 4. Number of IRSAMs in the Republic of Indonesia from 2006 to 2012

Year	IRSAM Class			Total
	Beginner	Improved	Professional	
2006	7,390	141	39	7,570
2007	7,543	409	65	8,017
2008	8,571	851	100	9,522
2009	8,145	1,783	318	10,246
2010	8,887	2,250	219	11,356
2011	8,801	2,693	453	11,947
2012	9,485	2,136	423	12,044

Source: Unadi (2014)

Table 5. The IRSAM classification

Items of IRSAM	IRSAM Class		
	Beginner	Improved	Professional
1. Organisational aspects			
a. Legal aspects (Article of Association)	No	Yes	Yes
b. Organisational structure			
- Manager	Yes	Yes	Yes
- Administration staff	No	Yes	Yes
- Operators	Yes	Yes	Yes
- Mechanics	No	Yes	Yes
c. Member of IRSAM Association	No	Yes, but has less participation	Yes, with high participation
d. Meetings	No meetings	Yes, but not regularly	Yes, with regular meetings
2. Technical aspects			
a. Types of machinery	One to two types	Three to four types	more than five types
b. Number of units of machinery	One to four units	Five to nine units	more than ten units
c. Machinery warehouse	No	Yes	Yes
d. Machinery condition	Well maintained and operational	Well maintained and operational	Well maintained and operational
e. Repair workshop owned by IRSAM	No	No	Yes, partnership with a third party
f. Participation in Training			
- Manager	No	Yes	Yes
- Administration staff	No	No	Yes
- Operators	No	Yes	Yes
3. Economic aspects			
a. Procure additional machinery	No	Yes	Yes
b. Financial source for procuring additional machinery	Self-funded	Self-funded and bank	Self-funded and bank
c. Additional customers	No	Yes	Yes

Source: MoA (2011)

Along with the implementation of the strengthened IRSAM programme, the government launched a pilot project of fully mechanised farm operations in 2014 (MoA, 2015b). This pilot project is dedicated to accelerating agricultural mechanisation, particularly in the

eight selected provinces, including the Special Region of Yogyakarta. The government believes that through accelerating agricultural mechanisation, the increase in production and productivity of strategic commodities, such as rice, soybeans, and maize, will be achieved (MoA, 2015b). Furthermore, the government's targets for securing food supply and increasing farmers' welfare will be attained (MoA, 2015b). This pilot project promotes IRSAMs to increase their performance in utilising farm machinery, particularly for an IRSAM that serves a minimum of 100 hectares' service area. The selected IRSAMs will receive various farm machinery types from the government, including on-farm and off-farm machinery, such as 2WT, 4WT, transplanters, combine harvesters, and water pumps, to accelerate the use of farm machinery at the farm level.

2.5 Summary

With the growing population and the decrease of farm labour, the Republic of Indonesia is facing serious challenges in developing the agricultural sector. The agricultural mechanisation strategy has been implemented as part of the national strategy to develop agriculture since the 1950s. Along with the intention of the government to increase the production of staple commodities, such as rice, to secure the food supply, the role of agricultural mechanisation has increased significantly. Supported by agricultural mechanisation, the Republic of Indonesia was able to achieve rice self-sufficiency in 1984.

With the national goal to attain food security, the government is accelerating the implementation of the agricultural mechanisation across the country. One of the strategies has been the introduction of the IRSAM programme in 1998. Through the programme, the MoA has been able to promote farmers to establish IRSAMs and increase the application of farm machinery at the farm level. However, the outputs of programme implementation are varying across the country. The majority of the IRSAMs are still delivering limited machinery services to farmers and unable to extend the machinery services business. On the other hand, there are some IRSAMs which can develop the machinery hire services business. The MoA is continuing to accelerate the use of farm machinery at the farm level by introducing the pilot project of fully mechanised farm operations to provide more benefits for farmers.

CHAPTER THREE: LITERATURE REVIEW

3.1 Introduction

The research aims to understand different factors that shape the success of the IRSAM programme implementation that has been applied to various regions of the Republic of Indonesia. More specifically, the research focuses on gaining an insight into the dynamic changes of different factors around the IRSAMs, which may contribute to the operation of the particular IRSAMs in the Special Region of Yogyakarta. While the majority of research tends to highlight important features contributing to the operation of machinery service providers through a snapshot way (in a given time through surveys and quantitative methods), this research includes the implication of various factors in shaping the operation of the IRSAMs. The study will contribute to the literature as it presents an in-depth examination of factors that shape the operation of small-scale machinery hire service providers in the research area. How and why these factors influence the operation of the selected IRSAMs are investigated. Agricultural mechanisation system is used as an approach to this research to explain the complexity of the network of actors involved in the system.

The chapter reviews the relevant literature starting with the roles of mechanisation in agriculture in developing countries (Section 3.2). Following this section is an overview of machinery hire services (Section 3.3). Section 3.4 discusses issues contributing to the operation of machinery service providers, including the role of skilled staff, demand for machinery hire service and institutional support (financial, agricultural extension services, training, repair and maintenance facility and rural infrastructure). This chapter is summarised in Section 3.5.

3.2 The role of mechanisation in agriculture in developing countries

The objective of this section is to highlight a broad field of agricultural mechanisation, which includes the application of agricultural mechanisation in crop production operations. With its wide use in conducting farm operations, this section also highlights

the significant roles of farm mechanisation in influencing the increase of labour and farm production and productivity. Additionally, some conditions that affect the implementation of mechanisation in agriculture are discussed. Viewing agricultural mechanisation as a system, provides the opportunity to identify major components in the systems, which are indicated as factors that should be considered while developing agricultural mechanisation.

3.2.1 Definition of mechanisation in agriculture

Mechanisation in the agricultural sector has been defined in several ways. It refers to the use of tools, implements, and powered machinery, as part of the agricultural inputs to achieve agricultural production and to improve the productivity of labour and land (Clarke, 1997, 2000; Sims & Kienzle, 2006). Agricultural mechanisation requires power to conduct farm tasks (Kaul, 1985). There are three main energy sources in agricultural mechanisation: human power, draught animal power, and mechanical power (Kaul, 1985; Rijk, 1999; Sims & Kienzle, 2006).

Human power is the earliest and most basic level of agricultural mechanisation, because it uses human muscle to operate hand tools and simple implements (Houmy et al., 2013; Rijk, 1999), whereas draught animal power utilizes animal muscle in operating implements and machines to perform farm tasks (Houmy et al., 2013; Rijk, 1999). The higher level regarding technology in agricultural mechanisation is mechanical power, where the utilisation of farm machinery is from other sources rather than muscular power (Houmy et al., 2013; Rijk, 1999). Some of the examples of agricultural energy sources other than muscular power, which are needed for a variety of farm operations, either mobile or stationary operations, are wind power, solar energy, water power, electric power, and internal combustion engines (Kaul, 1985). The application of these sources varies across countries and depends on local circumstances (Starkey, 1998), especially the availability of power sources (Lohan et al., 2015).

The field of agricultural mechanisation is very broad, cover the use of farm equipment and the techniques associated with its use (Kaul, 1985). Agricultural mechanisation covers the process of supplying mechanisation inputs to farmers in an efficient and effective manner, which includes the material input of mechanisation (manufacturing and or importation), distribution of farm machinery, repair and maintenance services

(including spare parts), institutional support, management, and utilization of agricultural tools, implements and machines (Houmy et al., 2013; Kic & Zewdie, 2013). Meanwhile, the use of mechanisation in the operation of agricultural production by farmers, includes agricultural land development, crop production, harvesting, preparation for storage, storage, and on-farm processing (Rijk, 1999).

3.2.2 The role of agricultural mechanisation

3.2.2.1 Mechanisation to increase farm labour productivity

Agricultural mechanisation has contributed significantly to agricultural and rural development in many parts of the world (Paman, 2016). The role of mechanisation in agriculture is to reduce labour peaks through improving the quality of work and assist carrying out work on schedule (Gego, 1986). A survey by Paman, Inaba, and Uchida (2012a) in Riau Province, the Republic of Indonesia, indicated that the application of farm machinery during a high demand for labour could relieve pressure on human labour; this was particularly evident during land preparation for rice farming. Additionally, mechanisation in agriculture can increase labour productivity by complementing existing farm labour (Yogatama, Ciptohadijoyo, & Masithoh, 2002). Yogatama et al. (2002) found that agricultural mechanisation through the use of machinery hire services in the Special Region of Yogyakarta, has been able to complement existing farm labour in the research area, particularly land preparation and paddy milling, because labour for these particular farm operations is limited.

3.2.2.2 Mechanisation to increase agriculture production and productivity

Many developing countries are increasing the application of farm mechanisation in their farm operations to improve agricultural production (Paman, Inaba, et al., 2012a). Mechanisation in agriculture has been shown to play a significant role as it correlates positively with agricultural productivity (Giles, 1975). Similarly, mechanisation has a major role in increasing agricultural yields (Gego, 1986). Application of farm mechanisation has enabled farmers to increase production and productivity through improved quality or precision of completing farm tasks, and timeliness of farm operations (Crossley, 1983; Singh, 2013). Furthermore, more efficient farm operations can be achieved using mechanisation, which, in turn, results in a positive correlation with yields (Binswanger, 1978). For instance, a study by Hutahaeen, Anasiru, and Sarasutha (2005) in Central Sulawesi Province, the Republic of Indonesia, reported that tractors are faster

than draught animal power in terms of time required to complete farm tasks, such as land preparation for growing paddy. Similarly, the application of agricultural machinery in paddy farming can reduce the time needed to conduct farm operations, and it increases the cropping intensity through advancing the schedule of land preparation (Yogatama et al., 2002). By advancing land preparation before the wet season starts, sufficient water availability for growing paddy is assured (Yogatama et al., 2002).

3.2.2.3 Mechanisation to increase returns to farmers

There is accumulating evidence that agricultural mechanisation can increase a farmer's livelihood regarding income (Miah & Haque, 2015; Paman et al., 2016; Rahman, Miah, & Hossain, 2011). Studies by Miah and Haque (2015) and Rahman, Latifunnahar, and Alam (2013) in Bangladesh revealed that small-scale machinery entrepreneurs benefited substantially from hiring machinery to farmers, particularly in increasing their livelihood. Similarly, in Riau Province, mechanisation in agriculture, through the provision of farm machinery services by farmers, has enabled them to earn income during their operations in wetland paddy fields (Paman et al., 2016; Paman, Uchida, & Inaba, 2010). Additionally, mechanisation has been able to lower the cost of production, which implies an increase of farmers' income (Yogatama et al., 2002).

The significant roles of mechanisation in agriculture to farmers, whether as the users of machinery or as the provider of machinery services, can be summarised as follows: 1) increasing farm labour productivity and reducing drudgery, 2) increasing agricultural production and productivity, and 3) increasing returns to farmers by reducing costs of production (Gego, 1986; Giles, 1975; Miah & Haque, 2015; Paman, Inaba, et al., 2012a; Singh, 2013; Yogatama et al., 2002). With these essential roles of mechanisation in agriculture, many developing countries continue to implement mechanisation in their policy (Biggs & Justice, 2015; Diao et al., 2014).

3.2.3 Agricultural mechanisation as a system

Looking at the roles and a broad field of agricultural mechanisation, some conditions influence the implementation of agricultural mechanisation in many developing countries. To promote farmers in adopting agricultural mechanisation, there is "an evolutionary process influenced or induced by a set of country specific agro-climatic factors, economic factors, and social conditions for which the government's policy

choices have impact” (Diao et al., 2014, p. 168). Agricultural mechanisation also consists of a complex network of actors (Sims, Rottger, & Mkomwa, 2011). Therefore, mechanisation as argued by Houmy et al. (2013), should be viewed in a broad context and considered as a system (Rasouli, Sadighi, & Minaei, 2009). A well-functioning agricultural mechanisation system is performed by all related actors with their respective roles and their efficient working performance (Houmy et al., 2013). A strong linkage between these actors is fundamental to ensure the sustainability of an agricultural mechanisation system (Clarke, 2000).

To develop agricultural mechanisation, Rasouli et al. (2009) identified major components in the system as follows: government, financial institutions, research and development sector, education and extension sector, manufacturing sector, and distributing sector. Some of these components had been identified by Sarker and Sarker as cited in Paman (2016), particularly the services conducted by government, education and extension, and manufacturing. Moreover, the authors identified other components that would encourage the development of agricultural mechanisation in developing countries if the following services were developed simultaneously. These components are 1) establishment of service centres with adequate repair and maintenance facilities and skilled mechanics in the rural area, and 2) creating job opportunities for the displaced labour by establishing industries and agro-based factories. Collaboration in the form of mutual work of these components would be able to supply appropriate machinery which fits the need of local conditions (Rasouli et al., 2009). Furthermore, Rasouli et al. (2009) stated that other factors might contribute substantially in influencing agricultural mechanisation at farm levels which were not investigated in that study, and this needs further research.

3.3 Overview of farm machinery hire services

In many developing countries, ownership of farm machinery is very limited because of the small-sized farms owned by the majority of farmers (Gego, 1986). Additionally, the ownership of machinery for many farmers in developing countries is mainly determined by its economic viability (Singh & Kingra, 2013). Furthermore, it requires capital investment, and depends on the availability of finance of farmers (IRRI, 1986). This fact often leads to the collective use of farm machinery by farmers or individuals in groups or organisational form (Gego, 1986). In general, these organisational forms are classified into public and private sector categories, but some forms are organised by both parties

(FAO, 1985). In developing countries, the following forms of farm machinery ownership exist: 1) public hire service, 2) private hire service, 3) private owner-user with hire service for excess capacity, 4) exclusive private owner-user, 5) cooperative ownership, and 6) informal joint ownership (IRRI, 1986). From these forms, farm machinery hire services are one of the organisational forms of machinery ownership, which can be organised by public and private sectors (FAO, 1985; IRRI, 1986). More detail on machinery hire services is reviewed in the following section.

3.3.1 Definition and types of machinery hiring services

According to Sims et al. (2011) hire services (rental, custom, or leasing services) in agriculture are an activity of a machinery service provider in delivering services to farmers, which may include land preparation, planting, spraying, threshing, or transportation. In addition, hire services may include the use of draught animals as the source of power to deliver services to farmers (Houmy et al., 2013). Agricultural machinery services are popular in developing countries, because the majority of farmers are smallholder farmers who are unable to expand and intensify the production of food and cash crops due to the lack of availability or access to farm mechanisation (Sims et al., 2011). “Hire services offer an affordable and cost-effective means for farmers to obtain the use of farm machinery and equipment” (Houmy et al., 2013, p. 41). Through machinery hiring, small-scale farmers can utilise farm machinery without owning it, so that they can get benefit from it (Paman, Inaba, et al., 2012a; Singh & Kingra, 2013).

Based on ownership in the private sector category (FAO, 1985; IRRI, 1986), usually there are two types of hire services organised by service providers: farmer to farmer service, and a private company to farmer service (Houmy et al., 2013). Farmer to farmer hire services are machinery services provided by farmers themselves for their use and also for other farmers’ use through a commercial service (Sims et al., 2011). Meanwhile, private company to farmer services are machinery services offered by a company that specialises in providing commercial farm machinery services as their main business (Houmy et al., 2013). Such hire service providers exist in Bangladesh, China, India, and Ghana (Diao et al., 2014; Houmy et al., 2013; Houssou et al., 2013).

There are two ownership types of farmer to farmer hire services (FAO, 1985). The first category is farmer contractors (individual ownership), where an individual farmer provides commercial machinery services to other farmers. This condition occurs when there is surplus capacity of a tractor and associated equipment after they have finished their farming operations. The second type is farmer group machinery hire providers (group ownership), where farmer groups provide commercial machinery hire services to their members by pooling their resources and purchasing the required machinery or obtaining the machinery from a government mechanisation programme (Clarke, 2000; FAO, 1985; Houmy et al., 2013). As opposed to individual ownership, it is argued that group ownership will often have easier access to government programmes, such as access to credit to develop the group (Sims & Kienzle, 2016). However, there are problems associated with group ownership. The first issue is the timeliness of service because all members will probably require machinery services at the same time (Sims & Kienzle, 2016). The second problem is deciding who will be the person in charge of managing the machinery and operating the machinery (Sims & Kienzle, 2016). It is argued that the farmer group ownership model will work in situations where all the members have mutual respect and confidence in operating the machinery hire services unit (Sims & Kienzle, 2016).

According to Kienzle, Ashburner, and Sims (2013), initially, the establishment of hire services was part of the agricultural mechanisation policy developed by many developing countries in the 1960s and 1970s. In the past, many governments in developing countries, such as in Asia and Africa, introduced tractor hire schemes to assist farmers in improving their commodity production (Kienzle et al., 2013). Recently, the pattern of government-led hire services still exist. Many farmers obtained farm machinery and started their hire service business through government mechanisation programmes. These programmes can be found in the Republic of Indonesia, India, Kenya, Brazil and several countries in Sub-Saharan Africa (Houmy et al., 2013; Mayrowani & Pranadji, 2012; Sims et al., 2011; Singh, 2013). Furthermore, there are also some farmers who have the capacity to invest in farm machinery and provide machinery hire services (Sims et al., 2011). Moreover, international donors, such as Japan International Cooperation Agency (JICA) are also involved in providing farm machinery to farmers (Kienzle et al., 2013; Sims & Kienzle, 2009).

3.3.2 Public-led machinery hire services

According to Kienzle et al. (2013), due to the ineffective and the uneconomic scheme of government-led machine hire service, many countries in Africa abandoned this scheme in the 1980s and 1990s. As mentioned earlier, farmer to farmer hire services have existed as part of the government policy in many developing countries through subsidised mechanisation programmes (Clarke, 2000; Houmy et al., 2013). However, the programme of subsidised machinery hire services is reported to be unsustainable in some developing countries (Diao et al., 2012; Houssou et al., 2013; Kienzle et al., 2013). A review of the government intervention programmes, in promoting the use of agricultural machinery through state-led agricultural machinery services in Asia and Africa, was conducted by Seager and Fieldson (1984) as cited in Diao et al. (2014). Seager & Fieldson reviewed 38 public mechanisation programmes in 21 countries during the period of the 1970s and 1980s, and found that most of the programmes were unable to make the adoption process of mechanisation sustainable. Some studies have reported several causes of the unsustainable mechanisation programme in developing countries, particularly hire services schemes (Diao et al., 2014; Houmy et al., 2013). These are 1) small fields owned by the hire service clients and their location being relatively far from the hire service providers, which resulted in high operating costs of hire services, 2) state-led farm mechanisation service units were unable to operate efficiently because the service charges were too expensive for farmers, 3) rigid and inefficient public administration (bureaucratic issue), and 4) undercutting private hire machinery providers (Seager & Fieldson, 1984) as cited in (Diao et al., 2014) and Houmy et al. (2013).

The evidence of previous efforts of many governments in delivering agricultural mechanisation intervention is also found in more recent research. Studies by Clarke (2000), Sims and Kienzle (2009) and Singh (2013) argue that the provision of farm machinery services in some developing countries was unable to serve farmers in terms of timely and profitable mechanisation services and undermined the role of the private sector which, in the long run, lead to the programme being unsustainable. For instance, in Kenya and Brazil, Sims and Kienzle (2009) identified that public machinery hire services were not profitable because service charges were set cheaper than the service provided by the private sector. Meanwhile, in Punjab, India, Singh (2013) found that the service of the government-led farm hire machinery units was not timely and adequate, which resulted in delays in sowing crops.

Likewise, Julius (2014) argues that in Abuja, Nigeria, farmers have low access to farm machinery hire services, which may be due to bureaucratic issues. Tractors were not distributed to agencies that serve farmers with machinery services, which depicts the weakness of the public sector in fostering the use of the tractor by farmers (NAERLS & NPFS, 2011) as cited in Julius (2014). Similar to the cases in Kenya and Brazil, Houssou et al. (2013) discovered that in Ghana, the state-led mechanisation programme, the Agricultural Mechanisation Service Enterprise Centres (AMSEC) was unable to make profits because of underutilization of tractor-hire services. AMSECs mainly offered tilling services locally and rarely served farmers by migrating to different areas (Diao et al., 2014).

Pingali (2007) has observed the pattern of poor performance of agricultural mechanisation policies. The implications of government intervention in this context were examined by looking at the adoption patterns and economic impacts of agricultural mechanisation, especially in Asia and Africa. The author argues that in promoting the policy of tractor-hire operations, the public sector tends to believe that providing tractors to farmers is a way to achieve agricultural modernization (Pingali, 2007). Meanwhile, according to the author, the introduction of tractors to farmers would not directly influence the farmers' decisions in using this piece of technology, which would not lead to intensification.

In fact, as argued by Clarke (2000), mechanisation is similar to other agricultural inputs, such as seeds and fertiliser which, in reality, are part of the management tools that farmers use to maximise production and profit. Pingali (2007) states that the public sector, as the main donor for the establishment of agricultural machinery hires services, does not shape the intervention system into a more self-sustaining system, which considers other related services to hire services. In this case, related services provided by the private sector, include supplying equipment, spare parts, or maintenance services (Pingali, 2007). As a result, many of the government interventions have poor longevity, which can be seen with the collapse of the public-led hire service providers along with the withdrawal of government from the programme (Pingali, 2007).

3.3.3 Private-led machinery hire services

Even though the majority of public-led machinery hire service programmes are not sustainable, there is growing evidence that government initiatives have promoted private-led farm mechanisation to spread in rural areas over the past years, particularly in Asia, Africa, and Latin America (Biggs & Justice, 2015; Kienzle et al., 2013). For instance, in Zambia, the number of commercial farmers increased 38 percent between 1970 and 1988, and the number of subsistence farmers fell by an average 0.5 percent per annum in the same period as a consequence of the subsidised mechanisation programme by the Zambia Government (Simalenga, 2013).

Meanwhile, a study by Biggs and Justice (2015) identified the transformation of farm machinery over the past 50 years, particularly smaller-scale machinery in some regions of South Asia, as an implication of the subsidised mechanisation policy in the era of past Asian Green Revolutions. The authors argue that smaller-scale machinery has been able to increase the intensity of farmers in using various rural and agricultural resources. This is indicated by the increase of yields and cropping intensities, careful use of fertiliser and water management, and the growing use of agricultural post-harvest processing equipment. In Ghana, the private sector has started to lead the machinery hire services in parallel with the AMSEC subsidised programme since 2003 (Diao et al., 2012). This is different from South Asia, where medium and large-scale farmers are the main players in the machine hire business in Ghana because the government hire services were unable to meet the market demand for hire services (Diao et al., 2012).

Many scholars have argued that one of the triggers of private-led mechanisation uptake, particularly in hiring agricultural machinery, is a facilitating mechanisation policy that attracts and supports the private sector to conduct business in farm machinery services (Biggs, Justice, & Lewis, 2011; Clarke, 2000; Diao et al., 2014). For instance, Biggs et al. (2011), identified that the government of Bangladesh in the 1990s altered the import policy on agricultural machinery allowing small Chinese power tillers to enter the Bangladesh market. The shift of mechanisation policy in Bangladesh was a response to a major decline of draught oxen population, due to major calamities (floods and cyclones) that struck Bangladesh in the late 1980s (Biggs et al., 2011). As a result, the private sector quickly exceeded the public sector in farm machinery importation by importing less expensive equipment from China (Gisselquist & Jean-Marie, 2000; Roy & Singh, 2008).

Along with the increase of agricultural machinery population in the Bangladesh market, a national survey revealed that 72% of farmers used farm machinery, particularly power tillers, while the rest were using draught animals for land preparation (Ahmed, 2013) as cited in Diao et al. (2014). As the majority of farmers in Bangladesh use power tillers, it indicates that the market for machine services flourishes (Ahmed, 2013) as cited in Diao et al. (2014). A similar case was found in Ghana as documented by Diao et al. (2014), where in this country, parallel to the importation of farm machinery conducted by the government of Ghana to supply AMSECs, the private sector benefited from the import tariff exemption imposed on all farm machinery imports. As a consequence of this import policy, the private sector has been able to import affordable second-hand tractors over the past ten years and become the main providers of machinery hire services in the country (Diao et al., 2014).

In order to create a facilitation policy to foster mechanisation in developing countries, many scholars suggest that the role of the public sector should be adjusted to give the opportunity for the private sector, to develop their market in the machine hire business (Clarke, 2000; Diao et al., 2014; Houssou et al., 2013; Kienzle et al., 2013; Pingali, 2007; Sims & Kienzle, 2009). For instance, the public sector should be able to promote the demand for farm machinery and the provision of spare parts. The public sector should facilitate the private sector in acquiring and maintaining farm machinery through the reduction of transaction costs, such as changing the importation policy as evidenced in Bangladesh and Ghana (Biggs et al., 2011; Diao et al., 2014; Pingali, 2007).

Clarke (2000) suggests that the government should consider how much mechanisation should be introduced to farmers to foster the demand for agricultural machinery from the farmers or the private sector. However, materialising this policy poses a challenge for the government. For instance, Biggs and Justice (2015) argue that in developing countries, where the majority of agricultural policy is dedicated to supporting farmers through subsidies, adjusting policy is challenging because there is a dependence of farmers on subsidies. In this case, Biggs and Justice (2015) illustrate that farmers and rural entrepreneurs might delay the process of buying new farm machinery, even though they realise that business in hiring machinery is profitable, due to waiting for cheaper machinery from the subsidy programme (Biggs & Justice, 2015). Many scholars agreed that more actors are needed in formulating an agricultural mechanisation strategy to

promote more sustainable farm mechanisation at the farm level (Biggs & Justice, 2015; Clarke, 2000; Kienzle et al., 2013; Sims & Kienzle, 2009).

3.4 Factors shaping the operation of farm machinery hire services

The operation of machinery service providers (public or private providers with individual or group ownership), is affected by the local circumstances where the providers are operating. As stated by Bigot and Binswanger (1987), mechanical technology is sensitive to agro-climatic factors and economic factors. Different environmental or economic conditions will affect the utilisation of technology (Bigot & Binswanger, 1987). Many studies have found various factors shaping the operation of farm machinery hire services in developing countries. Some of the factors are the characteristics of seasonal demand for machinery services, the performance of managers of machinery service providers, the availability of skilled operators, the availability of financial resources, the supply of agricultural machinery services, access to training, access to repair and maintenance networks (including spare parts), and rural infrastructure (Ariningsing & Tarigan, 2005; Diao et al., 2014; FAO, 1985; Julius, 2014; Miah & Haque, 2015; Mottaleb, Krupnik, & Erenstein, 2016; Paman, Inaba, & Uchida, 2014; Paman et al., 2016; Sims et al., 2011; Xi & Baofeng, 2007; Yogatama et al., 2002).

In some studies, some factors were found to be significant in contributing and shaping the operation of machinery service providers, even though these factors were categorised into broader categories, or in some cases, not categorised into a specific category. For instance, Miah and Haque (2015) argue that socio-economic characteristics of the farmers (age, level of education, length of experience in delivering farm machinery services, and source of financing to acquire farm machinery) are important in influencing farmers to operate power tiller operated seeders (PTOS) as a profitable business in Bangladesh.

Additionally, some factors are linked to, or supported by other factors, which lead to the operation of a machinery service provider. For instance, Rahman et al. (2013) found that in Bangladesh, the operation of tractor service by rural entrepreneurs was influenced by the demand for tractor services. The demand for tractor services was also influenced by the topography of the land, cropping pattern, and diversified crop production (Rahman et al., 2013). While, Paman et al. (2014) in Riau Province, revealed that the demand for

machinery services tends to be seasonal, where it is influenced by seasonal work and the use of machinery, which varies across machine types.

In this research, the factors that contribute to shaping the operation of machinery hire services are categorised into three main categories: 1) the role of skilled staff in supporting the business, 2) demand for machinery hire services, and 3) institutional support. The categorization is based on the themes that emerged in the results, which were considered as being important in this research. These topics fitted into these categories. In the next section, these factors are reviewed.

3.4.1 The role of skilled staff in supporting the business

3.4.1.1 A manager of a machinery service provider

It is argued that a competent manager of a machinery service provider is an essential factor in influencing the direction and the performance of machinery hire business (Ariningsing & Tarigan, 2005; FAO, 1985; Hamidah & Soedarto, 2006; Mayrowani & Pranadji, 2012; Paman et al., 2014; Yogatama et al., 2002). A manager of multi-farm use system – “the same farm power, machinery and equipment is used on more than one farm unit”, such as providers of machinery hire services should have sound knowledge of business management (FAO, 1985, p. 2). This knowledge includes an understanding of record keeping and accounting, personnel management, government regulations, procurement, and marketing (FAO, 1985). A manager should also possess technical skills and relevant knowledge for the operation, management and repair of farm machinery, and have a sound understanding of agriculture (FAO, 1985).

According to Mayrowani and Pranadji (2012) and Paman et al. (2014), due to the organisational structure of the machinery services managed by farmer groups, particularly in the Republic of Indonesia, which positions the manager as the leader of the machinery service group, the role of the manager becomes essential. Studies in the Republic of Indonesia by Ariningsing and Tarigan (2005) in Indramayu Regency, West Java Province, and Hamidah and Soedarto (2006) in Gresik Regency, East Java Regency, have revealed that important skills of a manager, such as good record keeping and managerial skills determine the success of the IRSAMs. Furthermore, according to a survey of small-scale farm machinery service providers in Riau Province, a manager has a key role in determining the service charge (Paman et al., 2014). However, with the significant role

of the manager, Ariningsing and Tarigan (2005) postulated the possibility of a manager using the machinery hire business to pursue his interests or goals. The authors emphasised that honesty of the manager and the other members of the business in conducting their roles are essential to the group's development.

Additionally, it is argued that a manager should possess marketing skills. As suggested by Yogatama et al. (2002), to help the business flourish, the manager needs to introduce and promote mechanisation at the farm level (Yogatama et al., 2002). Meanwhile, the performance of a manager in leading the business is arguably related to the role of government in empowering farmer groups that are operating machinery hire services. A study by Hutahae et al. (2005) in Central Sulawesi Province, found that the role of managers in the surveyed areas, tended to be unprofessional in managing the groups. The authors argued that lack of empowerment and monitoring from the government, particularly in the management aspects, was one of the causes of this problem.

3.4.1.2 Farm machinery operators

There is common agreement that farm machinery operators of hire service providers have essential roles in influencing the operation of the group (Diao et al., 2014; Houssou et al., 2013; Miah & Haque, 2015; Paman et al., 2014; Paman, Uchida, & Inaba, 2012; Sims et al., 2011; Yogatama et al., 2002). Farm machinery operators perform field operations of a hire service provider (FAO, 1985). Scholars agreed that sufficient technical skills, sound knowledge, and experience of agricultural machinery operation are required for operators to be able to perform machinery services (FAO, 1985; Houssou et al., 2013; Sims et al., 2011).

Through mastering the operation of farm machinery for hire services, the operators will gain skills and knowledge, which will financially benefit the group as they are recognised by other farmers and will help the hire service providers capture a larger market share (Sims et al., 2011). The operators' skills and knowledge can be improved through technical training (Paman et al., 2014). For instance, two entrepreneurs in the villages of Ekenywa and Ilkhiushin Arumeru District, United Republic of Tanzania, have successfully created and developed a hire service business after participating in FAO technical and business training in 2008 (Sims et al., 2011). In contrast, it is found that insufficient skills of operators in handling farm machinery influenced the seasonal

workload of machinery service which, in turn, affected the business operation (Paman et al., 2016; Paman et al., 2010; Yogatama et al., 2002).

The operation of machinery hire services is also affected by the availability of skilled operators. A study by Paman et al. (2010) in Riau Province, found that machinery providers were unable to identify machinery operators due to a very limited number of capable operators, especially during the paddy growing season. As a result, the owners increased the hourly rate fee of the operators to find them in time (Paman et al., 2010). Similarly, Yogatama et al. (2002) found that in the Special Region of Yogyakarta, operators received a greater portion of the total variable cost (fuel, oil, and operators), because this is the strategy of the managers to keep the operators in the business and to encourage them to maintain the quality of work.

In relation to the increase of operator wages, a study in Ghana found that due to the characteristics of incentives received by operators of the AMSEC model, they tended not to take good care of farm machinery (Diao et al., 2014). The authors stated that to deliver services to farmers, operators are hired by the owner of AMSEC, and the owners provide remuneration by the total amount hectares of cultivated land. As a result, the operators have no incentives to look after the machines, which caused frequent machinery breakdowns (Diao et al., 2014). Nevertheless, the high wages received by operators are, in fact, insufficient to attract young people in Riau Province, who are looking for a job (Paman et al., 2016). The authors argued that the seasonal job contract of a farm machinery operator was the reason why people are not interested in this particular job. As a consequence, it is still difficult to find operators during the paddy growing season for some hire service providers in the survey areas (Paman et al., 2016).

3.4.2 Demands for machinery hire services

It is widely agreed that the demand for machinery hire services by farmers is one of the essential factors in shaping the operation of machinery service providers (CSAM, 2014; Julius, 2014; Paman et al., 2014, 2016; Paman et al., 2010; Sims et al., 2011; Takeshima, 2015; Xi & Baofeng, 2007; Yogatama et al., 2002). Machinery hire services tend to have seasonal demands, which is time-bounded and synchronic (all machinery demand rises at the same time) as a result of the seasonality of agriculture (Paman et al., 2014; Sims et al., 2011). A survey of machinery hire services in Kampar Regency, Riau Province,

revealed that seasonal demand is influenced by seasonal work, which varies across machine types and is dominated by tillage operation or land preparation (Paman et al., 2016).

Furthermore, the seasonal work of machinery is influenced by various factors, such as the total working days during the rice-growing season, water supply into paddy fields, and the limited number of machines available to farmers (Paman et al., 2014, 2016). Field conditions also influenced the work of machinery, these include field size and shape, weed population, and distance from the machine centre to the farm (Paman et al., 2014, 2016). Likewise, a survey of farm machinery services in rural Shanxi Province, China identified that land size, the degree of specialisation on planting, and the availability of machinery service providers influenced demand for machinery services by farmers (Xi & Baofeng, 2007). Furthermore, a study by Rahman et al. (2013) in Bangladesh found that different cropping patterns and diversified crop production because of different topography, the fertility of land, and availability of water resources for irrigation, are factors influencing the demand for tractors for tilling across time and seasons.

Additionally, service charges set by machinery service providers influence the demand for machinery hire services. For instance, the service charge of machinery service providers in Riau Province, and Sausu District, Central Sulawesi Province, are set lower than the Government's rate, due to the low purchasing power of farmers, and to increase their demand (Hutahaeen et al., 2005; Paman et al., 2010). Meanwhile, a study by Julius (2014) in Abuja, North Central Zone, Nigeria found that the cost of hiring farm machinery was too high for farmers, thus limiting farmers' utilisation of machinery hire services. However, it is argued by Yogatama et al. (2002), as evidenced in their study in the Special Region of Yogyakarta, that if they are unable to set a profitable custom rate, machinery hire service providers lose their opportunity to generate profit from the business.

Migration to other areas by machinery service providers, is another factor, which influences the demand for machinery services (Diao et al., 2014; Houssou et al., 2013; Paman et al., 2010; Yang et al., 2013; Yogatama et al., 2002). The number of operational days of machinery services can be increased through migrating to other places, which can lead to more profits received by the providers (Houssou et al., 2013). For instance, in Ghana, Diao et al. (2014) found that government-led machinery hire services (AMSEC)

were infeasible because, mainly, these providers only provide local ploughing services. Conversely, in China, the provision of farm machinery services has been able to increase the demand for machinery services by migrating across different agro-ecological conditions (Yang et al., 2013). Similar instances have been identified in the research of Paman et al. (2010) and Yogatama et al. (2002). The authors suggest that through migrating to neighbouring villages, the annual use of tractors can be increased and eventually receive more profit. However, machinery service providers need to first understand the necessary conditions that will enable them to migrate, such as different harvesting time for the same crops across different areas, coordination problems and infrastructure conditions, such as road networks (Diao et al., 2014; Yang et al., 2013).

3.4.3 Institutional support

Institutional support has arguably influenced the performance of machinery hire providers (Takeshima et al., 2014). As stated by FAO (1985), institutional support is needed to create a sustainable environment for introducing and sustaining the multi-farm use of machinery, provided by farm machinery owners, including the machinery hire providers. Institutional support arrangements will vary across developing countries and may be grouped according to the type of activity and service provided (Houmy et al., 2013). In general, the institutional supports are financial/credit services, extension services, training for machinery operators, repair and maintenance facilities (including spare parts), and infrastructure (FAO, 1985; Houmy et al., 2013; IRRI, 1986). According to Sims et al. (2011, p. 8), “the presence of support services and necessary infrastructure are an important catalyst for the establishment and operation of hire service enterprises in the smallholder context”. Many scholars have provided empirical evidence of these institutional supports in influencing the operation of machinery hire providers (Miah & Haque, 2015; Mottaleb et al., 2016; Paman et al., 2014; Paman et al., 2010; Paman, Uchida, et al., 2012; Takeshima et al., 2014). These institutional supports are discussed in the following section.

3.4.3.1 Access to financial/credit support

Financial assistance in the form of credit or subsidies is arguably an effective means to support agricultural mechanisation in developing countries (FAO, 1985). For most smallholder farmers in these countries, not owning farm machinery is not only a result of low purchasing power, but also because purchasing agricultural machinery is an

investment decision. It may not suit them because the returns on investment are unlikely to cover the investment (Diao et al., 2014). Tools, implements and farm machinery requires an initial capital investment (Houmy et al., 2013). This reason has usually become the justification for the public sector to intervene and provide machinery subsidy to farmers, as experienced by many governments in Africa and Asia (Biggs & Justice, 2015; Diao et al., 2014; Takeshima et al., 2014). In many Asian countries, government subsidies are usually in the form of capital grants and low-interest loans (Biggs & Justice, 2015).

Financial support provided by the governments in developing countries can set the pace and direction of agricultural mechanisation (IRRI, 1986). For instance, in Ghana, financial support promotes public and private sectors to hire out machinery services after the Government of Ghana imported tractors by utilising concessional loans from Brazil, China, and India (Diao et al., 2014). Meanwhile, in India, because of farmers' low purchasing power, the government has made credit available at a reduced rate to assist farmers in procuring agricultural machinery (Singh, 2006). Private sector can provide the financial aid to farmers so that they can purchase agricultural machinery. In Thailand, machinery hire services are using local and foreign commercial banks to borrow funds to develop their business (IRRI, 1986). Similarly, a study by Miah and Haque (2015) in Bangladesh found that the providers of the custom hiring of the power tiller operated seeders (PTOS) have been able to utilize more loans from commercial banks and other lenders compared to before, because the business is profitable (Miah & Haque, 2015).

A frequent problem arises when providing financial support to small-scale farmers, because small farmers are unable to cover interest and loan amortisation, due to not having off-farm income, and their farm production is sufficient only for their consumption (IRRI, 1986). This problem can be overcome if farmers possess agricultural machinery, such as tractors and they provide machinery services to start earning income and paying the loan (IRRI, 1986). Therefore, looking at the lack of capital for smallholder farmers, it is argued that financial support from the government may be a viable option for them to own farm machinery in the early stages (FAO, 1985) as a way to overcome investment constraints (Takeshima et al., 2014). It is suggested that the role of government should only be to stimulate the mechanisation process and to emphasise the

demand side (Sims & Kienzle, 2016) by keeping financial support relatively small to avoid rent seeking behaviour (Takeshima et al., 2014).

3.4.3.2 Access to agricultural extension services

According to FAO, agricultural extension services disseminate information to farmers and operators on the use of farm machinery and mechanisation problems in general, along with the provision of specialised training facilities (FAO, 1985). In China, strong agricultural extension services have made mechanisation available for small-scale farmers in the country (Sims & Kienzle, 2016). Access to agricultural extension services is arguably influencing the operation of machinery service providers (Sims et al., 2011). High-quality extension services can effectively provide technical and business training to farmers (Sims et al., 2011). The efficacy of the extension service provision involves adequate and timely access by farmers (Anderson & Feder, 2003). To adopt new technology or new farm practices, farmers tend to accumulate information to improve their knowledge before they adopt new technology (Feder & Slade, 1984). As one way to obtain information, contact with extension agents, in the form of training and visits, can be expected to stimulate farmers to adopt technology. This technology adoption can be done through increasing the farmers' awareness and knowledge on the potential benefits of available technologies (Hussain, Byerlee, & Heisey, 1994; Polson & Spencer, 1991). Farmers who have had contact with extension agents are likely to benefit from extension services (Anderson & Feder, 2003).

Previous studies have identified that contact with the extension agencies, and vice versa, is important in influencing the adoption of technology (Bagheri & Ghorbani, 2011; Folefack, 2015; Ghosh, 2010; Miah et al., 2016; Owombo et al., 2012). A study by Owombo et al. (2012) in Ondo State, Nigeria revealed that the frequency of extension visits, the level of education, and access to farm machinery, were significant determinants of adoption of mechanisation practices. Miah et al. (2016) in Bangladesh found that contact with agricultural extension, was one of the important influences in the adoption of raised bed technology for cultivating crops by farmers. Likewise, Folefack (2015) identified that farmers living in nearby Yaoundé, Cameroon, who had frequent contact with extension, were more likely to adopt compost from household waste for crop production. Farmers who regularly meet extension agents have the opportunity to get

information on the compost efficacy, productivity issues, and other information regarding the advantages of using compost for farming activities (Folefack, 2015).

However, there are some challenges for farmers and extension agents to establish regular contact, particularly in developing countries; such challenges are adequate infrastructure, like rural road networks and communication infrastructure (Anderson & Feder, 2004; Leta, Murray-Prior, & Rola-Rubzen, 2004; Peterson, 1997). According to Anderson and Feder (2004), poor rural road networks increase cost and difficulty for extension agents to reach farmers. Furthermore, it is difficult for farmers to adopt improved technology if their geographical position prohibits vehicle access (Leta et al., 2004; Peterson, 1997). Similarly, inadequate communication infrastructure affects farmers' access to mass media, such as publications, radios, or television, which are provided by extension agents (Peterson, 1997). Extension agents may have insufficient access to telecommunication infrastructure, which affects them in conveying messages to farmers (Peterson, 1997). However, good infrastructure conditions can increase farmers' technology adoption. As evidenced in Bangladesh, paved roads positively and significantly affect a household's decision to adopt hybrid and modern rice varieties (Mottaleb, Mohanty, & Nelson, 2014). These authors argued that the flow of useful information from farmers to extension agents, and vice versa, was enhanced by the excellent condition of paved roads. With excellent road conditions, farmers can easily visit government extension offices in the cities, and the extension agents can more easily visit farmers in the villages (Mottaleb et al., 2014).

3.4.3.3 Training for machinery operators

It is argued that ensuring farmers' access to technical information is crucial for the development of machinery hiring services at the farm level (Sims et al., 2011), because most small-scale farmers have limited technical knowledge of agricultural machinery (CSAM, 2014). According to Kic and Zewdie (2013), technical expertise of many farm machinery operators in developing countries is often shallow, which could lead to interruptions during machinery operations and thus reduce the quality and efficiency of work and decrease the economic life of machinery (Kic & Zewdie, 2013). Farm machinery operators gain operating and maintaining machinery skills through on-the-job training and trial and error (IRRI, 1986). They commonly learn these skills from other operators, or are supervised by family members (Paman, Uchida, et al., 2012). In this

regard, Paman et al. (2014) state that acquiring sufficient technical information is beneficial for small-scale farmers who run machine services to improve the quality of service.

To be able to conduct proper operation and maintenance of farm machinery, it is suggested that farm machine operators should be equipped with sufficient technical knowledge and skills, as in the case of small-scale machinery hiring services in Kampar Regency, Riau Province (Paman et al., 2014). Furthermore, a survey conducted by Miah and Haque (2015) revealed that due to the scarcity of trained and efficient operators, especially in the peak season, the operation of machinery service providers was disturbed. It is suggested that training on repair and maintenance for operators is necessary (Miah & Haque, 2015).

Given the essential role of knowledge and technical skills that should be developed by farmers in conducting machinery services, it has been widely agreed that training for operators of machinery service providers is a vital factor in influencing the performance of delivered services (Akinfiresoye & Agbetoye, 2013; Miah & Haque, 2015; Paman et al., 2014; Paman, Uchida, et al., 2012; Yogatama et al., 2002). There is growing evidence that, due to lack of training, the performance of operators has influenced the productivity of machinery hire services, such as the frequency of machinery breakdowns due to lack of proper maintenance (Paman, Uchida, et al., 2012). In Riau Province, a study by Paman, Uchida, et al. (2012), discovered that due to lack of government training, 90% of 115 tractor operators in four regencies, have poor technical knowledge and skills in operating and maintaining tractors. These operators can only perform the most basic levels of service and repair, such as adjusting the v-belt of 2WT (Paman, Uchida, et al., 2012). Similarly, in Ondo State, Nigeria, lack of regular training for machinery operators contributed to machinery breakdown (Akinfiresoye & Agbetoye, 2013).

In many developing countries, there have been several government efforts in facilitating machinery operators to strengthen their knowledge and skills through training (Atanda, Salokhe, & Soni, 2009; Singh, 2006; Soni & Ou, 2010). For example, in Nigeria, the government has introduced the Agricultural Mechanics and Operators' Training Centre (AMMOTRAC) since the late 1980s (Atanda et al., 2009). Similarly, in India, the government has established Machinery Training and Testing Centres (Singh, 2006). In

1980, China introduced education and training systems to support an agricultural mechanisation system in the country (Soni & Ou, 2010). However, training in many developing countries are generated in the short term (Kic & Zewdie, 2013). Even back in 1985, the Food and Agricultural Organisation of the United Nations cautioned that training in the operation, repair, and maintenance would need to be intensified as mechanisation develops because there will be a growing demand for capable operators to keep pace with the development of farm technology (FAO, 1985). Training will enhance operators' knowledge and skills in operating, maintaining and repairing the machinery being used (Sims et al., 2011).

3.4.3.4 The availability of repair and maintenance facilities and spare parts

Repair and maintenance facilities are necessary to support the longevity of farm machinery operation by ensuring the supply of fuel, spare parts, and other essential supplies are available at any time when needed, particularly in rural areas (Akinfiresoye & Agbetoye, 2013; IRRI, 1986; Paman, Uchida, et al., 2012). Farm machinery, such as tractors need to be maintained, otherwise, the effective operating life will be very short (Crossley, 1983). Regular maintenance also needs to be implemented to lower the cost of maintenance. A study by Kumar and Ahmad (1996) in Allahabad District, India found that based on a mathematical model, the maintenance cost increased along with the age of the tractors and the repair rate. The limited availability of repair and maintenance facilities has hindered the development of machinery service providers (Paman, Uchida, et al., 2012).

The existence of spare parts is also an essential factor shaping the operation of machinery service providers (Crossley, 1983; Houssou et al., 2013; Miah & Haque, 2015; Olaoye, 2007; Paman, Uchida, et al., 2012; Sims et al., 2011). Spare parts are essential components of a maintenance service of machines (Crossley, 1983). The availability of spare parts is one of the factors that cause a high frequency of tractor breakdowns in Riau Province, which affects the service of tractor providers (Paman, Uchida, et al., 2012). Through a survey, the authors found that a lack of spare parts depots, and maintenance and repair facilities in survey areas, caused delays in repair work of tractors and raised the price of components. Most of the repair shops are located in the Regency Capital, while tractors commonly operate in village areas (Paman, Uchida, et al., 2012). Likewise, a survey by Miah and Haque (2015) in Bangladesh found that non-availability and the

higher price of spare parts are some of the problems encountered by the providers of machinery hiring of PTOS. In Ghana, Houssou et al. (2013) found that unavailability of spare parts and lack of qualified mechanics were contributory factors in delays in repair causing frequent tractor breakdowns.

Additionally, based on a survey in Niger State, Nigeria, Olaoye (2007) identified that lack of supply of spare parts was one of the reasons for the high proportion of tractors idle and kept in the tractor pool. Problems of the components' acquisition were also experienced by providers of machinery hire services in southern and central Iraq (Bishay, 2003). Many tractor fleets were aged in these areas, due to lack of spare parts. However, this problem has been partly resolved after the government imported spare parts and distributed them through their warehouse system. The private sector now handles the distribution network. As a result, many machinery service providers can obtain spare parts through the network, as well as from the local market (Bishay, 2003).

3.4.3.5 The availability of rural infrastructure

There is common agreement among scholars that the availability of rural infrastructure, such as road networks, irrigation networks, or network of repair and maintenance facilities, in supporting the operation of machinery service providers is essential (CSAM, 2014; FAO, 1985; Kic & Zewdie, 2013; Mottaleb et al., 2016; Paman et al., 2014; Paman et al., 2010; Sharma, Singh, & Panesar, 1998; Sims & Kienzle, 2009; Takeshima, 2015). According to Sharma et al. (1998) infrastructure needed for the success of custom hiring operations includes all weather roads, servicing network, and spatial distribution of machinery ownership. Good condition of rural roads allows easy movement of equipment for delivering services and easy access to repair and maintenance facilities (Sharma et al., 1998). In the northern region of India, adequate infrastructure has supported the spread and success of hire service on-farm machines (Sharma et al., 1998).

Likewise, in Bangladesh, according to a recent survey, the condition of physical infrastructures, such as paved or gravel road at the sub-district level positively correlated with the intention of farmers to use and deliver farm machinery services (Mottaleb et al., 2016). With improved road networks, farmers provide machinery services to other farmers in the same, or nearby villages, especially irrigation pumps and threshers but not power tillers (Mottaleb et al., 2016). The authors argued that, for irrigation pumps, road

networks are essential for ensuring that surplus of harvested agricultural products in irrigated farming system can be efficiently sent to markets, meanwhile for threshers, good quality roads are required to move threshers from one point to another (Mottaleb et al., 2016). Road conditions are not significant for power tillers, because these machines are versatile (can be used for tilling and transporting farmers) even in difficult terrain (Mottaleb et al., 2016). However, the authors did not explore the impact that the condition of the road had on the movement of power tillers between fields.

It is argued that the poor condition of road infrastructure influences time required and fuel consumption to travel to remote areas to provide farm services (Sims & Kienzle, 2009). A study by Paman et al. (2010) in Riau Province, revealed that poor road infrastructure has influenced tractor hire services in reaching fragmented fields, which influences the annual use of machinery services from the providers. On the other hand, the good condition of rural networks has enabled some hire providers to travel long distances, ranging from 3 km to 5 km to neighbouring villages (Paman et al., 2010). In addition to the condition of rural road infrastructure, Mottaleb et al. (2014) claim that the prevalence of good road conditions augments the flow of information between farmers and agricultural extension officers who can frequently visit farmers.

The other essential infrastructure that supports the operation of machinery service providers is irrigation infrastructure (Paman et al., 2014; Takeshima et al., 2015). According to Takeshima (2015), functional irrigation facilities with lower-cost irrigation, are more likely to affect the propensity to hire tractor services because, in using tractors, farmers are more likely to combine them with irrigation. It is believed that improving the condition of irrigation infrastructure can increase cropping intensity, which influences the use of tractors for land preparation in the dry season (Paman et al., 2010). As evidenced in Kampar Regency, Riau Province, poor irrigation infrastructure in paddy irrigated fields has caused farmers to experience water shortage and were unable to grow paddy during the dry season (Paman et al., 2014).

3.5 Summary

Agricultural mechanisation is a broad field. It involves the use of machinery, including, techniques associated with the utilisation of the machinery in crop production operations, starting from agricultural land development to crop processing. The roles of

mechanisation in many developing countries are: 1) to increase farm labour productivity and reducing drudgery, 2) increasing agricultural production and productivity, and 3) increasing returns to farmers by reducing costs of production. With its role, its broader context, and a complex network of actors involved, agricultural mechanisation should be viewed as a system. By looking at agricultural mechanisation as a system, it can be argued that many components, or factors, influence the operation of farm mechanisation. As one of the forms of machinery ownership, machinery hire services are popular with small-scale farmers in developing countries, because this rural business entity provides small farmers with affordable and low-cost access to farm machinery as a way to improve agricultural production. The development of machinery hire services is part of the government policy of agricultural mechanisation. The unfortunate experience of public-led agricultural mechanisation policy has promoted a silent revolution in the private sector to emerge.

In developing countries, the operation of machinery hire services is shaped by various factors that have been identified by many scholars. Some of these factors are shown to be significant in influencing the operation of machinery service providers, including 1) the role of skilled people involved in the hire business (manager and machinery operators), 2) demand for machinery services from farmers as the client of the hire services, and 3) institutional support provided by the government and private sector, including financial aid, access to agricultural extension services, training, repair and maintenance network (including spare parts), and rural infrastructure. Most of the literature explored these factors by implementing a snapshot view (explore the situation at a point in time) using surveys, questionnaires and quantitative methods. In this regard, this research will contribute to the body of literature by, not only looking at the identified factors mentioned earlier, but also looking at how and why these factors affect the operation of the IRSAMs.

CHAPTER FOUR: RESEARCH DESIGN

4.1 Introduction

This chapter outlines the reason behind the selection of a research method and describes the research strategy and case study design (Section 4.2). The following section discusses the consideration of selecting the research site and case selection (Section 4.3). Sections 4.4, explains the selection of participants, followed by section 4.5, which outlines the data collection methods and fieldwork process. Sections 4.6 and 4.7, discuss the data analysis techniques and ethical considerations, respectively. Finally, Section 4.8 summarises the chapter.

4.2 Research design

The purpose of the research is to understand the implementation of the IRSAM programme that has been applied to different areas of the Republic of Indonesia to highlight the various factors which shape the outcome of the programme implementation. The research is focused on gaining insight into those factors that influence the operation of particular IRSAMs and how IRSAMs are working with these factors. By understanding the different factors that shape the functioning of the IRSAMs, recommendations can be provided, and insights attained as to how the MoA may be able to improve the IRSAM programme.

To gain insights on various factors that shape the IRSAMs, this research has used a qualitative research method. According to Berg (2007, p. 8) qualitative research methods “allow researchers to share in the understandings and perceptions of others and to explore how people structure and give meaning to their daily lives“. It can be argued that the operation of the IRSAMs and its relationships with other actors in the IRSAM programme may be shaped by different perspectives based on each actor’s interest and the local setting in which the programme was implemented. According to Marshall (2011), people’s actions are significantly influenced by the social and physical setting in which these actions occur. Therefore, qualitative research methods are used to understand how

different perceptions of these actors, and the various settings around the IRSAMs, are shaping the operation of the IRSAMs, which affects the IRSAM programme implementation.

4.2.1 The selection of research strategy and case study design

This research used case studies as a research strategy as it offers an in-depth and comprehensive assessment of a single subject, or a few subjects in their natural environment and unaltered setting (Adams & Schvaneveldt, 1991). Furthermore, the research was able to identify pertinent information, situations and aspects, associated with the object of the case in great detail by implementing a case study research strategy (Adams & Schvaneveldt, 1991). Moreover, as stated by Philliber, Schwab, and Sloss (1980), case study design can be used to view the effectiveness of programmes administered by a government, a corporation, or an educational institution, which requires collecting detailed information. Multiple case studies were implemented in the research to obtain information about the various factors and settings that exist around the selected IRSAMs, which contribute to the effectiveness of the IRSAM programme implementation.

4.3 Research site and case selection

4.3.1 Research site selection

The research was conducted in the Special Region of Yogyakarta, the Republic of Indonesia, because it was one of the first pilot sites of the IRSAM programme in 1998, and has a long history in developing government programmes for machinery hire (MoA, 2008). The research was expected to gain insight from the province based on experience in developing the IRSAM programme for the past 18 years. In addition, the researcher considered the ease and site accessibility to collect data. Site accessibility was essential because it supported the researcher in building rapport with the research participants to build relationships and trust. The researcher was familiar with the local language (Javanese language) spoken in the research areas, and he was aware of the local culture. The researcher was able to engage and build rapport with the participants, which helped the researcher to gain insight into the situation in the research sites. This rapport-building activity has assisted the researcher to obtain in-depth information from the participants, which was beneficial to the research. As stated by Marshall (2011, p. 118) “closeness, engagement, and involvement can enhance the richness of the research”.

4.3.2 Cases selection

The Special Region of Yogyakarta consists of four regencies (Bantul, Gunungkidul, Kulon Progo and Sleman) and the city of Yogyakarta. To understand the different factors around the IRSAMs at the regional level, two regencies (Gunungkidul Regency and Bantul Regency) were selected. Two reasons underpin their selection. The first reason was based on the extensive use of farm machinery in the regencies. According to the Statistics Agency of the Special Region of Yogyakarta, in 2014, two of the largest users of agricultural machinery were Gunungkidul Regency and Bantul Regency. These regencies used various farm machines, such as 2WTs, 4WTs, transplanters (paddy planter machines), water pumps, multi-crop threshers, and pest control machinery (Statistics of the Special Region of Yogyakarta, 2014). The second reason was based on differences in the physical characteristics of the agroecology of both regencies, which may contribute to shape the operation of the IRSAMs. The agro-ecological characteristics include soil properties and water availability for irrigation. For instance, in Gunungkidul Regency, most of the farmland is dry land, and water availability for irrigation is limited. In contrast, in Bantul Regency, wetlands dominate the farmland and water for irrigation is available all year round (Statistics of the Special Region of Yogyakarta, 2014).

Two IRSAMs were chosen to capture the different factors in shaping the operation of the units. The selection was based on the recommendation of agricultural agencies in both regencies, who identified the IRSAMs as productive. Productive IRSAMs, in this case, were IRSAMs that owned more than one farm machine, actively provided agricultural machinery services to member farmers, and had well-structured organisation. One IRSAM was selected in Gunungkidul Regency, and the other was an IRSAM in Bantul Regency. From the two selected IRSAMs in two different regencies, the researcher expected to learn from the dynamics of factors associated with the operation of both units from the beginning of the establishment until present.

4.4 Selection of participants

Participants were chosen who had knowledge of the IRSAM programme and/or involvement in the programme at the national, provincial, regional, or village levels. Sixteen groups of participants were drawn from both public and private sectors (see Appendix 1). Some of these actors were the elite, “individuals in positions of power and influence” (Marshall, 2011, p. 155), which were necessary for the research because they

may have a broad view and be quite familiar with the development of a policy (Marshall, 2011). These actors were government officials, a sales manager of the local agricultural machinery manufacturer, and a university lecturer. This study utilised purposive and snowballed sampling methods to select participants (Ruane, 2004; Scheyvens & Storey, 2003). According to Adams and Schvaneveldt (1991, p. 181), purposive sampling is “a procedure for building a sample based on cases, individuals, or communities judged as being appropriate or very informative for the purpose of the research”. In addition, snowball sampling was used to identify other participants who were relevant to the purpose of the research based on the reference of the initially identified participants (Adams & Schvaneveldt, 1991).

4.5 Data collection methods and fieldwork process

Data was gathered through interviews, focus group discussions, and document analysis from both IRSAMs and government officials at the national level down to the regional level. Information from the private sectors (individual machinery service provider and a local manufacturer of farm machinery) and a university was also collected.

4.5.1 Semi-structured interviews

Semi-structured interviews, with open-ended questions, were implemented in the study to identify the experiences and perspectives of actors toward the IRSAM programme. Semi-structured interviews offer the researcher the opportunity to explore and uncover the participant’s perspective about some topics and, at the same time “respect the way the participant frames and structures the responses” (Marshall, 2011, p. 144). The questions in these interviews were designed to cover the experience of each actor, which includes their roles and perspective in the IRSAM programme (see Appendix 2). The language used for the questions were the Indonesian Language. However, when the researcher interviewed participants at the village level, the researcher used the Javanese Language.

In conducting interviews, the researcher firstly interviewed actors as listed in the list of participants, which covers actors at the national, provincial, and regional levels. In interviewing these actors, the researcher asked about their roles and actions that had been executed to support the IRSAM programme. The contributions of these actors could be in the form of training, meetings, and other coordination and consolidation actions from the national level down to the regional level.

Secondly, the interviews were conducted at the village level in Gunungkidul Regency and Bantul Regency. These villages were the Karangrejek village in Wonosari District, Gunungkidul Regency and the Argorejo village in Sedayu District, Bantul Regency. In these villages, the researcher interviewed the IRSAM employees, which included the manager and the operators, and the farmer groups (the head of farmer groups and its members). The researcher also interviewed an individual machinery service provider to look for a different point of view in delivering machine hire services to farmers, and to observe the relationship between the individual provider and an IRSAM. Furthermore, an interview was conducted with a farmer who was the user of the individual machine hire services and not part of the farmer group associated with the IRSAM in the area.

4.5.2 Focus Group Discussion (FGD)

According to Thomas (2013, p. 204), a Focus Group Discussion (FGD) can be used to capture “the understandings, beliefs, and values of the participants”. Therefore, to obtain information, particularly to generate comments and perspectives from farmers associated with the IRSAM, the researcher carried out FGDs in Gunungkidul and Bantul regencies. The purpose of using this method was to facilitate participants to discuss among themselves, particular topics provided by the researcher, such as the reason behind the group formation and the reason why farmer groups established the IRSAM. Two farmer groups participated in the research. These farmer groups were the Tirto Sari farmer group in Gunungkidul Regency and the Argorejo farmer group association in Bantul Regency. In addition, the researcher carried out other FGDs for both IRSAMs. The Tirto Sari IRSAM, under the management of the Tirto Sari farmer group in Gunungkidul Regency, and the Argorejo IRSAM under the Argorejo farmer group association in Bantul Regency, participated in the FGD. These FGDs were used to capture information regarding the process of the formation of the IRSAM and their operation in delivering services to the farmers.

4.5.3 Document analysis

The researcher employed a document analysis to review any relevant documents related to the IRSAM programme. The purpose of analysing relevant documents was to find information regarding the role of actors in rolling out the IRSAM programme and the assumptions that they used to administer the programme. The documents were collected

from the public and private sectors. Some relevant documents compiled by the researcher were:

- a. From the central government, the researcher collected official documents, such as rules and regulations, and some technical guidance documents of the IRSAM programme published by the MoA.
- b. From the agricultural offices at the provincial and regional levels, the researcher collected documents containing data on the existing IRSAMs, which includes types of farm machinery and how the IRSAMs procured it, the total land area of food crops, crop productivity and cropping index, and other related official documents.

4.5.4 Fieldwork process

The data collection process took around three months from late May 2016 to mid-August 2016. Upon the arrival of the researcher in the Special Region of Yogyakarta, he prepared a tentative schedule of interviews and revisited the list of potential participants. The researcher divided the schedule based on the participant's administrative levels, which were the national, provincial and regional levels. To understand the implementation of the IRSAM programme, the researcher decided to interview participants at the national level down to the regional level. When finished with the interviews at the national level, the researcher used the same procedure to contact and arrange interviews with participants at the provincial level. Together with the interview process, the researcher was also collecting some relevant documents. Along with the interview process at the provincial level, the researcher conducted interviews with other related actors at Gadjah Mada University and a local agricultural machinery producer to capture more perspectives on the delivery of the IRSAM programme.

At the Regency level, the researcher interviewed the MoA officers of the Gunungkidul Regency and the Bantul Regency. To comply with local regulations, the researcher requested research permits before conducting interviews in both regencies as shown in Appendix 3. During the discussion, the MoA officers of both regencies highlighted some potential farmer groups and IRSAMs that might be relevant to the research. Both officials in Gunungkidul Regency and Bantul Regency recommended some potential farmer groups and IRSAMs that could be looked up at the village level. The researcher considered the recommendations.

At the village level, the researcher made an initial contact with the head of the farmer groups and with the manager of the IRSAMs. Upon the first visit to these groups, the researcher briefly explained the purpose of the research and provided them with sufficient information (see the participants' information sheet of the research in Appendix 4). After explaining the purpose of the study, and asking them to participate, the researcher made arrangements regarding the interviews and FGDs.

4.6 Data analysis techniques

The research used Qualitative Data Analysis (QDA) as the data analysis technique. Dey (1993) presents the process of QDA as an iterative spiral as shown in Figure 3. To conduct QDA, firstly, the interviews were transcribed in the Javanese and Indonesian Languages by transferring the audiotaped interviews into word processing. The transcribed interviews were analysed, particularly important statements from the actors. Secondly, the QDA analysis began with the process of describing the data. In this process, the important aspects of phenomena in the interview transcripts were thoroughly and comprehensively described and translated into English. The following step is classification. In this step, the researcher placed the raw data into categories and subcategories and placed the categories into a logical hierarchy. The last step was connecting the categories into meaningful relationships and defining these relationships (Dey, 1993).

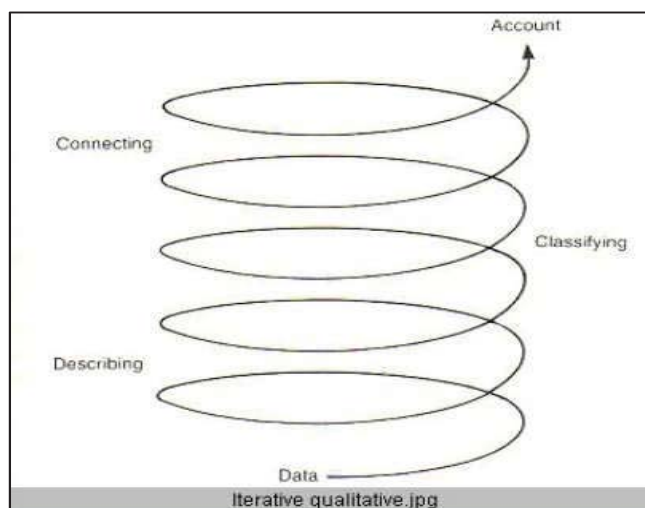


Figure 3. Qualitative analysis as an iterative spiral

Source: Dey (1993)

4.7 Ethical considerations

Ethical considerations are required when conducting research that is associated with human participants. Based on an ethical assessment of this research done by the Massey University Human Ethics Committee (MUHEC), the research complied with all of the major ethical principles to minimise the potential harm to the participants (MUHEC, 2015). The research was classified as a low risk with no potential harm to the participants or the researcher (see Appendix 5). To minimise the ethical implications for participants, the researcher informed the participants about the details of the research before rolling out the interviews. The researcher ensured that the participants understand the details of the study by asking for their feedback or comments. During the interviews, the researcher again stated the purpose, methods and benefits of the research. Furthermore, the researcher provided the participants with an opportunity to consider taking part in the research, or decline. To do this, the participants were invited to give oral consent (see the participants' consent form of the research in Appendix 6). The researcher guaranteed the confidentiality of the participants. The researcher ensured that the identity of the participants would not be revealed. For instance, the participants that belonged to and institution would be identified as a staff member of their institution, not by their names. In addition, the researcher considered the social and cultural sensitivity such as age, gender, culture and religion, particularly in the study area.

4.8 Summary

The aim of the research was to understand the implementation of the IRSAM programme that has been applied to different areas of the Republic of Indonesia. The research intended to highlight the different factors that shape the outcome of the programme implementation. More specifically, the research focused on gaining insights into the various factors that affect the particular IRSAMs and how these IRSAMs were interacting with these factors.

To achieve the aim, the research used a qualitative research method and employed multiple case studies in Gunungkidul Regency and Bantul Regency in the Special Region of Yogyakarta. The Province was chosen because it was one of the first pilot sites of the IRSAM programme implementation in 1998, which has a long history in developing the government-led machinery hire services programme. Additionally, the significant difference of the agro-ecological conditions of Gunungkidul Regency, and Bantul

Regency and the extensive use of farm machinery in both regencies, were further considerations in selecting the research areas. A well-performing IRSAM that had been identified by the local government was selected. One IRSAM was chosen in Gunungkidul Regency, and another IRSAM was selected in Bantul Regency.

The research involved participants from the public and private sectors at the national level down to the regional level. The research used semi-structured interviews, FGD and document analysis to collect data. The interviews were transcribed and analysed using Qualitative Data Analysis (QDA) technique. As the research involves human participations, ethical considerations were implemented. The research was categorised as a low risk, with no potential harm to the participants or the researcher. The researcher ensured the participants' rights and confidentiality by not revealing any information regarding their identity.

CHAPTER FIVE: CASE DESCRIPTION

5.1 Introduction

This chapter describes the cases studied in this research. First, the IRSAM programme in the Special Region of Yogyakarta is outlined in Section 5.2. The selected farmer groups (the Tirto Sari farmer group in Gunungkidul Regency and the Argorejo farmer group association in Bantul Regency) are described in section 5.3 and 5.4 respectively, because the IRSAMs are part of these farmer groups. The description of the farmer groups also provides the context of the characteristics and circumstances of these communities associated with the IRSAMs. Section 5.5 summarises the chapter.

5.2 The Special Region of Yogyakarta

The Special Region of Yogyakarta is situated in the central part of Java Island as shown in Figure 4. Under the administration of the Province, there are four regencies: Bantul, Gunungkidul, Kulon Progo and Sleman and the city of Yogyakarta (see Figure 5). In 2014, the total population of the Province was 3.66 million people. With an area of 3185.8 km², the population density reached 1,142 people per square kilometre in 2014 (Statistics of the Special Region of Yogyakarta, 2015). The climate in the Special Region of Yogyakarta is tropical and strongly influenced by the dry season (from June to October) and the rainy season (from November to May). In 2014, the average temperature in the Province was recorded as 26.3⁰C. The Province grows several major crops, which are paddy (wetland and dryland), cassava, maize, ground nuts, and soybeans (Statistics of the Special Region of Yogyakarta, 2015).

Since 1998, the Government of the Special Region of Yogyakarta has been promoting farmer groups and farmer group associations in establishing IRSAMs in the four regencies. In 2014, according to the Department of Agriculture of the Special Region of Yogyakarta, there were 191 IRSAMs in the Province, a small number compared to other Provinces because most of the IRSAMs are based on the districts and the size of

agricultural land (The Department of Agriculture of the Special Region of Yogyakarta, 2014).



Figure 4. Map of the Republic of Indonesia and the Special Region of Yogyakarta.

Source: CIA (n.d) and DPPKA (2015)

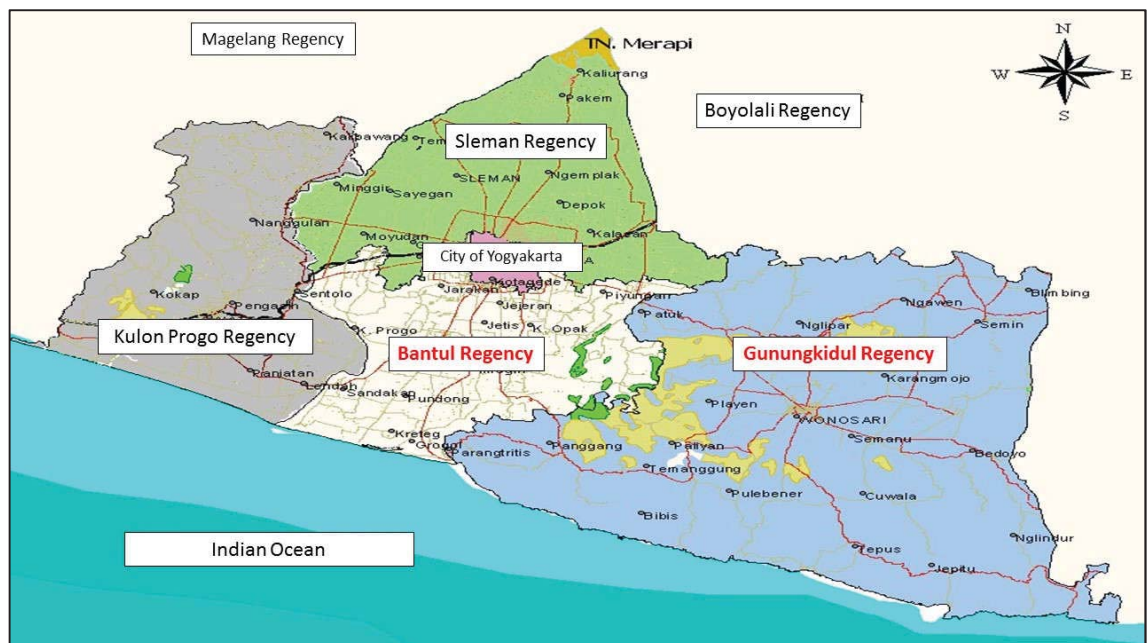


Figure 5. Map of the Special Region of Yogyakarta showing Gunungkidul and Bantul Regencies

Source: DPPKA (2015)

5.3 Description of Gunungkidul Regency

5.3.1 Introduction

Gunungkidul Regency is the largest Regency in the Special Region of Yogyakarta based on area (46 %) (see Figure 6). The Regency is situated between 7°46' – 8°12' latitude and 110°21' – 110°50' longitude and covers a total land area of 1,485.36 km² (Statistics of the Special Region of Yogyakarta, 2015). The Regency consists of 18 districts. In 2014, the total population was estimated to be 698,825 people residing in 144 villages, with a density of 470 inhabitants/km² (Statistics of Gunungkidul Regency, 2015b). The majority of the population dwells in the capital Regency, Wonosari district (81,493 people) (Statistics of Gunungkidul Regency, 2015a).

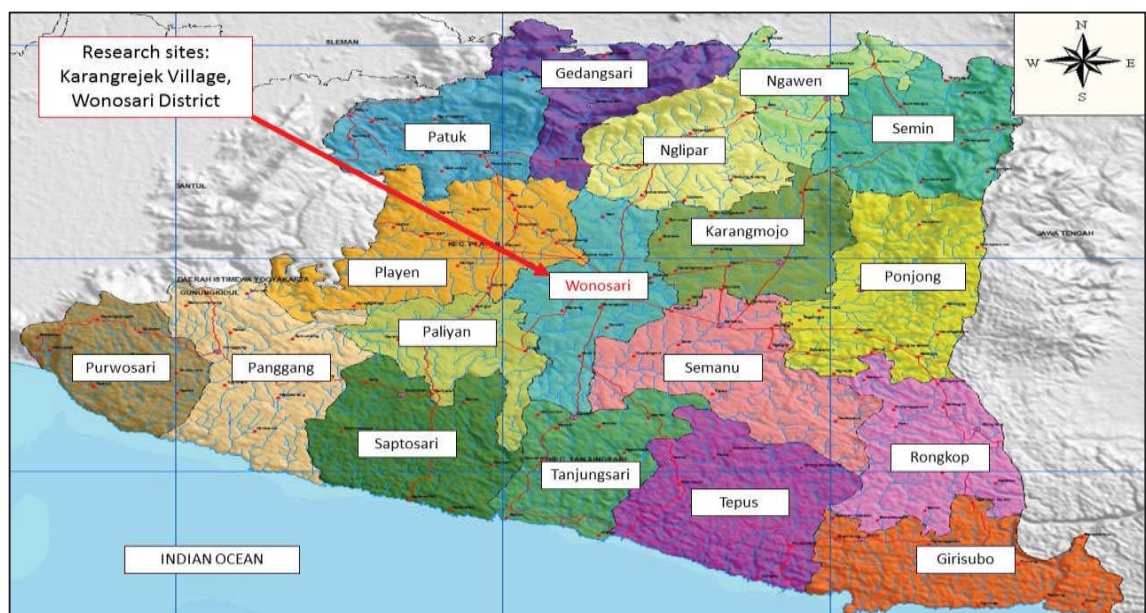


Figure 6. Map of Gunungkidul Regency showing the research site

Source: DPPKA (2015)

5.3.2 Agro-ecological conditions

Located 40 km to the south-east of the Special Region of Yogyakarta, Gunungkidul Regency has three characteristics of agro-ecological conditions based on the topography (Statistics of Gunungkidul Regency, 2015b):

1. The North Zone (Batur Agung): the elevation of this zone ranges from 200 m to 700 m above sea level, and the terrain of this zone is hilly. Regarding soil profile characteristics, Latosol and volcanic soil dominate the profile in this zone. Water resources are available through groundwater, and the water table can be accessed from 6 m to 12 m below land surface. Several districts included in this zone are Gedangsari, Ngawen, Nglipar, Patuk, the northern part of Ponjong, and Semin.

2. The Central Zone (Ledok Wonosari): the elevation of this zone ranges from 150 m to 200 m above sea level. Red Mediterranean and Black Grumusol dominate the soil profile of this area. The availability of surface water from rivers and streams is limited and only available during the wet season. Meanwhile, ground water is available from a depth of 60 m to 120 m below land surface. Several districts included in this zone are Wonosari, Karangmojo, the central part of Ponjong, and the northern part of Semanu.
3. The South Zone (Gunung Seribu): this zone is known as karst topography. The elevation of this zone is from 0 m to 300 m above sea level. Regarding soil profile, this area is dominated by conical limestone. There are some underground rivers around this zone. This zone covers several districts: Giri Subo, Panggang, Paliyan, the southern part of Ponjong, Purwosari, Rongkop, Saptosari, the south part of Semanu, Tanjungsari and Tepus.

The average temperature of Gunungkidul Regency is 27⁰ C, and humidity ranges from 80% to 85%. Meanwhile, average annual rainfall was 1,881.94 mm/year as recorded in 2014, average monthly rainfall is shown in Figure 7. The northern zone of Gunungkidul Regency experiences the highest annual rainfall, compared to the central and south zones (Statistics of Gunungkidul Regency, 2015b).

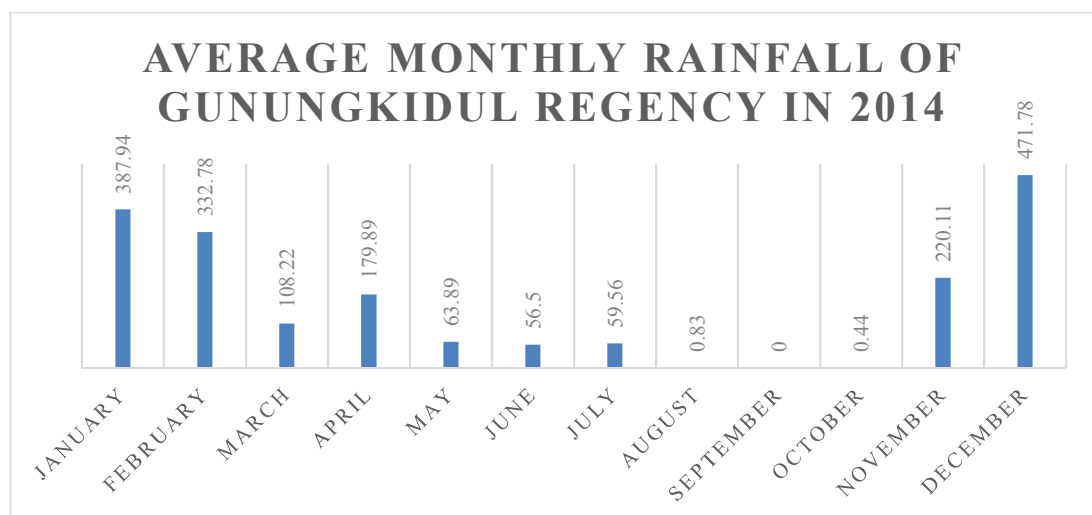


Figure 7. Average monthly rainfall of Gunungkidul Regency in 2014

Source: Statistics of Gunungkidul Regency (2015b)

5.3.3 The role of agriculture sector in the Regency's economy

Gunungkidul Regency is dominated by rural areas (144 villages). The majority of people who reside in the countryside, or villages in Gunungkidul Regency, are working in the agriculture sector (Statistics of Gunungkidul Regency, 2015b). Therefore, the agriculture sector in the Regency has a major role in supporting the Regency's economy. According to the Statistics Bureau of Gunungkidul Regency, the agriculture sector is the main contributor to the Gross Regional Domestic Product (GRDP) of the Regency, compared to other sectors, such as industry, trade and services. In 2014, agriculture contributed 25% of the total GRDP of Gunungkidul Regency (Statistics of Gunungkidul Regency, 2014).

5.3.4 Land-use allocation, farm practices, agricultural production and farm machinery population

The uniqueness of the agro-ecological characteristics influences the land-use allocation in Gunungkidul Regency. As reported by the Statistic Bureau of the Special Region of Yogyakarta in 2014, of the total land available in Gunungkidul Regency (148,536 hectares), 44% is dryland farming systems, 5% is wetland farming systems, 18% is allocated to woodlots, 17% of is devoted to agriculture, and 15% is non-agricultural land (Statistics of the Special Region of Yogyakarta, 2014). Furthermore, with the unique set of agro-ecological characteristics, the majority of farmers (90%) in the Regency have been practising rain-fed agriculture. In practising rain-fed agriculture, farmers are cultivating dry fields and rely on rainfall for water (Statistics of Gunungkidul Regency, 2015b). Farmers mainly produce cassava, maize and dryland paddy, as shown in Table 6.

Table 6. Main agricultural production of Gunungkidul Regency

No	Commodity	Production (Ton)				
		2010	2011	2012	2013	2014
1	Paddy Wetland	85,481	91,667	87,006	93,957	92,602
2	Paddy Dryland	173,011	186,146	204,689	195,563	197,185
3	Maize	256,443	200,353	248,252	207,623	227,013
4	Cassava	994,271	762,554	772,006	933,414	844,773
5	Ground nuts	49,466	53,511	52,069	59,563	59,251
6	Soybeans	30,654	25,830	26,476	25,540	13,465

Source: Statistics of Gunungkidul Regency (2015a)

Local government has been facilitating farmers with various types of farm machinery to support the agricultural development in the Regency. Gunungkidul Regency is one of the largest users of farm machinery in the Special Region of Yogyakarta, particularly for the pest control machinery. The number of farm machines such as 2WTs and 4WTs, pest control machinery and water pumps, was growing (see Table 7) (Statistics of the Special Region of Yogyakarta, 2014).

Table 7. The number of farm machinery in Gunungkidul Regency in 2009 and 2014

No	Type of Machinery	Number of Machinery (unit)	
		2009	2014
1	Land Processing Machinery (two and four wheel tractors)	176	509
2	Pest Control Machinery (hand sprayer, swing fog, rat rumigator, weed cleaner)	31,576	43,805
3	Water pumps	382	657

Source: Statistics of the Special Region of Yogyakarta (2014)

5.3.5 The Tirto Sari Farmer Group

5.3.5.1 Introduction

Tirto Sari Farmer Group (TSFG) is the parent group of the Tirto Sari IRSAM. It is a farmer group / Kelompok Tani (POKTAN), located in Karangrejek village, 2 km to the south of the capital region of Gunungkidul Regency. Karangrejek village consists of seven sub-villages (Blimbing, Karangduwet 1, Karangduwet 2, Karangumuk 1, Karangumuk 2, Karangrejek, and Karangsari). The village is under the administration of Wonosari District, situated in the central zone of Gunungkidul Regency. TSFG benefits from its location because of the excellent condition of the road, and irrigation networks. TSFG has developed significantly in providing benefits to member farmers.

5.3.5.2 The historical development of Tirto Sari Farmer Group (TSFG)

The TSFG was founded in 1983. The reason behind the formation of TSFG was because farmers around the Karangsari sub-village under the administration of the Karangrejek village, wanted to increase production and productivity of their crops. They believed that by establishing a farmer group, they could have access to some agricultural programmes administered by the government, such as various kinds of agricultural inputs (fertilisers, seeds or farm machinery), and other relevant information or new technology development

disseminated by the government. They also wanted to have a fair distribution of water to irrigate their land. At that time, in the Karangrejek village, the majority of farmers were accessing water for irrigation through pumping stations provided by the government. However, as nobody organised the distribution of water, many farmers were unable to get a fair distribution of irrigation. Therefore, they established a farmer group.

After TSFG had been established, the farmer group began to show some improvements in their performance marked by the increase in production and productivity of their farm operations. Through TSFG, the member farmers were able to access some of the government programmes, such as seeds and fertilisers. The farmer group formed a water user unit to overcome the water distribution issue (see Figure 8), responsible for the operation and management of one of the pumping stations located in the Karang Sari sub-village (see Figure 9). The main task of this unit is to deliver an irrigation service to TSFG members by creating a water distribution schedule and collect service fees from the members. Furthermore, the development of the farmer group was marked by the establishment of the Sari Mandiri production unit, which is responsible for managing the agricultural inputs, such as seeds and fertilisers to produce agricultural commodities cultivated by this group, such as paddy and horticulture crops. In 2003, the Tirto Sari IRSAM was established to manage farm machinery provided by the government, and to deliver commercial agricultural machinery services to TSFG members and non-members.

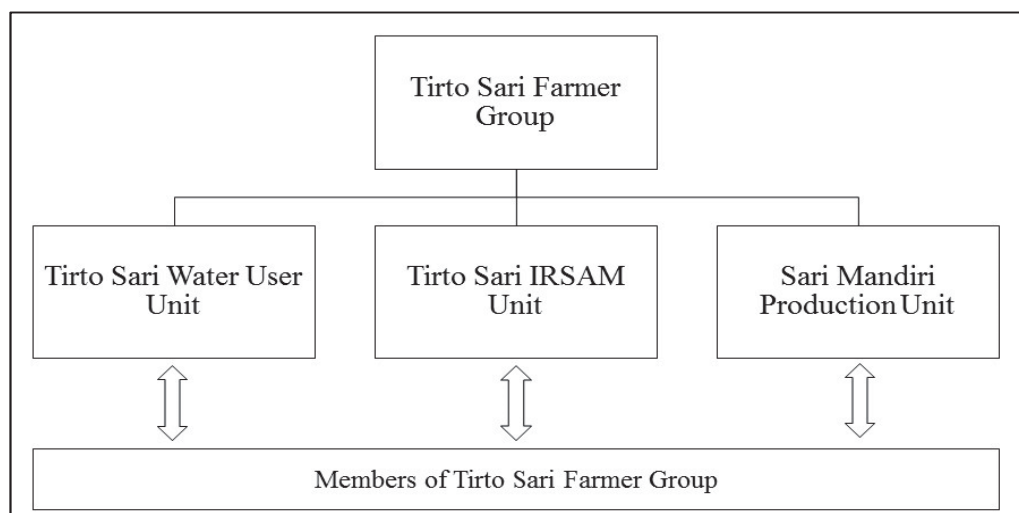


Figure 8. The units under the TSFG



Figure 9. The TSFG pumping station

The farmer group has performed reasonably well, particularly in developing the earnings they received from the members. TSFG has been able to generate income from the three units (the water user unit, the IRSAM unit, and the Sari Mandiri production unit). TSFG is also generating revenue from delivering credit to the members in the form of cash and, in return, the members pay the loans with some interest. Therefore, TSFG has been able to fund their group operations. Since 2007, the group has been collecting a sufficient amount of money to erect a building to be used as a meeting place to arrange their daily farm activities, such as allocating water for irrigating the farms and distributing fertiliser subsidised by the government. In 2012, this building was erected in the Karangsari sub-village (see Figure 10). Furthermore, the group has been able to facilitate its members to access fertilisers provided by the government. Also, TSFG can gain access for the members to the local market. By joining TSFG, farmers can market their agricultural products, particularly horticulture products, to the local wholesaler. Based on this achievement, TSFG has been categorised as the top class of a farmer group by the agricultural extension agency of Gunungkidul Regency. In determining the class of a farmer group, the agricultural extension agency was looking at the way TSFG planned and conducted their farm activities, developed their assets, and marketed their agricultural products.



Figure 10. TSFG secretariat building

5.3.5.3 The management of TSFG

TSFG is under the management of the farmer group, which consists of the head of the farmer group, a secretary, a treasurer, and persons in charge of related units, as shown in Figure 11. The management of TSFG are farmers, and the members elect them during the general assembly (GA) of TSFG for one-year terms. The head of the farmer group is responsible for running the organisation by coordinating with the business units and other related units under TSFG and with other stakeholders, such as the government and the private sector. Since the group was established in 1983, the current head of the group has been the same person. In several GA meetings, the members agreed to keep the position of the chairman of the group to the current head because they were satisfied with the development of TSFG.

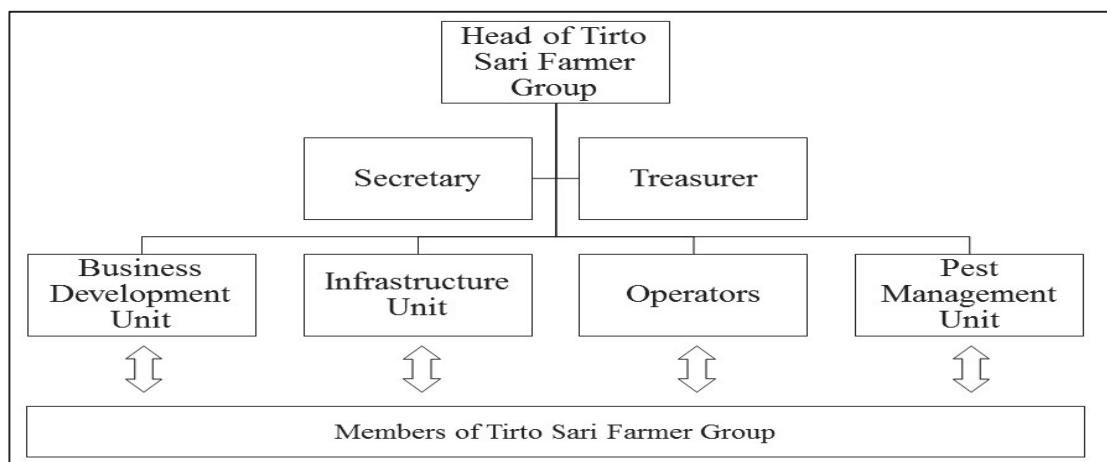


Figure 11. The organisational structure of the TSFG

Under the management of TSFG, the farmer group organises a monthly meeting to discuss relevant issues regarding farm operations. Some of the discussion topics are a strategy in planting a commodity, water allocation and distribution schedule, fertiliser and seed distribution schemes, scheduling of agricultural machinery services, and information about government programmes. The management of TSFG implemented a democratic system with respect to most of the strategic decision-making of the group. The farmer group also applied the open management system to maintain transparency of information in the group. It means that all the transactions and cash flows recorded by the management are disclosed during the monthly meeting so that the members would be able to get first-hand information from the management and they could comment on it. Therefore, the participation of the members in the meeting is essential. As a way to maintain the involvement of each member in every session, the management of TSFG introduced “*arisan*”. *Arisan* is a term for raising financial contributions in the form of money from the members and revolving the money to other members once a month through the group meeting so that each member can have the opportunity to use the money to support their daily needs. *Arisan* is different from the credits delivered by TSFG to its members. The practice of *arisan* has proven to be effective in increasing the number of farmers participated in the meeting.

In addition to enhancing the participation of the members and maintaining the group cohesion, TSFG implements sanctions. Sanctions are given for those who broke the agreement decided during the TSFG meeting. For example, when in a TSFG meeting, all members agreed to grow shallots in the next cropping pattern on a certain date, and some members broke the agreement, these members would not get access to irrigation or seeds. From the experience of TSFG, only a few member farmers broke the agreement.

5.3.5.4 Membership

Membership of TSFG is based on the ownership of agricultural land concentrated in Karangsari sub-village. It means that TSFG members are open to all farmers who dwell in the sub-villages of the Karangrejek village (Blimbing, Karangduwet 1, Karangduwet 2, Karangumuk 1, Karangumuk 2, Karangrejek, and Karangsari), and who own agricultural land concentrated in Karangsari sub-village. Currently, there are more than 110 farmers who have joined TSFG with the total agricultural area of around 40 hectares.

On average, the ownership of farmland of the members of TSFG ranges from 1000 m² to 2000 m². Most of the members of TSFG are full-time farmers.

5.3.5.5 Cropping patterns and water availability

As mentioned earlier, TSFG implements simultaneous farming operations in the Karangsari sub-village. By growing the same crop simultaneously, farmers have more benefits. They can utilise some farm inputs, such as seeds, fertilisers and agricultural machinery services more efficiently. The same situation applies when farmers are using water to irrigate their land. Even though, in general, farmers in Gunungkidul Regency are implementing rain-fed agriculture systems, farmers in the TSFG are combining rain-fed agriculture systems with irrigated agriculture systems. This is possible because TSFG has a pumping station that extracts groundwater and channels the water through irrigation networks for irrigating their crops. By implementing farm operations simultaneously with all the member farmers of TSFG, efficiency of utilising ground water has been achieved. Efficiency in extracting ground water, and effectiveness of using other agricultural inputs, were important for them because they have to pay the service fee of Rp. 60,000 per hour (NZ \$6.6/hour), which becomes part of their cost of production. With the implementation of simultaneous farm operations, member farmers can develop three cropping patterns as illustrated in Table 8. The TSFG farmers have practised the combination of this cropping pattern for a long time.

Table 8. Cropping patterns of the TSFG in 2016

Farm Operation	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Paddy (cropping pattern 1)												
Sowing/Planting												
Growing Stage												
Harvesting												
Mechanical Threshing												
Land Preparation												
Maize and or Ground Nuts (cropping pattern 2)												
Sowing/Planting												
Growing Stage												
Harvesting												
Land Preparation												
Vegetables: Shallots, Chilli, Spinach, Water Spinach (cropping pattern 3)												
Sowing/Planting												
Growing Stage												
Harvesting												
Mechanised Land Preparation												

The first crop is paddy, usually from November to February, as Gunungkidul Regency, in general, is experiencing the rainy season, an appropriate season for growing paddy. In this case, farmers are implementing a rain-fed agriculture system. Meanwhile, with respect to the utilisation of farm machinery provided by the Tirta Sari IRSAM, farmers are utilising tractors to prepare paddy fields and powered threshing machines for shelling the rice. Along with the decrease of rainfall, farmers are manually converting their land to the second crop pattern, which is maize and groundnuts from March to June. In this crop pattern, farmers are using available soil moisture left from paddy and added to by the rain between March and June to irrigate their crops. In early July, farmers are preparing the land for the third crop sequence. Farmers are growing some horticulture cash crops, such as shallots, chilli, spinach, and water spinach from July to October. Owing to limited water availability, and that this crop sequence is in the dry season, farmers are utilising ground water to irrigate their crops from the pumping station. The distribution of water for irrigation has been managed well by TSFG through water distribution and allocation schedules.

During the third crop sequence, farmers are practising intercropping of horticulture crops to increase their harvest and increase the efficiency of farm operations. Intercropping techniques are applied to intensify the use of agricultural land so that farmers could plant different crops in their limited land by utilising the differences in the length of time for these crops to grow. Irrigation was supplied through the water pump. For instance, in the third cropping pattern, farmers of TSFG plant shallots in early July and, 20 days later, they plant chilli in the space available around the shallots. When it comes to harvesting shallots, the chilli would be at the flowering stage, and soon it would be at the harvesting stage. Therefore, these farmers would not need to wait longer to harvest the chilli. Chilli can be harvested seven to eight times before these farmers prepare for the next crop in early November. It means that farmers have secured their income by producing shallots and chilli because these crops are high-value crops and the price of these crops is relatively high when entering the rainy season. Furthermore, for receiving income, farmers would not need to wait for a long time after selling shallots because they would soon be harvesting chilli in a relatively close time to the harvesting time of shallots. With the member farmers of TSFG using three cropping patterns, the next section elaborates on their farming system and the market orientation.

5.3.5.6 Farm system and market orientation

Looking at the farm operations of member farmers of TSFG in implementing three cropping patterns, it can be categorised that these farmers are part-commercial, small independent specialised family farms (McConnell & Dillon, 1997). According to McConnell and Dillon (1997), part-commercial, small, independent, specialised, family farms are characterised by their specialisation in growing particular crops or raising livestock with the orientation of farming being family sustenance. These farmers are generating income by selling some of their agricultural products, while the rest of the products are consumed by the family members (McConnell & Dillon, 1997).

In the case of member farmers of TSFG, most of them have the same perception that they have to make some profits in farming. This perception is influenced by the way they accessed water and farm machinery services, which adds to the cost of production of the farm operations. They realise that Karangrejek village has farming potential, particularly for high-value crops, such as horticulture crops. As a result, these farmers are implementing the three cropping patterns as their strategy to capture more value from doing farm operations and to secure their income. They believe that growing paddy as the first cropping pattern would secure their food supply for a year so, rather than spend money to buy rice, they consume their rice. Rice is the main staple of the TSFG members. Meanwhile, maize and groundnuts, as the second cropping pattern, provides them with income for three months. Therefore, these farmers would harvest these crops within three months and sell it to local wholesalers. In the third cropping pattern, farmers are growing some vegetables, such as shallots, chilli, and spinach, which can be harvested on a weekly basis. As a result, these vegetables provide them with monthly income.

Regarding selling agricultural products of the members, TSFG has facilitated member contact with some local wholesalers around Gunungkidul Regency and invited them to visit TSFG whenever these farmers want to sell their products. When member farmers are harvesting their crops, some of the members contact the local wholesalers using mobile phones. The farmers start to offer a price to them, and both parties are negotiating the agreed price of the agricultural products. If the price is decided, these wholesalers then visit the farmers in their fields to pick up the products. TSFG also facilitates the transaction between the farmers and the local wholesalers with weighing scales. The weighing scales are bought by the IRSAM to be rented to member farmers. As a result,

member farmers would be able to determine the weight (kg) of their products and calculate the total cost to the local wholesalers. TSFG farmers benefit from the transaction made in their field because they do not need to transport and market their products to the nearest wet markets, rather, the local wholesalers pick up their products, and the member farmers could receive money instantly. TSFG benefits from renting the weighing scales to the members.

5.4 Description of Bantul Regency

5.4.1 Introduction

Bantul Regency is located to the south of Yogyakarta city, the capital of the Special Region of Yogyakarta. This Regency lies between $7^{\circ}44'04''$ and $8^{\circ}00'27''$ latitude and between $110^{\circ}12'34''$ and $110^{\circ}31'08''$ longitude. Bantul Regency has a total area of 506.85 square kilometres, and consists of 17 districts and 75 villages (see Figure 12). The entire population of Bantul Regency in 2014 was 968,632 people with a density of 1,911 inhabitants/km² (Statistics of Bantul Regency, 2015; Statistics of the Special Region of Yogyakarta, 2015).

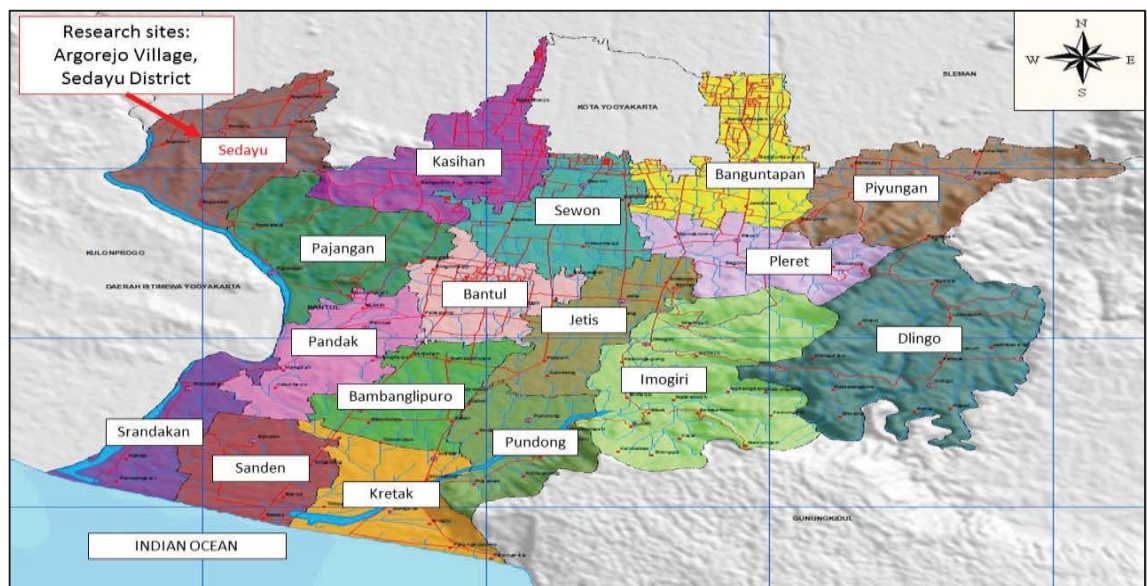


Figure 12. Map of Bantul Regency showing the research site

Source: DPPKA (2015)

5.4.2 Agro-ecological conditions

The agro-ecological characteristics of Bantul Regency are dominated by flat and fertile lands with an elevation less than 40 m above sea level. The majority of the soil profile in the Regency is Regosol. Surface water, which is mainly used for irrigation, is available through perennial rivers that pass through this Regency. Water for irrigation is distributed through irrigation networks, which exist in most districts (Ministries of Agriculture Marine Affairs and Fisheries and Forestry & FAO, 2007; Statistics of Bantul Regency, 2015; Statistics of the Special Region of Yogyakarta, 2015). Bantul Regency experiences high rainfall from November to April, and low rainfall from May to October, as shown in Figure 13.

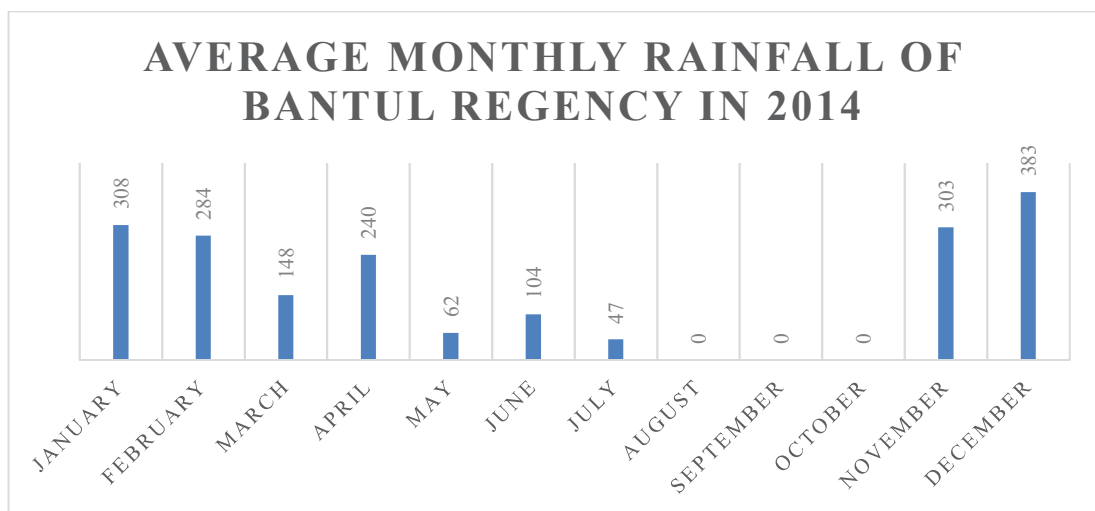


Figure 13. Average monthly rainfall of Bantul Regency in 2014

Source: Statistics of the Special Region of Yogyakarta (2015)

5.4.3 The role of the agriculture sector in the Regency's economy

The agriculture sector in Bantul Regency is one of the major contributors to the Gross Regional Domestic Product (GRDP) of the Regency. As recorded in 2014, agriculture contributed 18.64% of the total GRDP. Furthermore, the majority of people in Bantul Regency work in the agriculture sector (The Regional Development and Planning Agency of Bantul Regency, 2015). With the important role of the agriculture sector in the Regency's economic growth, the Government of Bantul Regency has been trying to increase the quality and quantity of agricultural products through agricultural development. The Government of Bantul Regency delivers agricultural development programmes, such as development of irrigation networks, application of certified seeds, and integrated pest management (Bantul Invest, 2013).

5.4.4 Land-use allocation, farm practices, agricultural production and farm machinery population

In developing the agriculture sector, the Government of Bantul Regency categorises land-use allocation according to the agricultural purpose and the non-agricultural purpose. In 2014, from the total area of 50,685 hectares available in the Regency, 30% went to wetland (paddy fields), 27% was devoted to non-wetland agricultural land (dry fields, woodlots, ponds, and others), and 43% went to non-agricultural land (Statistics of Bantul Regency, 2014). However, the Government of Bantul Regency is experiencing challenges in developing the agriculture sector because of the increasing use of land for non-agricultural purposes, such as human settlement and housing. In 2014, the Regency was the highest Regency in the Special Region of Yogyakarta regarding converting agricultural land to non-agricultural purposes (766 hectares) (Statistics of the Special Region of Yogyakarta, 2014). Another challenge is the decreasing number of people working in the agricultural sector because they are seeking opportunities to work outside the agriculture sector in the nearest cities (The Regional Development and Planning Agency of Bantul Regency, 2015). In 2006, farm labour in Bantul Regency accounted for 58% from the total labour available, and in 2015, it dropped significantly to 13% (BAPPEDA Bantul, 2007; Statistics of Bantul Regency, 2016).

Farmers with small farm sizes dominate farm operations in Bantul Regency. Most farmers are implementing irrigated agriculture systems in their farming practices. The implementation of the irrigated agriculture systems is possible because most of the agricultural fields in Bantul Regency are equipped with irrigation networks. Through these irrigation networks, farmers in the Regency can grow various agricultural commodities in each year, such as paddy wetland, maize, cassava, groundnuts, soybeans, shallots, and chilli. Paddy wetland dominates agricultural production of the Regency. The production of paddy wetland increased from 189,883 tonnes in 2010 to 192,711 tonnes in 2014 (Statistics of Bantul Regency, 2015).

However, with the decreasing number of people working in the agriculture sector, farmers in Bantul Regency are now relying on farm machinery to substitute for labour in intensive farm operations. Every year, the government delivers agricultural machinery in Bantul Regency to maintain and improve the production of agricultural commodities, particularly paddy. As a result, there has been an increase in farm machinery population

in the Regency over the past six years. For instance, in 2009, land processing machinery (2WTs and 4WTs) reached 621 units, and water pumps achieved 2,987 units. In 2014, there was a dramatic increase for both types of machinery, where land processing machinery reached 1,244 units, and water pumps achieved 5,608 units (Statistics of the Special Region of Yogyakarta, 2014).

5.4.5 The Argorejo Farmer Group Association

5.4.5.1 Introduction

Argorejo Farmer Group Association (AFGA) is the parent group of the Argorejo IRSAM. AFGA is Gabungan Kelompok Tani (GAPOKTAN) / a farmer group association, consisting of eight farmer groups. AFGA is located in Argorejo village, Sedayu District, close to a highway that connects the Special Region of Yogyakarta to the Central Java Province. Sedayu District is one of the districts in Bantul Regency, situated to the north-west of the capital of Bantul Regency. This district is characterised by flat and fertile lands suitable for growing paddy. Furthermore, in this district, surface water is available all year round through irrigation networks. The area of operation of AFGA is in 13 sub-villages under Argorejo village (Kalakan, Semampir, Kepuhan, Polaman, Senowo, Gunung Polo, Sundi Kidul, Bandut Lor, Bandut Kidul, Metes, Pendul, Pereng Wetan, and Ngentak) (Statistics of Sedayu District, 2015). Since it was established in 2004, AFGA has shown significant development, acknowledged by the government, in promoting farmer groups to improve the production, productivity and market access of their agricultural commodities.

5.4.5.2 The historical development of Argorejo Farmer Group Association

In 2004, representatives from eight farmer groups in the Argorejo village founded Argorejo Farmer Group Association (AFGA). The formation of AFGA was motivated by the intention of all farmer groups in Argorejo village to increase production and to improve the productivity of agricultural products, which includes food crops, horticulture crops, estate crops, livestock, and fishery. However, instead of developing their farmer groups individually, they formed AFGA. AFGA is an organisation which acts as facilitator and coordinator for them in accessing information, technology and agricultural programmes of the government and from the private sector. In 2008, the Government of Bantul Regency encouraged farmer groups in one village to form a farmer group association to increase the coordination and dissemination of information conveyed by

the government to the farmers. Therefore, in 2008, this farmer group association was acknowledged and legalised by the Government of Bantul Regency as stated in the Decree of Bantul Regent number 142A the year 2008 (Argorejo Farmer Group Association, 2013).

Since it was established in 2004, AFGA has shown significant development. AFGA has been facilitating farmer members in three areas: 1) accessing agricultural inputs from the local agricultural input suppliers, such as fertilisers and seeds, 2) developing agricultural commodities and farm practices (on-farm activity), and 3) developing agricultural products' processing and marketing. AFGA can actively participate in delivering services to farmer groups by disseminating information obtained from the government. For instance, in facilitating its farmer groups, AFGA cooperates with the agricultural extension officers of the Sedayu District and the agricultural officers of Food Crops and Horticulture of Bantul Regency. This cooperation enables AFGA to access information regarding government programmes. As a result, AFGA can distribute some government programmes, such as seeds, fertilisers, farm machinery and other supporting agricultural technology to assist on-farm and off-farm operations of farmer groups under AFGA. Moreover, AFGA has been able to establish partnerships with the private sector, such as Mandiri Bank and the Small and Medium Enterprise Development Centre (SMEDC) of Gadjah Mada University to develop organic farming and processing of AFGA agricultural products. With active participation in facilitating on-farm and off-farm operations of farmer groups, in 2013, AFGA received recognition from the national government (Agency for Food Security and Agricultural Extension of Bantul Regency, 2013).

5.4.5.3 The management of AFGA

AFGA comprises a head, a secretary, a treasurer and several units that serve the eight farmer groups as shown in Figure 14. The Headman of Argorejo village supervises the AFGA's operation. Members of management are AFGA farmers elected by AFGA members every three years in a General Assembly (GA) meeting. The head of AFGA is responsible for managing the AFGA to facilitate member farmers in developing their on-farm and off-farm operations.

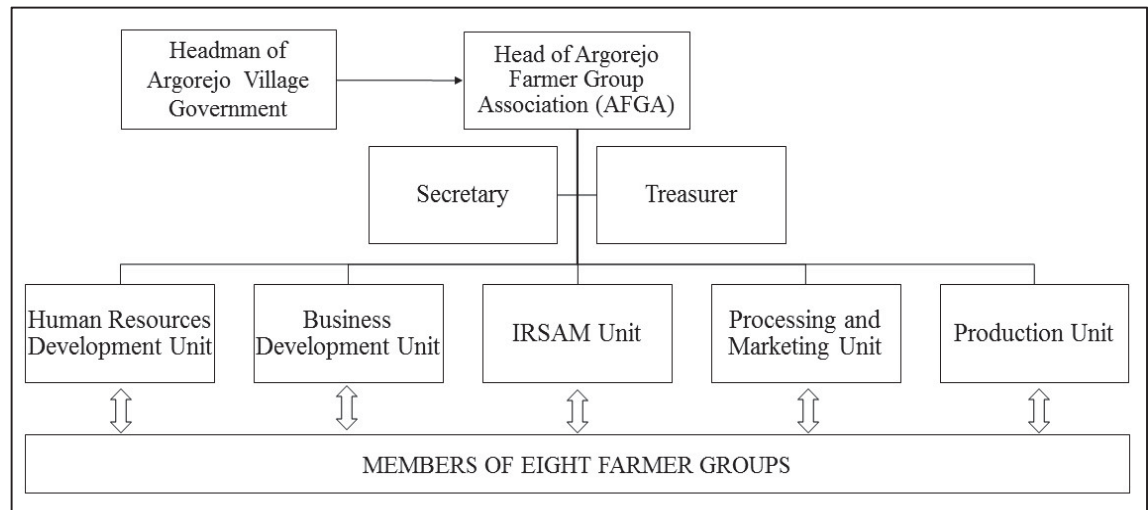


Figure 14. The organisational structure of the AFGA

In implementing his role, the head of AFGA coordinates with its business units. The role of these business units are as follows:

- a. **The AFGA Human Resources Development Unit:** this unit is responsible for facilitating the farmer groups in accessing the agricultural training (business and technical training) organised by the government and private sectors.
- b. **The AFGA Business Development Unit:** the role of this unit is to develop the capital and assets of AFGA. This unit provides credit to the members and encourages them to use this facility so that the revolving credit can be used to develop financial assets.
- c. **The Argorejo IRSAM unit:** this unit is responsible for managing farm machinery owned by AFGA and delivering machinery services to member farmers and non-members.
- d. **The AFGA processing and marketing units:** the processing unit is in charge of processing raw materials sourced from AFGA agricultural products into ready-to-eat products. Some of the AFGA processed products are banana chips, spinach crackers, mushroom chips and soybean chips. Meanwhile, the marketing unit has a role in establishing partnerships with retailers around Sedayu District to market AFGA processed products.
- e. **The production unit:** this unit has roles in developing on-farm operations and establishing partnerships with other related stakeholders to obtain agricultural inputs.

In conducting the day-to-day functioning, the head of AFGA is assisted by a secretary and a treasurer. AFGA has a secretariat office located in the Kepuhan sub-village. Every 35 days, the management of AFGA and the farmer members represented by the head of each farmer group and the secretary from the eight farmer groups conducts a meeting. Even though AFGA has a secretariat office, the meeting is often held in the agricultural extension office of Sedayu District. It is a monthly routine that the agricultural extension officer of Sedayu District facilitates the meeting. It is also part of the cooperation between AFGA and the agricultural extension officer that has been established for several years. In this meeting, the management of AFGA, its member representatives, the agricultural extension officers, and a representative from Argorejo village government discusses the problems and solutions of on-farm and off-farm operations. The meeting reviews the schedule of starting the next cropping pattern, pest management operations, and the scheduling of agricultural machinery services conducted by the Argorejo IRSAM. During the meeting, the head of AFGA conveys information from the government to the members.

5.4.5.4 Membership

Membership of AFGA is open to all farmers who owned or rented agricultural land in Argorejo village. Several farmer groups exist under AFGA based on the commodity that they grow. These groups are eight farmer groups of food crops, two farmer groups of the fishery, five women farmer groups, one farmer group of organic fertiliser and livestock production, one farmer group of horticulture, and three farmer groups of forestry. From these groups, the largest group, with respect to the number of members, is the food crops group. This farmer group of food crops is mainly growing paddy, which is the main commodity produced by AFGA. Currently, there are 875 farmers registered as the members of AFGA's food crop groups, with total wetland area of 146 hectares (see Table 9). The majority of farmers in this area own small farm-sized farms, ranging from 700 m² to 1000 m². Farming is not the main source of income, which classifies them as the part-time farmers.

Table 9. The member of AFGA in food crops in 2016

No.	Name of Farmer Group	Sub-village	Established in	Wetland Area (Ha)	Number of Members
1.	Ngudi Rejo	Kalakan	1983	18	105
2.	Tani Maju	Semampir	1990	24	141
3.	Kepuhan Pule	Kepuhan	1987	13	44
4.	Ngudi Raharjo	Sundi Kidul	1994	20	132
5.	Sedyo Makmur	Polaman	1985	25	115
6.	Ngudi Raharjo	Ngentak	1983	20	141
7.	Bulu Lestari	Pereng	1983	15	155
8.	Boga Lestari	Bandut	1994	11	42
Total				146	875

5.4.5.5 Cropping patterns and water availability

Paddy is the main commodity generated by this farmer group association. As a result, the AFGA farmers are developing paddy as the main cropping pattern (see Table 10). With the support of good irrigation networks available in most of the paddy fields, AFGA farmers can grow paddy three times a year. In accessing water for irrigation, the AFGA farmers use surface water from the nearest perennial rivers. Water is distributed through waterways built by the local government. In accessing water for irrigation, AFGA farmers have free of charge access.

Table 10. Cropping patterns of the AFGA in 2016

Farm Operation	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Paddy (cropping pattern 1)												
Mechanised Land Preparation												
Sowing/Planting												
Growing Stage												
Harvesting												
Mechanical Threshing												
Paddy (cropping pattern 2)												
Mechanised Land Preparation												
Sowing/Planting												
Growing Stage												
Harvesting												
Mechanical Threshing												
Paddy (cropping pattern 3)												
Mechanised Land Preparation												
Sowing/Planting												
Growing Stage												
Harvesting												
Mechanical Threshing												

In growing paddy, the AFGA farmers are starting the cropping pattern almost at the same time. From the eight farmer groups, the time difference in starting cultivating paddy fields is only a matter of days. When the rainy season begins in the first cropping pattern, between the late November and the early December, farmers in this area are starting to cultivate their land, mainly by hiring in tractors from the local providers (privately owned machinery providers and the Argorejo IRSAM). As a result, the demand for hand tractors reaches its peak during this season. While their fields are being prepared, the AFGA farmers are preparing the paddy seeds. In planting paddy, farmers are implementing the transplanting technique, where paddy seeds are germinated in a seedbed until they reach 15 days then they are planted in the paddy fields by groups of planters. From this point forward, farmers are maintaining the growth of paddy until the paddy is ready to be harvested in early March. In the first cropping pattern, farmers mainly utilise the rainwater to irrigate their paddy fields because of the high level of rainfall.

The second cropping pattern starts at the end of March and early April. After farmers have finished harvesting paddy from the first cropping pattern and threshed paddy using mechanical threshing machines, they begin to cultivate the paddy fields by hiring in tractors from the local machinery service providers. The rest of the second cropping pattern is the same as the previous cropping pattern. Rainfall is still the largest source of irrigation, and surface water from the irrigation networks is the secondary source of irrigation. Surface water is used to maintain water availability, especially when rainfall is decreasing at the end of the second crop. After the second crop has finished at the end of July and early August, the third crop of paddy begins. Similar to the previous pattern, farmers prepare their paddy fields through mechanised land preparation along with the preparation of the paddy seedlings. Unlike the previous crop patterns, in the third crop, farmers rely on surface water supplied by the irrigation networks to maintain the water availability. This is because, in the third crop pattern, the Argorejo village is entering the dry season. Therefore, it is common that farmers are practising irrigated agriculture. In the middle of November, farmers harvest the paddy, and the first cropping pattern begins again in early December.

5.4.5.6 Farm system and market orientation

Looking at the farm sizes of the AFGA farmer group members, the farm system of AFGA fits the description of small independent specialised family farm defined by McConnell and Dillon (1997). AFGA farmers are specialising in producing some particular crops and conducting livestock activities. The AFGA farmers are also selling some of their agricultural products to earn money as part of family sustenance. As mentioned earlier, one of the development aspects of AFGA are the processing and marketing units, which are part of the operating objective of AFGA in seeking profits. From these units, AFGA can establish partnerships with local retailers, local banks and local universities, to develop and market their processed and unprocessed products. For instance, in developing the AFGA's agribusiness of processed mushroom and banana chips, and the ready-to-drink herb products, AFGA has worked cooperatively with local universities (Gadjah Mada University and Mercu Buana University) and banks (Mandiri Bank, and the Central Bank of Indonesia). Furthermore, AFGA is selling some of the rice products to the local retailers, such as retailers in the Argorejo village. A few AFGA farmers who produce more than a sufficient amount of rice to be consumed by their family supply the rice. Therefore, these additional quantities of rice are sold through AFGA's partners. However, the farmer's family typically consumes most of their rice. AFGA also earns a small profit from the IRSAM as this unit was extending their machinery services to AFGA members.

5.5 Summary

The research was carried out in the Special Region of Yogyakarta. Two IRSAMs under the management of farmer groups were chosen. The Tirto Sari Farmer Group (TSFG) was selected in Gunungkidul Regency, and the other was the Argorejo Farmer Group Association (AFGA) located in Bantul Regency. Both research sites show similarities and significant differences regarding the attributes of the farmer groups and the environment surrounding the farmer groups. Table 11 summarises the similarities and differences of both farmer groups. The similarities include the support of the excellent condition of rural infrastructures, such as the road and irrigation networks, which benefits both farmer groups. Meanwhile, the significant differences between both regencies are the agro-ecological conditions, the population of farm machinery and the cropping patterns.

Table 11. Comparison between TSFG and AFGA

No.	Attributes	Tirto Sari Farmer Group in Gunungkidul Regency	Argorejo Farmer Group Association in Bantul Regency
1.	Agro-ecological condition (soil types and cost in accessing irrigation) and farming systems	<ul style="list-style-type: none"> - Mostly infertile soils in highland areas. - Pay for irrigation. - Mostly rain-fed agriculture farming systems, but TSFG were practising both farming systems (rain-fed and irrigated farming systems). 	<ul style="list-style-type: none"> - Flat and fertile lowlands. - Free of charge for accessing irrigation. - Mostly irrigated agriculture farming systems due to the abundant availability of surface water for irrigation.
2.	Infrastructure (road and irrigation networks)	<ul style="list-style-type: none"> - Good road networks due to the proximity of the TSFG to the region's capital, Wonosari. - Good irrigation networks supported by the pumping stations. 	<ul style="list-style-type: none"> - Good road networks due to AFGA situated close to a provincial highway. - Good irrigation networks supported by perennial rivers.
3.	Farm machinery population	Low population of farm machinery compared to other agricultural areas in the region.	The high population of farm machinery compared to other agricultural areas in the region.
4.	Types of farmers	Mostly full-time smallholder farmers with market orientation.	Mostly part-time smallholder farmers and less market oriented.
5.	Cropping pattern	Three cropping patterns in a year growing paddy, maize and groundnuts, and vegetables.	Three cropping patterns in a year growing one crop (paddy).

CHAPTER SIX: RESULTS

6.1 Introduction

This chapter describes the results of both cases starting with the Gunungkidul Regency case in Section 6.2. In this case, the development and the organisational structure of the Tirto Sari IRSAM are described (Section 6.2.1 and 6.2.2). Following this section, is a discussion of some circumstances that shape the way the Tirto Sari IRSAM is operating (Section 6.2.3). In the case of Bantul Regency (Section 6.3), the development and the organisational structure of the Argorejo IRSAM is elaborated in Section 6.3.1 and 6.3.2 respectively. These sections are followed by a discussion regarding some circumstances that influence the operation of the Argorejo IRSAM (Section 6.3.3). Finally, a summary of both results is presented in Section 6.4.

6.2 Case of Gunungkidul Regency

6.2.1 The development of the Tirto Sari IRSAM

In 2003, the Tirto Sari IRSAM was established by TSFG. The formation of this machinery service provider was motivated by the implementation of simultaneous farm operations with three cropping patterns which, at that time, had resulted in noticeable profits for the members. However, in conducting farm operations, particularly land preparation, member farmers of TSFG were using hand tools, such as hoes, which were taking a longer time than using machinery to prepare the land. Therefore, these farmers thought about converting these hand tools with farm machinery, such as a tractor, so that their farm operations would be faster and more efficient.

After discussing the intention of acquiring agricultural machinery with all the members, TSFG agreed and supported the initiative. The management of TSFG communicated its intention to an agricultural extension officer of Wonosari District and an officer of the Regency Office of Food Crops and Horticulture of the Gunungkidul Regency to access the government programme regarding farm machinery. In August 2003, this farmer group received a loan from the government. The loan was in the form of cash to be used by the

farmer group to buy agricultural machinery. According to this scheme, the financial support should be returned to the government within three years with interest. It was required by the government for the recipient of a farm machinery programme to form an Institution for Rental Service of Agricultural Machinery (IRSAM); this farmer group also formed the Tirto Sari IRSAM.

By utilising this scheme, the IRSAM bought a 2WT and associated implements, such as a plough and a trailer, and started to provide mechanised land preparation services to TSFG members. By working hard on delivering services to member farmers, the IRSAM was able to return the money to the government in 2006. From 2003 to 2006, there was an increase in the quality of service of the IRSAM marked by the growth of clients that they served, not only the TSFG members but also the non-member farmers in the neighbouring sub-villages. The limited number of IRSAMs available around Karangrejek village at that time was also influencing the increase of farmers using the service of the Tirto Sari IRSAM.

In 2006, the IRSAM received a 4WT and a water pump from the government as part of the IRSAM development programme. By operating the 4WT, the IRSAM gained significant profits from delivering machinery services to farmers, because this machine had a larger capacity of service compared to the 2WTs. As a result, the IRSAM was able to expand its services to other villages and increase their profits. Looking at the increasing demand for machinery service in 2009, the IRSAM added more machinery by accessing financial support from the government and a leasing company. Therefore, in 2009 the IRSAM bought a new 2WT and a multi-crop thresher. With the growing assets of farm machinery owned by the IRSAM and with the support of the machine operators, the Tirto Sari IRSAM was able to expand their services across districts. In the beginning, the IRSAM was operating around TSFG, with the total area of service reaching 40 hectares. Along with the development of the IRSAM, the area was expanded to serve non-member farmers around Karangrejek village, and other districts. Currently, the IRSAM serves 85 hectares. Table 12 shows all farm machinery owned by the IRSAM. Appendix 7 illustrates some of the agricultural machinery managed by the IRSAM.

Table 12. Farm machinery owned by the Tirto Sari IRSAM in 2016

No	Name of Farm Machinery	Brand and Specification	Qty	Year Procured
1	2WT	Quick G-3000	1	2003
2	4WT	Kubota MX 5000	1	2006
3	Water pump	Robin 3.5 HP	1	2006
4	2WT	Quick G-3000	1	2009
5	Multi crop thresher	-	1	2009
6	2WT	Quick G-1000	2	2010
7	Water pump	8.5 HP	1	2010
8	Paddy mower	-	1	2010
9	Paddy thresher	-	1	2010
10	Toolset	-	1	2010

Source: UPJA TIRTO SARI (2013)

6.2.2 The organisational structure of the Tirto Sari IRSAM

The Tirto Sari IRSAM comprises a manager, a secretary, a treasurer, and persons in charge of the business development unit, the maintenance and repair units and the public relations unit as shown in Figure 15. The manager is responsible for controlling the operation of this unit. In conducting his role, the manager is assisted by a secretary and a treasurer. To manage the IRSAM, the manager coordinates with the smaller units under the IRSAM.

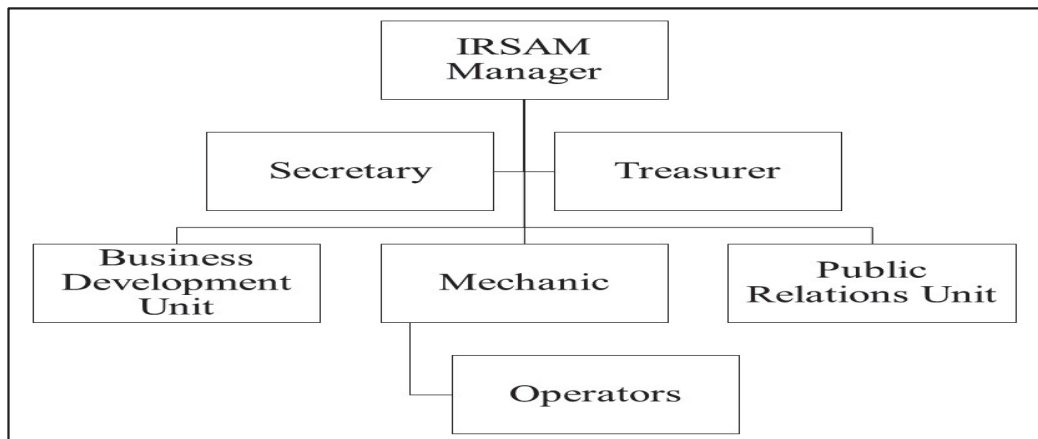


Figure 15. The organisational structure of the Tirto Sari IRSAM

The business development unit and the public relations unit serve to assist the managers in developing the IRSAM. Their role is to explore opportunities in expanding the business by cooperating with TSFG farmers and non-members. These units also create a network with other IRSAMs around Wonosari Districts. To deliver services to member farmers of TSFG or non-members, the manager assigns the operators. Furthermore, to sustain the

service, the manager orders the operators to maintain the farm machinery to ensure that they are operating. The operators coordinate with a mechanic, who is in charge of the maintenance and repair unit in the IRSAM.

6.2.3 Factors that shape the operation of the Tirto Sari IRSAM

Looking at the way the Tirto Sari IRSAM was operating, some circumstances were indicated to shape the functioning of the IRSAM (see Figure 16). The interviews as well as the FGDs revealed that the operation of the Tirto Sari IRSAM is shaped by 1) the capability and the availability of skilled staff, particularly the manager and the machinery operators, 2) the efforts of the IRSAM in maintaining the quality of services, 3) the way the IRSAM accesses supporting services, and 4) the cooperation established between the IRSAM and other IRSAMs around Wonosari District.

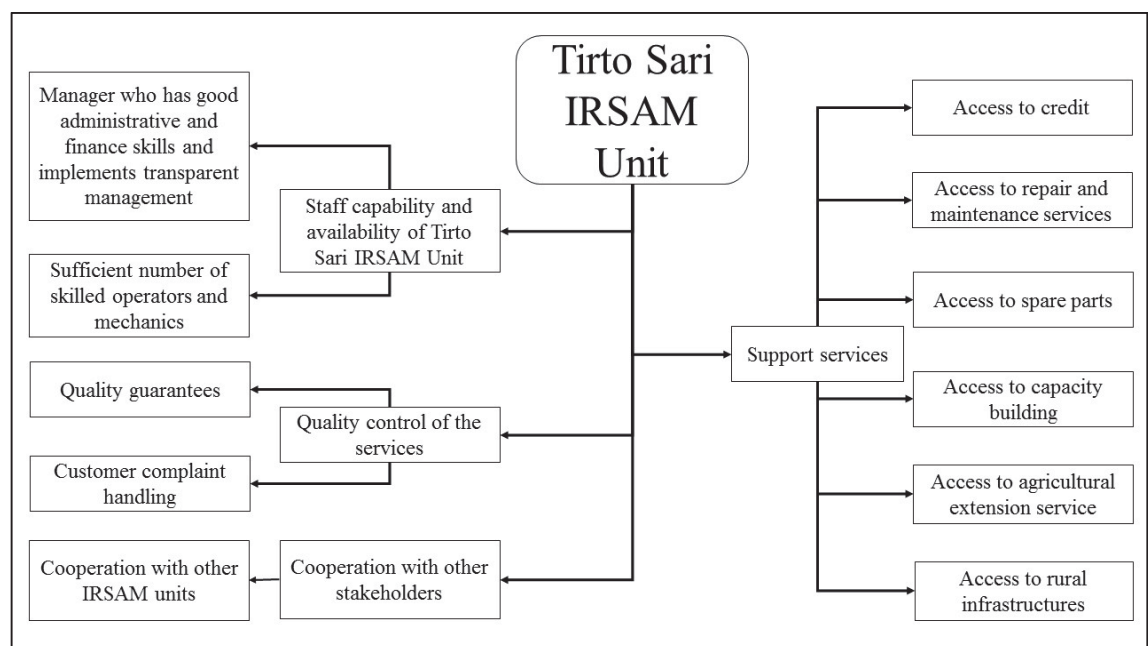


Figure 16. The influencing factors that shape the operation of the Tirto Sari IRSAM

6.2.3.1 The capability and availability of skilled staff of the Tirto Sari IRSAM

The manager

The operation of the Tirto Sari IRSAM was influenced by the way the manager controls the IRSAM. In managing the IRSAM, the roles of the manager include:

- Planning the service delivery schedule for member farmers and non-members,

- Managing the contracts of machinery hire services between the Tirto Sari IRSAM and its clients,
- Recruiting and training operators and equipping operators with handbooks to record transactions,
- Appraise the quality of service delivered by the operators,
- Organising maintenance and repair of farm machinery, and
- Managing the business, including budgeting and other administrative requirements.

The roles of the manager are significantly important in shaping the development of the IRSAM. There was agreement regarding the way the manager runs the IRSAM, identified in all of the interviews with the government officers of the Special Region of Yogyakarta and Gunungkidul Regency. The local government said that the manager has good administrative and finance skills to develop the IRSAM by utilising financial support provided by the government. Moreover, the manager is considered a young farmer who is passionate about developing the IRSAM, with some technical skills and eager to learn. They seemed to have the same expression that the development of an IRSAM is highly likely influenced by the performance of the manager, as captured in the provincial officer's statement:

It depends on the performance of the manager. If, for instance, the manager of an IRSAM is a person who is creative in managing the business, the IRSAM under his management will flourish. However, if the manager of an IRSAM has a lack of creativity, most likely the IRSAM will not develop, or at not least at the same level as it is now (Agricultural Officer of the Special Region of Yogyakarta, 2016).

From the perspective of TSFG farmers as the client of the IRSAM, the manager is considered a person who can manage the IRSAM to fulfil the demand of machinery services of TSFG farmers. The head of TSFG expresses:

The manager knows what is needed to manage an IRSAM because not every person can do it. He was the person who initiated the establishment of the IRSAM, therefore, under his management, this unit has grown until now. Many TSFG farmers are satisfied with the services delivered by the IRSAM because we have an

agreement that the IRSAM will prioritise TSFG farmers before serving the non-members.

The manager also implements transparent management in running the IRSAM. Transparency in managing the IRSAM is essential to inform members regarding the cost of operation of the IRSAM and other related expenses. The manager creates a schedule of machinery service delivery to the farmers and records all the transactions. To record the transactions, the manager provides the operators with handbooks for recording the hours of operation for tractors and how many hectares the operators plough in each farmer's field. The operator's handbook is used to calculate the amount of money paid to the operators based on the number of hectares they plough. The operators receive 30% of the total service fee paid by a client, while the rest of the fee goes to the IRSAM management. Furthermore, the handbook is also used to track the operating hours of the tractors to determine their engine and gearbox oil change intervals, which is part of the maintenance process in the IRSAM, as stated by the manager:

Inside the handbook, we will find the location where these machines were used to deliver services to farmers, the duration of the services, the price of services and other operational costs, such as buying food for the operators and fuel consumption for the tractors. Each operator has his handbook.

The operators

The operation of the Tirto Sari IRSAM is influenced by the availability of skilled operators. These operators are the assets of the IRSAM because their roles are significantly important to the unit. Currently, there are six operators to operate farm machinery in the IRSAM. Most of them are young farmers hired from the neighbourhood of Karangrejek village. These operators have been operating agricultural machinery in the IRSAM for more than five years. Previously, there were seven operators. However, one of the former IRSAM operators has been able to establish his own welding business. In delivering the service, these operators are assigned based on the schedule that the manager has created. The operators are mainly operating 2WTs, while the manager operates the 4WT. The manager has been an operator since the beginning of the IRSAM.

The manager advised that during the peak season of delivering farm machinery services to member farmers of TSFG and non-members, usually in July, August, September, and

October (4 months), skilled operators are needed to operate all tractors owned by the IRSAM. Based on the experience of the IRSAM, they have no issue in finding capable operators to handle the job because the IRSAM offers the operators relatively high fees compared to other casual jobs around the neighbourhood. The manager states:

It is the manager's right to recruit operators. In this case, we invite young farmers or youths to be our operators, because, through the IRSAM, the operators will get paid immediately after they finish delivering services to farmers. The younger generation is what we need in this business because this business requires people who have power, agility, and eagerness to learn. So, when these young operators are required to improve their technical skills, they still have some wider opportunities because they are young.

However, according to the officer of the Regency Office of Food Crops and Horticulture of the Gunungkidul Regency, there are some constraints to IRSAMs when looking for operators.

In developing an IRSAM, it depends on the individual in the farmer groups. One of the constraints to growing an IRSAM in Gunungkidul is that we have diverse farmer groups with different characteristics. Our hope is that young farmers handle the management of an IRSAM. However, looking for young farmers is hard nowadays.

With the current operators, the IRSAM has been able to manage and distribute the operators to service the clients without any issue. During service delivery, particularly from July to October, these operators are delivering agricultural machinery services to the member and non-member farmers. Most of the farm machinery services of the IRSAM are the mechanised land preparation and threshing. For the remaining times, some of the operators are continuing their own activities, such as farming or doing other seasonal jobs. When servicing clients, these operators are assigned by the manager to deliver services to certain locations as written in the transaction book.

6.2.3.2 The quality control of the services

The quality of service is shown to be essential in shaping the operation of the Tirto Sari IRSAM. The IRSAM has been serving the members of TSFG and non-members since 2003. The way the IRSAM maintains the quality of services is the reason why the IRSAM can have loyal customers across districts. This machinery service provider emphasises

their quality of service delivered by its operators, therefore their customers stay loyal to them, and the IRSAM can keep earning money from this business. To maintain their customers loyalty, the IRSAM uses two approaches: a) providing quality guarantees of services and b) listening to the client's complaint.

Quality Guarantees

There are two points that the IRSAM provides to ensure the quality of service to the customers (UPJA TIRTO SARI, 2013):

1. If a client thinks that the result of machine hire services has been inadequate, the client is allowed to reduce the agreed charging rate.
2. If a customer thinks that the result of machine hire services has been poorly executed with unacceptable results, the client is allowed not to pay for the service.

By providing a guarantee to their customers, the IRSAM seems to be able to retain its existing customers, attract more customers, and expand their area of operation outside TSFG. The expansion of service area to cover neighbouring villages and across districts is mainly generated by the satisfaction of their customers using the service of the IRSAM (UPJA TIRTO SARI, 2013). An officer of the Regency Office of Food Crops and Horticulture of the Gunungkidul Regency shares that machinery hire services of the Tirto Sari IRSAM received high appreciation from the farmers, as captured in the officer's statement below:

The quality of service provided by an IRSAM is the main thing to be considered by the manager and its operators. For instance, the Tirto Sari IRSAM has been able to provide services to several districts. This service is possible because the farmers have recognised the quality of the service delivered by the IRSAM, which is sufficient and acceptable. In fact, even though these farmers also have tractors in their groups, their preferences fall to the Tirto Sari IRSAM.

Similarly, the head of TSFG also express the satisfaction of member farmers and non-member farmers with the service delivered by the Tirto Sari IRSAM:

Most of the farmers are satisfied with the service. However, there is some work that is poorly executed, and the IRSAM admits it. That is why the IRSAM is willing to reduce the service fee if the clients are not satisfied. However, I believe that the manager has provided sufficient training to the operators.

Customer Complaint Handling

During the machinery hire service delivery, particularly mechanised land preparation service, it is indicated that the customers or farmers are usually appraising the result of the service executed by the operators. According to the manager, customers are allowed to criticise directly to the manager, if they have any objections or complaints regarding the services. The manager would follow up the complaints and talk to the operator to improve his performance in executing the service to the farmers.

6.2.3.3 Access to supporting services

The supporting services which exist around the Tirto Sari IRSAM also seem to shape the operation of the IRSAM. The ability of the IRSAM to access the supporting services, revealed in the interviews, is considered essential in influencing the development of the IRSAM. The supporting services include access to credit, access to repair and maintenance services, access to spare parts, access to capacity building, access to the agricultural extension service, and access to rural infrastructure.

Access to credit

Financial resources are indicated to be part of the factors which influence the operation of the Tirto Sari IRSAM. The IRSAM can develop its business because it received financial support from the Government of Gunungkidul Regency during its early development. The manager states that in 2003, the IRSAM received funding to stimulate the establishment of the IRSAM in the form of credit. As part of the agreement between the government and the IRSAM at that time, the financial support scheme had to be returned to the government in three years. In using the funding, the IRSAM used part of it to buy a 2WT and its implements, such as a trailer and a disc plough. The remaining funds were used to cover the initial cost of operation. From that point forward, the Tirto Sari IRSAM has been able to expand its business. The manager states:

By providing land preparation services to the farmers every year since we delivered our first service, the IRSAM has been expanding, and the farmers noticed our services. From 2003 to 2006, custom hire service was still rare if delivered by an IRSAM or individual providers. As a result, we were able to complete the payment of the financial support to the government, even though we completed the payment in the fourth year.

The officer of the Regency Office of Food Crops and Horticulture of the Gunungkidul Regency echoes the manager's statement:

In developing an IRSAM, most of the farmer groups are not as enthusiastic as the Tirto Sari IRSAM. The Tirto Sari IRSAM was able to buy a 2WT to run the business. Even though the financial support scheme was only a couple of million rupiah, they succeeded in growing the business.

The manager expresses the importance of the financial support provided by the government and also the private sector in the development of the Tirto Sari IRSAM. According to the manager, there was a growing demand for land preparation services in 2009, which required the IRSAM to add more machines. After considering the performance of the IRSAM in delivering services at that time, the IRSAM decided to borrow money from a leasing company and combined it with the financial support provided by the government. The manager expresses:

In 2006, the IRSAM received a 4WT from the government. The 4WT has been able to deliver an acceptable land preparation service to the farmers with a larger area of service compared to 2WTs. Also, the 4WT has become the preference for land preparation service by many farmers. This kind of tractor has been able to earn money for this business unit. Therefore, I was confident that from the operation of the 4WT, the IRSAM would be able to complete the payment to the leasing company in two years (The manager of Tirto Sari IRSAM, 2016).

Access to repair and maintenance services

Access to repair and maintenance services is also one of the essential conditions that shaped the operation of the Tirto Sari IRSAM. As a way to maintain the quality of service to customers, and to keep the business running, the IRSAM has been able to develop a repair and maintenance unit. With the growing assets of the IRSAM, the repair and maintenance unit is also gaining experience in handling maintenance activities since the IRSAM owned its first farm machine. From this point forward, this unit is expanding its service by maintaining and repairing agricultural machinery for many farmers in the Karangrejek village. The IRSAM's mechanic is responsible for this unit.

At the maintenance and repair workshop in the Karanggumuk I sub-village, the mechanic can take care of the Tirto Sari IRSAM farm machinery and reduce the frequency of

machinery breakdowns, which is significantly important to sustain the services provided by the IRSAM. According to the manager, the mechanic mostly handles major repairs, as advised by the manager:

Our mechanic handles simple, medium and major repairs. For major repairs, such as engine overhaul, it depends on the available spare parts, even though our mechanic is part of the Tirto Sari IRSAM, but if other IRSAMs need his service, he will be glad to help. Currently, a lot of farm machinery owned by farmers outside our farmer group is in his workshop waiting to be repaired.

Operators also perform farm machinery maintenance because it is part of their responsibility to take good care of the tractors and other agricultural machinery. The manager encourages the operators to maintain the machinery that they are operating. As a result, they can sustain the performance of these machines, which affects the quality of service delivered to farmers. These operators would be able to do simple maintenance, such as monitoring the oil change interval of the tractor engine, replacing the v-belt transmission, and other spare parts. One of the operators echoes the manager's statement regarding the way they managed to do a small repair to the tractor:

If there is a minor repair needed, it is our responsibility to fix it, for instance, if there is a part of the tractor that needs to be welded, we can do the welding. However, if it is a major repair, such as an engine overhaul, we have to report it to the manager (A tractor operator of Tirto Sari IRSAM, 2016).

The repair and maintenance activity is not merely fixing or replacing broken parts of the farm machinery, but also modifying the parts. The mechanic and the operators of the Tirto Sari IRSAM are gaining popularity in customising the parts of agricultural machinery, such as a disc plough and the 2WT's iron wheels, because most of the tractors sourced from the government need to be modified. For instance, according to the manager, the iron wheels are designed to be used on wetland (paddy fields). However, because most of the agricultural land in Karangrejek village is dry land, the iron wheels need to be modified. With the ability to modify tractor implements and with a lot of experience in operating tractors, the mechanic and the operators were invited to the headquarters of a farm machinery producer in the Special Region of Yogyakarta. The sales manager of the machinery producer indicates that these creative farmers can provide valuable

information and feedback to the company to identify potential opportunities to develop its products. The sales manager states:

Sometimes farmers are not satisfied with our products, particularly the tractor implements, such as the disc plough or the paddy field tractor wheels. Therefore, some of them can modify these implements according to their needs. As a result, we have considered that some of their modified implements are worth developing in our company. We realise that these creative farmers are essential to the development of agricultural machinery. That is why we ask for their feedback for improving our products to improve the productivity and the ergonomics of the machinery used by them.

Furthermore, the agricultural machinery producer might visit these creative farmers to test out their new prototypes and ask for their feedback. In the case of the Tirto Sari IRSAM, it was advised by the manager that the local farm machinery producer visited the IRSAM. The IRSAM manager states:

Recently, there were some employees of the local agricultural machinery producer that visited us. They came here to witness how we operate our 4WT and how we use a tractor rotavator or a rotary tiller. It was related to their current project, which is a 14 horsepower 4WT prototype they are currently developing. I know this prototype when I was invited to their workshop. Moreover, during the visit, they offered one of our operators to trial the prototype in one of their test fields in Kalimantan.

Access to spare parts

The availability of spare parts is also essential to support the functioning of the IRSAM. The manager states that most of the components, particularly for 2WTs, are easy to find in the local dealers around Wonosari District. However, the manager emphasises that spare parts for the 4WTs are hard to find, as captured in the manager's statement below:

We have to be very careful in operating the 4WT, because some parts, such as a gearbox, are hard to find in the market. If we do not take good care of this part, our 4WT will be useless. However, luckily, we have not experienced any issues regarding the gearbox.

The importance of making the farm machinery spare parts accessible to the IRSAM, particularly in Gunungkidul Regency, required the Regency Office of Food Crops and Horticulture of the Gunungkidul Regency to assist IRSAMs and farmers to access spare parts. When there is a request for particular components from the IRSAMs, the Regency Office contacts the local machinery producer regarding spare parts availability, the local machinery producer would then send the components to the IRSAMs.

Access to capacity building

Access to capacity building, such as the technical and business skills training is considered significant in shaping the operation of the Tirto Sari IRSAM. In order to strengthen the capacity of the manager and the operators, the staff of the Tirto Sari IRSAM have received different training programmes, which have been organised by the government, as stated by the IRSAM manager:

When we knew that the government would provide us with the financial support, we formed the Tirto Sari IRSAM. After we had bought a 2WT, the government provided us with training on how to operate and manage the tractor.

There is an agreement between local governments (the provincial and the regional governments), the machinery producers, and universities, that training is necessary to assist the manager and the operators to become familiar with this kind of business. In facilitating training for the IRSAMs, the local governments invite farmers to participate in training. The machinery producers and universities are involved in the training by delivering training materials. These institutions hold this kind of training programme annually, particularly for new recipients of the subsidised farm machinery. Training covers the business skills and technical expertise. A university lecturer delivers training in the business skills aspect:

We are more into providing the necessary soft skills required by the staff of an IRSAM to run their business, particularly in the field of management and administrative issues (Senior lecturer in farm machinery at Gadjah Mada University, 2016).

Through this training, the lecturer delivers information about how to determine a service fee, or charging rate for each piece of agricultural machinery. Furthermore, the lecturer provides the staff of the IRSAMs with information regarding how the cash flow and the contracts between an IRSAM and their clients (farmers) should be recorded. The lecturer

suggests that the documentation of every activity executed by the IRSAMs be registered in the form of a transaction book.

Meanwhile, the machinery producers deliver training in the technical skills aspect. A sales manager of a farm machinery producer in the Special Region of Yogyakarta expresses:

Technical training that we organise usually covers the operation and the maintenance of agricultural machinery. The technical training is free of charge, and it is part of the after-sales service provided by our company.

By participating in the business and technical skills training, it is suggested that the skills of the manager and the operators of the Tirto Sari IRSAM have improved after many years. With the increased skills in technical and business aspects, and the increased experience in handling the machines and managing the IRSAM, they can maintain the quality of service to their customers and have gained popularity around the Wonosari District. As a result, they are often involved in some agricultural machinery promotion events held by the national and local governments. Furthermore, by participating in these events, the IRSAM seems to reap benefits and see the opportunity to develop the IRSAM, as captured in the IRSAM manager's statement below:

If the regional government has an event related to agricultural machinery aimed at developing the capacity of the manager and the operators of an IRSAM, we used to be invited by the government. Sometimes we shared our experiences in managing the IRSAM, and sometimes we have an opportunity to witness the achievements of other IRSAMs in running the custom hiring business. We are happy to participate in these kind of events, and we know that we can benefit from it, even though it is not in the form of cash or money.

Access to agricultural extension services

The role of the agricultural extension officer of Wonosari District also has a positive influence on the operation of the Tirto Sari IRSAM. The good relationship between the agricultural extension officer and the Tirto Sari IRSAM, and TSFG, is an advantage of the IRSAM having access to the government programmes. There is agreement around TSFG members and the manager of the Tirto Sari IRSAM that the agricultural extension officer has been assisting them in accessing information, technology, and other essential programmes organised by the government. The extension officer also provides them with

solutions to farm operations and pest management. The manager of Tirto Sari IRSAM expresses:

When we wanted to own our first agricultural machine, we asked the agricultural extension officer of Wonosari District to give us suggestions on how to access the machinery programme. At that moment, the extension officer was able to facilitate us in accessing the government's programme through a loan scheme. From that point forward, we could start our machinery hire service business after we used the loan scheme to buy a 2WT.

One of the TSFG farmers states a similar expression regarding vital assistance and support that have been conducted by the agricultural extension officer for the farmer group:

The extension officer visits us almost every day, sometimes early in the morning, late afternoon, or the evening. The officer visits us because we grow various crops compared to other villages. As a result, we often experience many issues in farm operations, particularly pest management options. The extension officer also invites us to a monthly meeting to discuss some government initiatives to increase agricultural production. Currently, the extension officer provides us with the shallot-growing scheme. Meanwhile, last year, we got the chilli-growing scheme.

Access to rural infrastructures

Rural infrastructure, such as road networks and irrigation networks, which was built by the government, is also important in shaping the operation of the Tirto Sari IRSAM. The road networks around the Karangrejek village, and other neighbouring districts, are in good condition. The good state of the road networks might be influenced by the proximity of this village to the Regency capital, Wonosari. Most of these roads are hot mixed asphalt pavement, particularly roads which cross residential areas close to paddy fields. With the excellent condition of roads in the sub-villages, the mobilisation of farm machinery would be faster and fewer obstacles compared to the poor condition of rural road networks. Furthermore, the excellent condition of rural road networks reduces the fuel and time consumption of a tractor when moving from one field to another.

Meanwhile, good irrigation networks are required to support the operation of farm machinery services. In the Karangrejek village, particularly in the Karangsari sub-village, a good irrigation network exists in this area, and it is essential to increase the crop

diversity grown by farmers. This means that farmers would have a wider opportunity to grow several crops in a year (the three cropping patterns), because of the constant water availability supported by a good irrigation network. The increase of crop diversity grown by farmers influences the growing demand for machinery hire services, as farm machinery services are needed for land preparation when the farmers decide to transition from the first crop pattern to the second crop pattern. The IRSAM manager advises:

With the support of the water user unit and good irrigation network, farmers could rely on the machinery hire services to prepare their land for the next cropping pattern because converting crops, for instance, chilli to paddy, needs to be done as quickly as possible. Moreover, during this time, the fields are still dry because it has just entered the rainy season. Therefore, to smooth the process of mechanised land preparation, the land needs sufficient water.

The head of TSFG expresses the importance of irrigation for supporting the operation of the mechanised land preparation services:

All farmers' fields are equipped with small ponds to store water from the irrigation channel. Sometimes, water from the irrigation channel cannot directly flood the fields, as the fields are too far from the pumping station. From these ponds, farmers use small water pumps to irrigate the fields, after that, a tractor begins to cultivate the field.

6.2.3.4 Cooperation with other stakeholders

Cooperation with other machinery hire service providers

Collaboration between the Tirto Sari IRSAM and other IRSAMs around Wonosari District is also considered an influencing factor in the operation of the Tirto Sari IRSAM. The manager advised that the IRSAM benefits from this cooperation;

During land preparation, many IRSAMs contact us because they are unable to fulfil the high demand for machinery services from their clients. Meanwhile, the demand for machinery services from our clients has not reached its peak so that we can service their customers. Sometimes, we are invited by other IRSAMs to handle jobs that they are unable to take care of, because of less experience, or the terrain is too difficult for them. With our experience in handling similar ground, they think that the job is suitable for us.

This cooperation is possible because, during the expansion of the service area of the IRSAM, other IRSAMs in several districts, like Wonosari, Semin, and Paliyan noticed the quality of service delivered by the Tirto Sari IRSAM. These IRSAMs benefit from establishing cooperation with the Tirto Sari IRSAM because they gain business and technical skills about managing an IRSAM by sharing information with the Tirto Sari IRSAM. The cooperation also enables the Tirto Sari IRSAM to build a network among IRSAMs along with expanding their market to attract more clients.

6.3 Case of Bantul Regency

The Argorejo IRSAM is one of the units under the Argorejo Farmer Group Association (AFGA) that is responsible for managing farm machinery and delivering machinery services to the AFGA members. The Argorejo IRSAM has been operating since 2013. The IRSAM has been able to increase their machinery assets, and now they are in the stage of improving services to the AFGA farmers.

6.3.1 The development of the Argorejo IRSAM

Seasonal demand and the availability of farm machinery

It was common in the past that in Argorejo village farmers used hand tools, such as hoes, forks, and shovels, to prepare farm fields for growing paddy. However, for the past several years, there has been a decreasing supply of farm labour, particularly in land preparation, planting, and harvesting around AFGA and in Bantul Regency, in general. As a result, there has been an increased degree of farm machinery acceptance around the farmer groups for farm labour substitution. Farmers are using farm machinery for some of the farm operations, particularly land preparation and paddy harvesting, as highlighted by the two government officers of Bantul Regency:

In the past, when tractors were introduced to farmers, they did not accept them straight away. Farmers thought that tractors could damage the soil and the paddy because of the fuel and oil which may leak from the tractor engine. So, it was hard to introduce tractors some years ago. On the contrary, farmers now realise that tractors are needed to prepare the paddy fields, and the demand for this machine is high (Agricultural Extension Officer of Sedayu District).

Farm machinery, particularly tractors, is now becoming popular around farmers because it will be too late for them to grow paddy if they are not using this machine (Agricultural Officer of Bantul Regency, 2016).

Since 2010, most of the farmers under AFGA acquired farm machinery from the government mechanisation programme. 'There are four 2WTs owned by the farmer groups under AFGA since 2010, but these tractors are serving the respective groups without coordinating with AFGA' (Head of AFGA, 2016). As a result, the rest of the AFGA farmer group cultivated their paddy fields by hiring machinery from individual machinery hire providers around them. However, because of the characteristics of the paddy-cropping pattern, the demand for mechanised land preparation reaches its peak at the start of every cropping pattern. Consequently, at that time, there was an insufficient supply of farm machinery to conduct land preparation service. The low availability of machinery resulted in delays in planting paddy for most of the farmers in the Argorejo village, because they had to wait for the services of the machinery service providers.

Furthermore, the delay caused farmers to plant their paddy seeds more than 15 days after it had germinated, which was over-mature for the seeds to be transplanted to the paddy fields and it influenced the growth of paddy. Similarly, the availability of mechanised harvesting machines during the paddy harvest time was insufficient in the Argorejo village, exacerbated by the decrease of hired harvesting labour, creating delays for farmers to harvest paddy. Furthermore, some of the farmers had to harvest their paddy using hand tools, which resulted in considerable loss of their product. Paddy has to be harvested and stored as soon as possible after it has reached a sufficient level of ripeness, or the paddy is mature enough to be harvested. It is one way to maintain the quality of rice. Therefore, farmers race to harvest the paddy at the optimal time.

The establishment of Argorejo IRSAM

Realising the imbalance in supply and demand for farm machinery during land preparation and harvesting time, in 2013, the AFGA management decided to conduct a meeting with the rest of the AFGA members. They agreed to manage the farm machinery owned by each farmer group to be able to fulfil the demand for machinery services of other farmer groups under AFGA. Therefore, in 2013, the Argorejo IRSAM was established. The main task of this unit is to create a machinery service schedule for AFGA

farmers and to ensure that farmers receive the services. The Argorejo IRSAM is cooperating with private machinery hire providers by working together to overcome the imbalance in supply and demand for machinery services.

From this effort, the Argorejo IRSAM has been able to reduce the imbalance in supply and demand for farm machinery. However, an insufficient number of tractors and motorised harvesters still exists in AFGA. Realising this situation, the management of AFGA consulted with the agricultural extension officers of Sedayu District and agricultural officers of the Bantul Regency to access some farm machinery development programmes of the government.

In 2014, the Central Government launched a programme of fully mechanised farm operations across the Republic of Indonesia. Bantul Regency was one of the programme recipients. To select the participants, the Central Government, the Government of the Special Region of Yogyakarta, and the Government of Bantul Regency were assessing the performance of each farmer group association in Bantul Regency from late 2014 to early 2015. Considering the achievement of AFGA in facilitating farmer groups in 2013, and the existence of an IRSAM that serves more than 100 hectares of agricultural land under AFGA, in 2015, the Argorejo IRSAM was chosen as a recipient of the IRSAM development programme. The IRSAM received several agricultural machines free of charge, as summarised in Table 13. Appendix 8 illustrates some of the farm machinery owned by the Argorejo IRSAM.

Table 13. Farm machinery owned by the Argorejo IRSAM in 2016

No	Name of Farm Machinery	Brand and Specification	Qty	Year Procured
1	2WT	Quick G-3000	5	2015
2	4WT	Yanmar EF 393T	3	2015
3	Water pump	-	5	2015
4	Paddy Transplanter	Indo Jarwo Crown	3	2015
5	Combine Harvester	Quick H-140R	2	2016

6.3.2 The organisational structure of the Argorejo IRSAM

The Argorejo IRSAM consists of a manager, a secretary, a treasurer, and four people in charge of each smaller unit under the IRSAM, as shown in Figure 17. In running the IRSAM, the manager coordinates with the related units, which have their roles to support the operation of the IRSAM. The marketing and business development unit is responsible for looking at the opportunities to expand the business by finding new clients outside AFGA farmers. This unit is dedicated to coordinate with the existing IRSAMs, or private machinery providers around AFGA. The coordination process includes mapping the area of operations so that these machinery service providers can cope with the seasonal demand of machinery services in the Argorejo village. The repair and maintenance unit is responsible for conducting regular maintenance of the machinery. Meanwhile, the warehouse unit is responsible for storage of machinery when the machinery is not in use (idle). The operator unit is in charge of managing operators to provide machinery services to farmers.

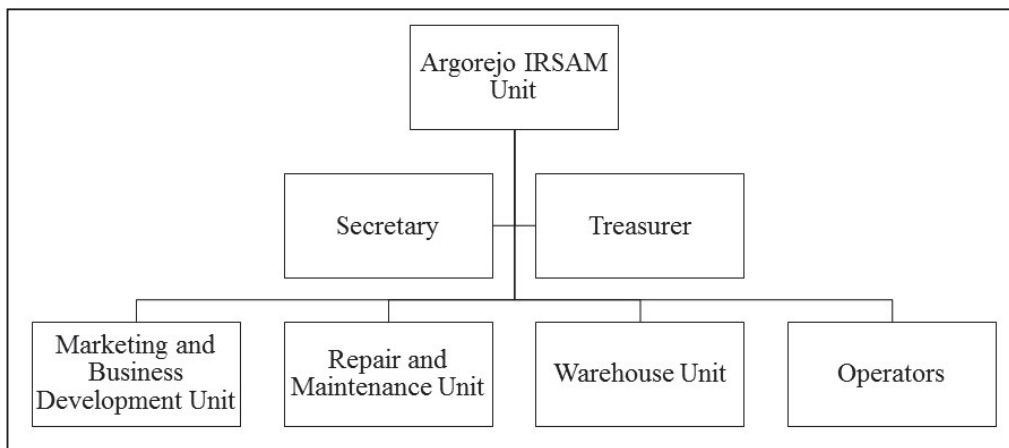


Figure 17. The organisational structure of the Argorejo IRSAM

6.3.3 Factors that shape the operation of the Argorejo IRSAM

Some factors shape the way the Argorejo IRSAM is operating. These are illustrated in Figure 18. These are; 1) the capability and availability of skilled staff of the Argorejo IRSAM, 2) the way the IRSAM accesses supporting services, and 3) the cooperation of the IRSAM with private machinery hire providers around the Argorejo village.

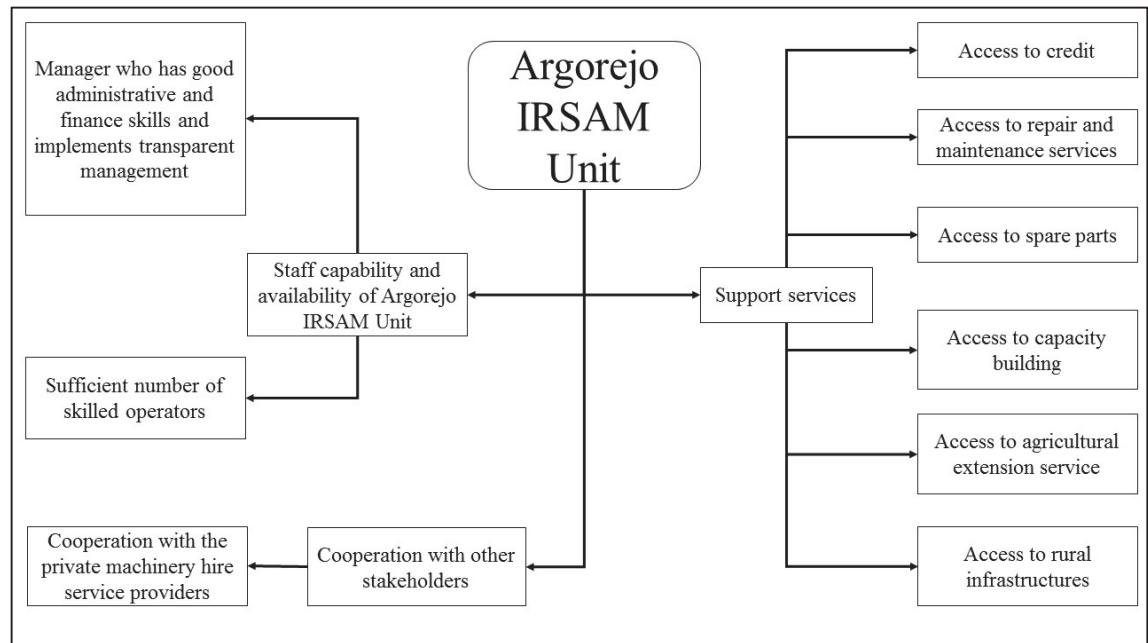


Figure 18. The influencing factors that shape the operation of the Argorejo IRSAM

6.3.3.1 The capability and availability of skilled staff of the Argorejo IRSAM

The manager

The manager of the Argorejo IRSAM has good administrative and finance skills, which shape the operation of the Argorejo IRSAM. In addition, the manager implements transparent management. For instance, he uses a logbook to write all the contracts, which includes the location of the machinery services undertaken by the operators, the tractor's fuel consumption, the service fee, and the operators' fee. After the cost of operation is documented, the manager reports to the AFGA members regarding the financial progress of the IRSAM at the monthly meeting. Moreover, the IRSAM manager states:

The agricultural extension officers use the financial report of the IRSAM to report the development of the IRSAM to the Bantul Regency.

Part of the transparent management is the involvement of the manager in all field activity along with the operators during the service delivery. Even though the manager is not capable of operating the machinery, because he is a middle-aged farmer, he assists the operators in preparing the machinery before and after entering the fields. He is also responsible for collecting the payment fee for machinery services from the farmers. The agricultural extension officer of Sedayu District appreciates the work of the manager.

The manager is a remarkable person, and he always supports all of the operation of the machinery hire service, and he can conduct proper record-keeping.

Meanwhile, from the farmers' perspective as the client of the IRSAM, the transparent management implemented by the manager is seen as part of the manager's character who is open to any suggestions to improve the quality of the services. A member farmer of AFGA expresses:

I saw the result of the ploughing service done by the operators when these operators used the 4WTs. However, the result is not sufficient. I understand that this is a young IRSAM with less experienced operators. However, I have communicated the situation with the manager.

The operators

It was observed that the operators' availability and capability are shaping the way the Argorejo IRSAM operates because of their important role in the IRSAM. They are responsible for delivering machinery services to the farmers, particularly during peak season, which is three times a year (December to January, April to May, and August to September). These operators were recruited from the farmer groups under AFGA so that they could serve their groups using the machinery available in AFGA's warehouse. However, from the eight farmer groups, not all of them sent operators to join the Argorejo IRSAM; this is because not many farmers are interested in handling machinery, most of them prefer to hire in machinery services. Currently, there are eight operators listed in the organisational structure of the IRSAM, but only five of them are the current operators; the rest of the operators are part-time. As a result, some machines have to stay at the warehouse because there are no operators. To reach its ideal performance, according to the manager, the availability of operators should be two people per unit of farm machinery. Therefore, with the current active operators, the IRSAM is looking for some new operators to operate the rest of the machines.

It was also seen that the IRSAM lacked operators. There are common observations between the agricultural officers of Bantul Regency, the Agricultural Extension of Sedayu District and the management of the Argorejo IRSAM, that operating farm machinery is less attractive compared to other casual jobs around Argorejo village. The Agricultural Officer of Bantul District states:

The operators are available around the IRSAM, however, they prefer to do another job, such as sand mining, particularly when the mining season starts, because they earn more by doing such kind of employment.

One of the active operators in the IRSAM echoes this situation:

The point is that the payment we get from operating farm machinery is not immediate, sometimes we have to wait for at least 20 days after we deliver the services (Operator of the Argorejo IRSAM, 2016).

With respect to the service fees, the management of the IRSAM is implementing agreed rates based on the common rate delivered by other IRSAMs or individual providers around AFGA. For 1000 m² of land preparation services, the IRSAM service rate ranges from Rp. 120,000 (NZ \$13.30) to Rp. 150,000 (NZ \$16.60). However, it is common with AFGA farmers that when the IRSAM delivers the services, the payment received for delivering these services is usually paid after the germinated paddy seeds are transplanted, which is around 20 days. As a result, the IRSAM has to cover the operation costs within that time. With this kind of payment method, it is a challenge for the IRSAM to attract more operators to join the business.

Operators in the IRSAM have sufficient experience operating farm machinery, particularly for the 2WTs, because most of them are the operators in their farmer groups. However, due to the complexity of the technology of other machinery, such as the 4WTs, the combine harvester, and the paddy transplanters, these operators are at an early stage of learning in delivering these services. An operator states:

We are mapping the compatibility of these machines, such as 4WTs by operating it in several paddy fields under AFGA. We want to know in which paddy fields this machine is suitable or not. Because in our experience, not all of the paddy fields under AFGA are appropriate for this kind of machine (Operator of the Argorejo IRSAM, 2016).

The complexity of the new machinery, compared to the 2WTs, has forced farmers to adapt to this kind of technology through training. One of the local machinery producers in the Special Region of Yogyakarta states:

Nowadays, we believe that farmers will be able to operate hand tractors (2WTs) straight away in the fields. However, for the larger machinery such as the combine harvesters, they will need to be trained by our mechanics.

6.3.3.2 Access to supporting services

The way the IRSAM accesses the supporting services around Argorejo village affects the shape of the operation of the IRSAM. The IRSAM has been able to access supporting services, such as credit, repair and maintenance, spare parts, capacity building, agricultural extension services, and rural infrastructure (road and irrigation networks).

Access to credit

Access to supporting services, such as access to credit, significantly influence the way the Argorejo IRSAM operates. After the IRSAM received new machinery in 2015, the IRSAM started to deliver services to the farmers. However, at the initial operation of these machines, the manager shared that the IRSAM needed to finance the first operation, which was not cheap. The manager of the IRSAM expresses:

These machines are unable to be used straight away in the AFGA's paddy fields. These farm machines need to be modified to fit the local condition of the AFGA's wet paddy fields, particularly for the 2WTs. The iron wheels of the 2WTs have to be modified. Similarly, the disc ploughs also need to be adjusted. With five units of new 2WTs, it will cost more than Rp. 10 million (NZ \$ 1,111).

As a result, the IRSAM was required to seek working capital to finance the initial operation of the IRSAM. To cope with this situation, the management of the IRSAM was communicating this matter with the Argorejo village government. With the full support of the Argorejo village government, the IRSAM was able to access the supporting fund from the village government in the form of credit. The terms of credit were short-term credit, where the IRSAM should return the credit in a year. The supporting fund was essential to cover expenses before services were delivered by the IRSAM because of the limited amount of savings owned by the IRSAM and AFGA. From this point forward, the Argorejo IRSAM has been able to deliver farm machinery services mostly to AFGA farmers.

Access to repair and maintenance services

Access to the repair and maintenance services, particularly in the initial operation of the IRSAM, is essential in shaping the functioning of the IRSAM. As described earlier, the repair and maintenance unit is responsible for conducting regular maintenance of the machinery, such as changing the tractor engine and transmission oil of each tractor, v-

belt transmission replacement, and other simple repairs. As a young IRSAM, the repair and maintenance unit is still improving the service in maintaining the machines. The age of these machines is relatively low (received by the IRSAM in 2015). Therefore, there are no major issues regarding the performance of these machines. Currently, the repair and maintenance unit is operated by a mechanic who is also an operator. This unit owns tools to handle simple repair.

However, as expressed earlier by the manager, there is a requirement for the IRSAM to modify some parts of the 2WTs. In Bantul Regency, other farmer groups commonly experience a situation where farm machinery acquired from the government needs to be modified because of the uniform design provided by the machinery suppliers. The agricultural officer of Bantul Regency confirms:

The standard 2WTs provided by the vendor, which includes the engine and the transmission or gearbox, have no issue to be used by all farmers. However, when it comes to the implements for the tractors, such as disc ploughs, farmers need to modify it according to their needs. Also, farmers will need to add a trailer to the tractor, and most of them are willing to do this modification.

The repair and maintenance unit cooperates with the local artisans around the AFGA neighbourhood, who can assist the mechanic of the IRSAM to modify some of the machinery components or implements to suit the local working area. This cooperation is essential for both parties because the IRSAM can alter the implements in a cheaper way, and the local artisans can earn profits from serving the IRSAM.

Access to spare parts

Access to spare parts for the farm machinery is seen to shape the operation of the Argorejo IRSAM, particularly their relationship with the local agricultural machinery providers. Facilitated by the agricultural officers of Bantul Regency and the agricultural extension officer of Sedayu District, the IRSAM has been able to establish good relationships with local agricultural machinery providers to ensure that they receive after sales service from these manufacturers. The manager and the officers of Bantul Regency and Sedayu District, agree that the producers have provided full support for farmers to access the spare parts. The manager states:

If there is a major repair for the machinery and it requires specific components, the producers will be able to help. In fact, they will handle the major repairs for us.

Similarly, the agricultural officer of Bantul Regency expresses:

The suppliers of these machines are quite helpful. They are willing to visit the farmer groups to provide technical support for them. Sometimes, when farmers report to us regarding the warranty or other issues of the group machines, we convey their concerns to the suppliers.

Access to capacity building

Improving the skills of the manager and the operators in the Argorejo IRSAM through access to capacity building programme is influential in shaping the operation of the IRSAM. At the initial operation of the IRSAM in 2015, the operators received various types of technical training provided by the government and machinery providers. Training is useful for the operators to become familiar with the new machinery, such as the combine harvesters, transplanter and the 4WTs. From that point forward, the operators started to provide services to farmers, along with improving their skills in handling the machines. The manager states:

Usually, we are participating in technical training invited by the government. In that training, we visited other IRSAMs to witness their operators in operating the machines. The 4WT providers also invited us to their workshop in Bandung for a couple of days. We learnt about operating these machines and the maintenance process.

As the organiser of technical training, the government and the machinery providers held training during the year. The agricultural officer of Bantul Regency expresses:

We often held several technical courses in a year, and it is also part of our cooperation with the machinery providers. The machinery providers are ready to deliver the technical training in the farmers' fields free of charge.

Access to agricultural extension services

The role of the agricultural extension officer of the Sedayu District is seen to be important in shaping the operation of the Argorejo IRSAM. The agricultural extension office has good relationships with the IRSAM and AFGA. The officer is found to be able to facilitate

the IRSAM and AFGA in accessing government programmes and technology updates to support their farm operations. The head of AFGA and the manager express that the full support of this organisation has helped AFGA and the IRSAM to grow at its early stage. The head of AFGA also states:

We are pleased that the agricultural extension officer is one of our people, and we have a good relationship with him because he lives here. When we have some issues, we can contact him anytime by phone. We can also use the agricultural extension office to organise the AFGA meeting.

The agricultural officer of Bantul Regency states a similar expression:

The agricultural extension officer of Sedayu District is one of the driving forces in the society around Argorejo village. Fortunately, he lives there, and he is part of the village consultative body.

With the initiative of the extension officer of Sedayu District, the IRSAM can create a schedule for servicing the AFGA's farmers and, the agricultural extension officer assists the IRSAM to expand the network of service outside the village.

Access to rural infrastructure

The rural infrastructure, provided by the government, such as road and irrigation networks affects the operation of the IRSAM. The rural roads, which exist around the Argorejo village, are in good condition. The village is situated near a highway that connects the Special Region of Yogyakarta to the Central Java Province via Purworejo Regency. Most of the roads are hot mixed asphalt pavement and connect the residential areas of the sub-villages in the Argorejo village. With a field of service more than 100 hectares across the sub-villages, these excellent road networks are advantageous to this IRSAM because it reduces the fuel and time consumption of the farm machinery when moving around their clients.

Similarly, the good condition of irrigation networks in the Argorejo village is required to support the service of the IRSAM. With good irrigation networks, the supply of water to the paddy fields can be maintained all year around, particularly during the dry season. As a result, the AFGA farmers can grow paddy three times a year. Therefore, the IRSAM can deliver services three times a year based on the peak demand for machinery services

in each cropping pattern. However, the IRSAM found that the time requirement for farm operation in each of the paddy fields is strongly influenced by the water available in the fields, not merely because of the good irrigation network, but because of rubbish that blocked the irrigation channel. An operator expresses:

With free access and the abundant water available for irrigation, most of the farmers are not paying attention to maintaining the irrigation networks. Sometimes we have to clear the rubbish from the irrigation channel before we start to plough (Operator of the Argorejo IRSAM, 2016).

6.3.3.3 Cooperation with other stakeholders

Cooperation with the private hire service providers

The IRSAM also cooperates with the private hire service providers in Argorejo village. According to the head of AFGA and the manager of the IRSAM, cooperation is the way for the IRSAM to cope with the high demand for machinery services. As most of the operators are at an early stage of learning in using the new machines, this cooperation helps the IRSAM to step-by-step improve the performance of their services to AFGA members. Furthermore, the current operation of the IRSAM is not at its full capacity because of the lack of operators. Therefore, private providers are still able to serve some of the AFGA members, while the Argorejo IRSAM would cover the rest of the area of AFGA paddy fields. The private hire machinery provider states:

It is about the limited amount of time in finishing the land preparation service. Because the demand is so high, and we need to make sure that farmers can transfer their germinated seeds to their paddy field on time, so we work together with the IRSAM.

From this cooperation, the head of AFGA and the manager are creating a service schedule. The head of AFGA states:

We are focusing on fulfilling the demand for machinery service for the AFGA members so that they will not experience any delays in planting the paddy. With the schedule, we will be able to map the service location of the private machinery hire service, and we will deploy our machines to the rest of AFGA members.

6.4 Summary

From both IRSAMs, there are some similarities and differences in the operation of both IRSAMs. Table 14 summarises the results based on several factors, which are indicated in shaping the functioning of both IRSAMs. There is a high demand for machinery hire services in the Argorejo IRSAM as a result of the paddy cropping patterns, which is three times a year. Meanwhile, a different cropping pattern practised by TSFG farmers is resulting in a peak demand for machinery services once a year during the paddy cropping pattern. However, based on the identified factors, both IRSAMs experience similar factors, which influence their operation. Owing to their long experience in delivering services for more than ten years, the Tirto Sari IRSAM seems to have been able to develop the business, compared to the Argorejo IRSAM.

Table 14. Factors which shape the operation of the Tirto Sari IRSAM and the Argorejo IRSAM

No.	Identified factors	Tirto Sari IRSAM in Gunungkidul Regency	Argorejo IRSAM in Bantul Regency
1.	The capability and availability of skilled staff of the IRSAMs (Manager and Operators)	<ul style="list-style-type: none"> - Both IRSAMs showed that the role of the manager in controlling the operation of the IRSAMs is essential. The transparent management implemented by both managers show essential influence in developing the IRSAMs, particularly in using the log book to record all transactions. - The capability and availability of the operators are critical in supporting the operation of both IRSAMs. 	<ul style="list-style-type: none"> - In contrast, it is a challenge for the Argorejo IRSAM to attract more operators to operate the rest of the machines.
2.	The quality control of the services	<ul style="list-style-type: none"> - The Tirto Sari IRSAM shows sufficient availability of the skilled operators in supporting their operations. 	<ul style="list-style-type: none"> - In contrast, the Argorejo IRSAM is still improving the services delivered to farmers.
3.	Support services (access to credit, repair and maintenance)	<ul style="list-style-type: none"> - The support services that are accessed by both IRSAMs, show significant influence in shaping the operation of both IRSAMs. For instance, access to credit is essential for both IRSAMs, particularly during the early operation. The Tirto Sari IRSAM was able to utilise the financial support from the government, and from the private 	

	service, spare parts, capacity building, agricultural extension services, and rural infrastructures)	<p>sector. Similarly, the Argorejo IRSAM was able to access the funding from the village government.</p> <ul style="list-style-type: none"> - Regarding the repair and maintenance services, the Tirto Sari IRSAM has been able to expand the repair and maintenance unit and become a local artisan. Meanwhile, the Argorejo IRSAM can utilise the local artisans around the neighbourhood to conduct the repair and maintenance services. - Both IRSAMs can access spare parts to support the repair and maintenance units. The local governments in both Regencies show their support in facilitating the IRSAMs to access components. Similarly, the role of the agricultural extension officers in both IRSAMs is essential in assisting them to access the government programmes. - Access to capacity building (training) to strengthen the technical and business skills of the operators and the manager are critical for both IRSAMs. The roles of both public and private sectors are essential in delivering the capacity building services to the IRSAMs. - Both IRSAMs benefit from the good condition of the rural infrastructure (road networks and irrigation networks) around their neighbourhood. 	
4.	Cooperation with other stakeholders (other IRSAMs or the private machinery hire providers)	<ul style="list-style-type: none"> - The Tirto Sari IRSAM is cooperating with other IRSAMs around them. The cooperation is beneficial for both parties. 	<ul style="list-style-type: none"> - The Argorejo IRSAM is cooperating with the private providers, which has been delivering machinery services to AFGA farmers for quite some time.

CHAPTER SEVEN: DISCUSSION

7.1 Introduction

This chapter discusses the research findings by comparing and contrasting with the literature. Significant findings are highlighted. Based on the Special Region of Yogyakarta, where two well-performed IRSAMs (the Tirto Sari IRSAM and the Argorejo IRSAM) were selected, this study found four influential factors affecting the operation of the IRSAMs. These are 1) managers with good administrative and finance skills, 2) the availability of capable operators, 3) demand for machinery services from farmers (farmer group members and non-members), and 4) the availability of institutional support from the public and private sectors that enable the IRSAM to flourish. A further contribution this study makes is to highlight that these multiple factors are interlinked in affecting the performance of the IRSAMs. This research also highlights that several characteristics of the cases, for instance, farmers and the IRSAM members are not the poorest farmers, and the local circumstances, such as agro-ecological conditions, cropping patterns, and rural infrastructure, are contributing to the performance of the IRSAMs.

Although many other scholars have identified most of these factors, this study found a new factor that is essential in influencing the demand for machinery services from farmers. This factor is the availability of alternative private providers or other IRSAMs. This factor emerged in this study because it relates to the implementation of the IRSAM programme, where this policy has been in place for 18 years. Through this programme, many other IRSAMs have been established around the study areas marked by the growing number of farm machines distributed to farmers. Additionally, this factor emerged because there is an increased demand for machinery services as a result of less farm labour available around the IRSAMs as well as the fact that farmers are now more accepting of using machinery in farming. This research also found that the formal organisational structure of an IRSAM seems only to exist in the Republic of Indonesia. The clearly defined roles of people in each of their management positions in the formal structure are important in shaping the operation of the IRSAM. This chapter begins with the

description of the characteristics of the case, to provide a context so that it can be compared to similar models in other countries (section 7.2). A discussion follows of the influence of the key factors to the operation of the IRSAMs (section 7.3). Section 7.4 summarises the chapter.

7.2 The characteristics of the cases

This section describes the characteristics of the cases. These specific features and circumstances gave the selected IRSAMs different characteristics from other small-scale machinery services studied in the literature, which affects the way they operate. The IRSAM programme was implemented at the village level and both IRSAMs studied were identified as performing well by local government. Each IRSAM is located in a different regency within the same Province. Both IRSAMs are under the management of farmer groups. The Tirto Sari IRSAM (established in 2003) is under the TSFG, while the Argorejo IRSAM (established in 2013) is under the AFGA. These farmer groups comprise farmers who are not poor because they have discretionary income, which is likely to contribute to their utilisation of machinery services and other inputs in their agricultural production. The farmer group's farms have significantly different soil properties and annual cropping patterns, which influences the seasonal pattern of machinery type and demand used.

Both IRSAMs operated agricultural machinery, which was mainly obtained from government mechanisation programmes. In the case of Gunungkidul Regency, the Tirto Sari IRSAM has been able to add more farm machinery during group development. Both IRSAMs, as small-scale machinery service providers, deliver services to smallholder farmers with small and fragmented land holdings. Most of the services are land preparation and threshing, as these two operations are the main utilisation of farm machinery by smallholders in the research areas. Relative to other provinces in the Republic of Indonesia, both IRSAMs are in an advanced position as these IRSAMs are supported by excellent rural infrastructures, such as rural road networks and irrigation networks, which shape their operations.

7.3 Key factors shaping the operation of the IRSAM

Four key factors have been identified as significant in shaping the functioning of the Tirto Sari IRSAM and the Argorejo IRSAM. These are 1) managers with good administrative

and finance skills, 2) the availability of capable machinery operators, 3) demand for machinery services from farmers (farmer group members and non-members), and 4) the availability of institutional support from the public and private sectors that enable the IRSAM to flourish (see Figure 19). These key factors are also influenced and interlinked with supporting factors. Many scholars have identified these factors, however, most of them tend to highlight one of two individual factors. The contribution of this study, therefore, is that rather than just identify one factor as many other scholars have, the results show that there are multiple interlinked factors that affect the operation of both IRSAMs. These factors are discussed in the following section.

7.3.1 Managers with good administrative and finance skills

One of the four factors identified is the capability and the ability of the IRSAM managers. This research has identified that good administrative and finance skills performed by managers in both IRSAMs shape the operation of the IRSAMs. The managers of the Tirto Sari IRSAM and the Argorejo IRSAM have demonstrated administrative skills, such as creating a schedule for machinery services and assigning operators to deliver machinery services. Furthermore, the managers have sufficient finance skills by performing good record-keeping of the service transactions. This finding is supported by other scholars. Previous studies in the Republic of Indonesia identified as vital skills of a manager in leading the IRSAM, such as work by Ariningsing and Tarigan (2005) in Indramayu Regency, West Java Province and Hamidah and Soedarto (2006) in Gresik Regency, East Java Province. The study by Ariningsing and Tarigan (2005) showed that lack of administrative and finance skills led to unprofitable machinery hire services businesses. The authors found that most of the six IRSAMs, which were operating in wet paddy fields and dry paddy fields in two districts in Indramayu Regency, were unable to perform good administrative record keeping, which was mostly done by the managers. As a result, the IRSAMs were unable to monitor the profitability of the business (Ariningsing & Tarigan, 2005). Meanwhile, Hamidah and Soedarto (2006) found that out of 17 districts in Gresik Regency that participated in the study, only several IRSAMs in four districts were categorised as reasonably profitable IRSAMs. The managers of these units demonstrated sufficient administrative and finance skills, enabling the IRSAMs to be profitable in their business by maintaining the quality of service (Hamidah & Soedarto, 2006).

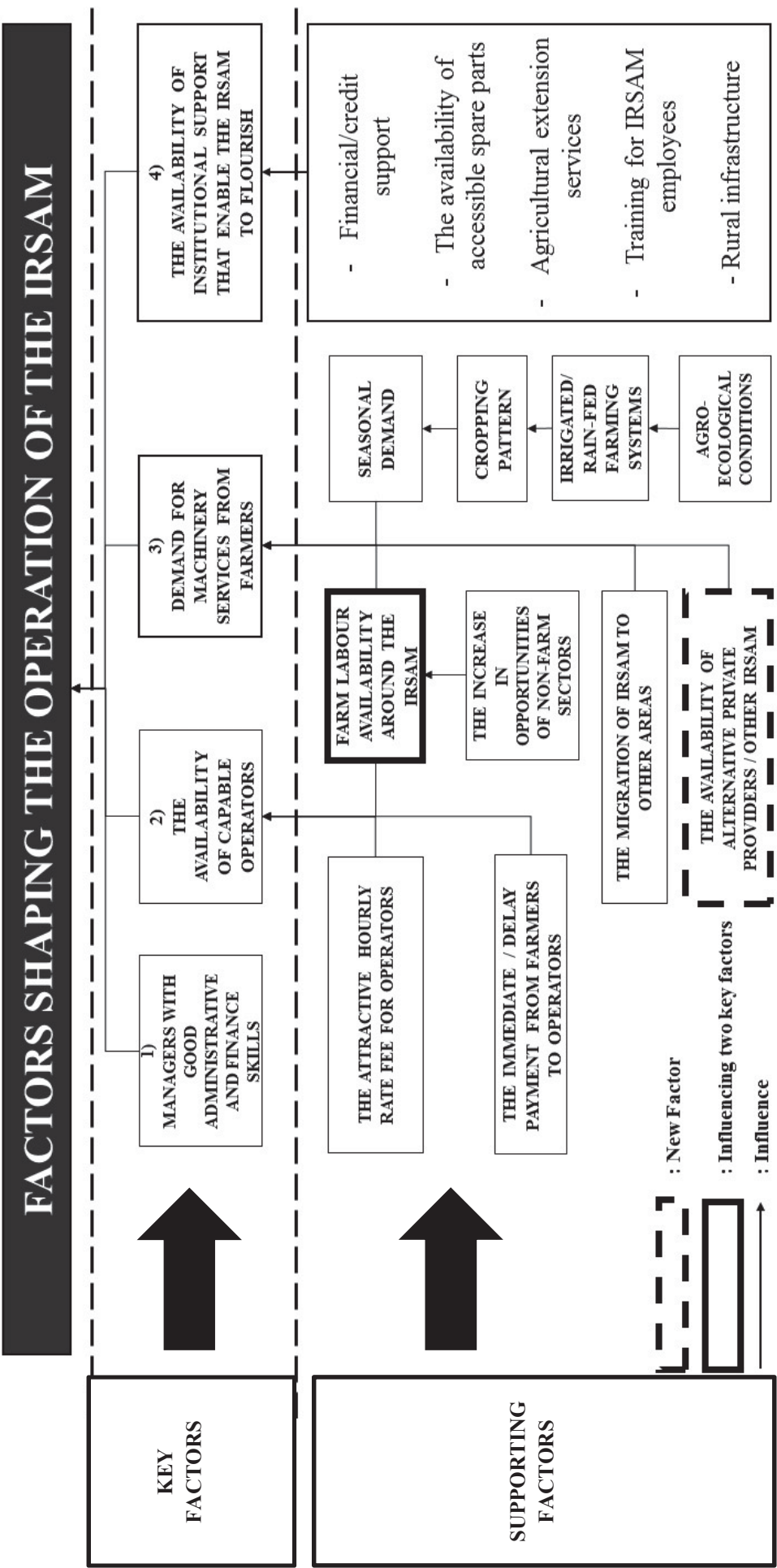


Figure 19. Key factors shaping the operation of the Tirta Sari IRSAM and the Argorejo IRSAM

The capability and ability of the manager in the IRSAM has emerged as an important factor in this study and not in other international studies because the manager is part of the formal structure of the IRSAM and also because the government delivers farm machinery to the IRSAM units. This is one of the unique characteristics of the government led machinery service providers in the Republic of Indonesia. In other studies, like in Ghana, for instance, a similar programme to the IRSAM has been introduced but through a different mechanism. The AMSEC model is designed by the Government of Ghana as private entities without formal organisational structure (Diao et al., 2014). In the case of Ghana, farmers are not managing agricultural machinery given by the government. In contrast, in the Republic of Indonesia, the IRSAMs are responsible for managing the subsidised farm machinery.

According to the IRSAM programme, a formal structure is required as part of the organisational aspects of an IRSAM unit (MoA, 2008). This formal organisational structure consists of a manager, administration staff (a secretary and a treasurer), operators and mechanics (MoA, 2008). As stated by Mayrowani and Pranadji (2012) and Paman et al. (2014), due to the organisational structure of the farmer group machinery services, the role of the manager becomes essential as the leader of the machinery service group. It can be argued that the formal structure of an IRSAM only exists in the Republic of Indonesia. This formal structure tends not to exist in other small-scale machinery service suppliers in other developing countries. Therefore, the clearly defined roles of people in each of their management positions, are important in shaping the operation of the IRSAM.

Additionally, not only the skills of both managers was a factor but also the longevity of these managers in their positions. Both IRSAMs did not have turn over in managers and both managers demonstrated good administrative and finance skills as well as transparent management in managing the IRSAMs. The capability and ability of both managers was contributed to training they were required to undertake at the point of the establishment of the IRSAMs. The government and private sector delivered training programmes to improve the skills of the managers as well as operators. These training programmes are part of the institutional support (discussed in a later section), that contributed to both IRSAMs performing well in delivering machinery services to its members in particular.

Farmer members in both IRSAMs are satisfied with the services, and this has contributed to the good relationship between managers and farmers. In addition, having the same managers in both IRSAMs since establishment has also enhanced their relationship with farmers.

7.3.2 The availability of capable operators

The availability of skilled operators is one of the important factors shaping the operation of the IRSAM. Although some scholars have reported similar findings, the contribution that this study makes is to identify multiple interlinked factors that affected the availability of skilled operators. Looking at both cases, the IRSAMs need proficient operators because they are responsible for operating farm machinery and delivering timely, high quality machinery services to farmers. In Gunungkidul Regency, for instance, a sufficient number of skilled operators in the Tirto Sari IRSAM has allowed the unit to deliver timely machinery services not only for the members of TSFG but also to non-members. In contrast, the lack of skilled operators has been a challenge for the Argorejo IRSAM in Bantul Regency to fulfil farmer demand. These findings are similar to other studies in the Republic of Indonesia (Paman et al., 2010; Yogatama et al., 2002). These authors reported that the availability of skilled machinery operators has been a significant influence on business performance. In the case of Tirto Sari IRSAM and Argorejo IRSAM, the availability of capable operators is interlinked with the supporting factors. The results highlight that there are connections between the availability of skilled operators and farm labour availability, demand of level of remunerations, and payment process from farmers to operators. The next section discusses these supporting factors.

7.3.2.1 Farm labour availability and attractive hourly rate fee for operators

The availability of agricultural labour around the IRSAM influences the supply of farm machinery operators. In both cases, different circumstances are affecting the availability of farm labour. The availability of agricultural labour is affected by the rise of off-farm opportunities in the farming area. When the opportunity for off-farm employment increases, and provides benefits to farmers, they tend to choose this kind of occupation rather than operating machinery. This situation exists in the case of Argorejo IRSAM, where some farmers prefer to work in sand-mining. The hourly rate fee for operators also influences the decision of farmers to become machinery operators. These findings are

consistent with a recent study by Liu and Liu (2016) in suburban Shanghai, China, who found that wages and other factors, such as age, education, and crop prices are significant in influencing the off-farm employment decision for rural households. However, as in the case of the Tirto Sari IRSAM, it can be argued that when the income generated from operating machinery is higher than other jobs around the farmer's neighbourhood, finding trained operators was not an issue for the IRSAM. The Tirto Sari IRSAM offered the operators relatively high fees compared to other jobs around the Karangrejek village. The results also indicate that there are less off-farm employment opportunities in the Karangrejek village, which will influence some farmers to become machinery operators.

A similar situation was found by Paman et al. (2010) in four regencies in Riau Province. Approximately 60% of operators, from 46 machinery service providers, who participated in the study, were hired-operators. Owing to the seasonal demand for machinery services and the contractual characteristics of the job, it was hard for these machinery service providers to find skilled operators because of the limited availability of the trained operators. As a result, the providers needed to increase the hourly rate fee for the skilled operators to get them operating the machinery (Paman et al., 2010). Likewise, a study by Yogatama et al. (2002) in the Special Region of Yogyakarta, found that operators were paid well by the manager to make them stay in business and to encourage them to maintain the quality of work.

7.3.2.2 The immediate/delay payment from farmers

The payment process influenced the availability of the operators around IRSAM. This study highlights different payment processes in the cases, due to different types of farmers and different cropping patterns. In the case of the Argorejo IRSAM, because the payment was not immediate, most of the farmers, who were potential operators, preferred to do another job. The AFGA farmers, who are mostly part-time farmers and only grow paddy, often paid for the services after 20 days, which has implications for the cash flow of the IRSAM. In contrast, in the Tirto Sari IRSAM, the operators were able to stay loyal to the IRSAM because they were paid straight after delivering services. This is because the Tirto Sari farmers are mainly full-time farmers who grow three different crops, including cash crops.

The delay of payment is a common case for smallholder paddy farmers in the Republic of Indonesia because of the limited amount of capital they have. The work of Nasution et al. (2012) and Paman et al. (2014) in Kampar Regency, Riau Province showed similar cases of the delayed payment as experienced by the Argorejo IRSAM. Most of the paddy farmers in Kampar Regency often delayed their payment to the machinery service providers due to their limited cash flow. As a result, it affects the cash flow of the machinery service vendors (Nasution et al., 2012; Paman et al., 2014).

7.3.3 Demand for machinery services from farmers

The demand for machinery services is one of the key factors affecting the operation of the IRSAMs. This factor emerged in this study because it relates to services provided by the IRSAMs and different demand fluctuations caused by various local circumstances in both cases. These circumstances are the agro-ecological conditions, farm labour availability, and the migration of the IRSAMs to other areas, such as to other villages or districts. Although numerous studies have reported some of these factors, this study found a new factor that has previously not been identified. This factor is the availability of other IRSAMs or private machinery providers. This occurred in this study because the IRSAM programme has been implemented for more than 18 years and the use of machinery in farming is well accepted by farmers. This study also highlights the relationships between those factors. The following section discusses these factors.

7.3.3.1 Seasonal demand

The use of machinery services by farmers is affected by the characteristics of the seasonal demand. The seasonality of machinery use is affected by the cropping patterns, which are shaped by different agro-ecological characteristics such as soil properties and water availability in both cases. These conditions influence farmers in implementing different farming systems (irrigated or rain-fed farming systems or a combination of both). These results are in agreement with those of Rahman et al. (2013) in Bangladesh.

The different cropping patterns cause distinct demand patterns for machinery. Cropping patterns have an affect on the demand for farm machinery within a season (Rahman et al., 2013). This demand fluctuation influenced both IRSAMs in serving farmers, particularly in land preparation during paddy growing season and threshing. This situation

is identified by other scholars (Hamidah & Soedarto, 2006; Paman, Inaba, & Uchida, 2012b; Rahman et al., 2013). Paddy cropping pattern creates high demand for machinery services from farmers, which encourages the IRSAMs to perform well in fulfilling the demand. This is because as machinery hire service providers, both IRSAMs earn profits by delivering reliable machinery services to member farmers and non-members. High demand means high utilisation of farm machinery, which, in turn, means more profits made by the IRSAMs.

Both cases show different demand patterns for machinery. For instance, the Argorejo IRSAM tends to serve only member farmers because there is a high annual demand for mechanised land preparation services in the Argorejo village compared to the Karangrejek village, because farmers in AFGA apply the paddy-cropping pattern three times a year. This is also the reason most private providers serve the AFGA members, as this is an opportunity for them when farmers require service at the same time. However, utilisation of machinery over a year might be low for the Argorejo IRSAM, because mostly, the Argorejo IRSAM only serve AFGA farmers during the growing season, while for the rest of the season, machinery is idle. Conversely, even though there are three cropping patterns in the TSFG, they only have one peak demand per year because of the paddy-cropping pattern in the first season. Consequently, with low utilisation of machinery services by the TSFG farmers, the Tirto Sari IRSAM has been able to increase demand by servicing non-member farmers through migration.

7.3.3.2 Farm labour availability around IRSAM

Supply of agricultural labour around IRSAM also influences the demand for machinery hire services from farmers. This factor also affects the existence of capable operators, as mentioned in the earlier section. The results identify that many farmers, especially part-time farmers seek opportunities for off-farm income sources available in their neighbourhood and give some of their farm operations, such as land preparation to machinery service vendors. This also reflects farmers' acceptance of the use of machinery in farming.

In the case of the Argorejo IRSAM, the availability of agricultural labour is decreasing rapidly, which is influenced by the increase in off-farm employment opportunities. In this case, as stated by Pingali (2007), there is a possibility of labour displacement because the opportunity for off-farm employment is increasing. Previous studies found similar results, such as the works of Diao et al. (2014) in Ghana and Yang et al. (2013) in China. These authors revealed that, due to increased opportunities in off-farm sector, the limited availability of farm labour enabled many small-scale farmers to utilise labour-saving technology from hire service providers, particularly mechanised land preparation for growing food crops, such as paddy and maize (Diao et al., 2014). This explains why many AFGA farmers use machinery hire services from the Argorejo IRSAM and the private providers, as the opportunity for higher income is in off-farm employment.

On the contrary, when there is less opportunity for off-farm income sources around them, and agricultural production offers more benefits (as indicated in the full-time farmers with diversified crop production), farmers tend to use farm machinery to increase output and productivity of their farm operations. In the case of the Tirto Sari IRSAM, with its diversified crop production and discretionary income, farmers use farm machinery to improve farm operations by hiring land preparation and threshing services from the IRSAM. A previous study by Takeshima (2015) in the Terai of Nepal found similar results. Additionally, farmers employ the Tirto Sari IRSAM to release some of their time in farm operations to conduct other farm operations. As stated by Pingali (2007) and Paman, Inaba, et al. (2012a), the application of mechanised land preparation shifts the demand for labour from land preparation to other farm operations, such as seeding, transplanting, weeding, harvesting and drying.

7.3.3.3 The migration of IRSAM to other areas

Migration of IRSAMs to other regions also influences the demand for machinery services. For instance, the Tirto Sari IRSAM has been able to increase the hourly utilisation of farm machinery through migration. Therefore, the utilisation of machinery over a year in the Tirto Sari IRSAM is higher compared to the Argorejo IRSAM because the IRSAM provides services across districts. Furthermore, with good cooperation between the Tirto Sari IRSAM and other IRSAMs around Wonosari District, the IRSAM has been able to build a network among IRSAMs and expand the market to serve more clients. According

to Bigot and Binswanger (1987), the migration of machinery service vendors is one of the characteristics of successful tractor-rental operations because, through migration of tractors across agroclimatic zones, it can increase the utilisation of the machines. In local applications, tractors usually have short ploughing seasons (Bigot & Binswanger, 1987). As evidenced in Ghana, because of the local utilisation of machinery service, the AMSEC model has an infeasible operation model, which contributes to the poor performance of AMSEC (Diao et al., 2014; Houssou et al., 2013). Additionally, the limited migration of tractors under AMSEC's management was influenced by a number of factors including providers' lack of knowledge and limited networks outside their regions, lack of support in making the necessary logistic arrangements, and additional costs imposed to supervise operators (Houssou et al., 2013).

The migration of the Tirto Sari IRSAM to increase the utilisation of farm machinery is similar to the effort of professional machinery providers in China, India, and the United States (Binswanger, 1986; Yang et al., 2013). In China, for instance, the migration of specialised businesses of machinery service provision across different agro-ecological zones has led them to increase the demand for machinery services (Yang et al., 2013). The process of migration is also possible because machinery hire suppliers consider different harvesting times for the same crops, such as maize, rice or wheat across different agro-ecological characteristics (Diao et al., 2012).

However, to be able to migrate to particular areas, including long-distance service provision, the providers need to consider road infrastructure and the coordination challenges, particularly when they are servicing small-scale fragmented farmers (Diao et al., 2012). In this case, the Tirto Sari IRSAM benefits from the availability of good road networks around their districts. The rural infrastructure around both IRSAMs is discussed in a later section. In addition, the Tirto Sari IRSAM has demonstrated excellent cooperation with its clients thereby minimising coordination challenges, and gaining benefits as a result.

7.3.3.4 The availability of alternative private providers or other IRSAMs

The presence of alternative machinery service providers, such as private providers or other IRSAMs in the neighbourhood of both IRSAMs is influenced by the demand for

machinery services. The demand cause them to be present. This factor has not been identified in other literature, and emerged in this study for two reasons. The first reason is because in both cases the IRSAM programme has been implemented since 1998. After 18 years of implementation, there is growing number of other IRSAMs established by the government around Gunungkidul Regency and Bantul Regency, marked by the increasing amount of farm machinery distributed to farmers (Statistics of the Special Region of Yogyakarta, 2014). The second reason is that demand for machinery services is increasing because of less farm labour available, especially around the Argorejo IRSAM. This explains why there are some private providers supplying machinery services around the Argorejo village. This situation is interlinked with the cropping patterns that are implemented by most AFGA farmers.

The presence of these alternative providers creates competition among providers to fulfil the farmers' needs. Furthermore, as stated by Paman et al. (2010), this rivalry may affect the service charge rate. Even though, in reality, the situation would be more complex, and it may depend on the population of service providers in a particular area, competition might exist if the demand for machinery services from farmers is low relative to the supply. On the other hand, if the demand for machinery services is high, it is possible that there will be less competition among machinery providers because the supply is insufficient to fulfil the demand. In the case of the Argorejo IRSAM, for instance, during the paddy-growing season, the demand for machinery services is relatively high. Owing to the high demand from farmers, the Argorejo IRSAM and the private providers around the Argorejo village tend to serve AFGA farmers. At times these providers collaborate to get the work done on time, based on the farmers' requests. There is a possibility that the number of operational machinery around the Argorejo village is still insufficient to fulfil the demand for machinery services from farmers, thus less competition occurs among these providers. However, it is highly likely that if all tractors (2WTs and 4WTs) owned by the Argorejo IRSAM are operational, competition will exist. This rivalry will influence the development of the Argorejo IRSAM in the future, as evidenced in a study by Hutahaeen et al. (2005) in Central Sulawesi, the Republic of Indonesia. These authors identified that several IRSAMs were unable to earn profits from operating because of the high tractor density owned by farmers around their neighbourhood, which influenced their market share. Meanwhile, in the case of the Tirto Sari IRSAM, due to the low

demand for machinery services from farmers, there are less private providers around the Tirto Sari IRSAM creating less competition. This explains why the Tirto Sari IRSAM has been able to meet demand from member farmers and increase demand through migrating across the districts.

7.3.4 The availability of institutional support

Availability of institutional support provided by the public and private sectors has also shaped the operation of the IRSAMs. The institutional support services are financial/credit aid, spare parts, agricultural extension services, training programmes, and rural infrastructure. In both cases, these services are in the position of supporting the operation of both IRSAMs to perform well. Other provinces in the Republic of Indonesia or other countries, might have different circumstances regarding the institutional support, which may have different implications. Many scholars have identified various influences of these supporting services to the operation of machinery hire services providers in developing countries, (Miah & Haque, 2015; Mottaleb et al., 2016; Sims et al., 2011; Sims & Kienzle, 2009; Takeshima et al., 2014; Takeshima, Nin Pratt, & Diao, 2013). However, a contribution this study makes is to highlight the relationship between institutional support services with other factors identified earlier. The next sections discuss these supporting services.

7.3.4.1 Financial/credit support

The findings highlight that the availability of financial aid is identified to be substantial in supporting the operation of both IRSAMs, particularly during the initial establishment phase. At the early stage of development, both IRSAMs had limited amounts of capital to fund initial activities of the businesses. With this limited amount of capital at the early stage of the IRSAM development, it is highly likely that the unit would be unable to flourish. A study by Nasution et al. (2012) in Kampar Regency, Riau Province, identified that lack of capital hindered the operation of IRSAMs. The Tirto Sari IRSAM was able to utilise some government financial support to buy a 2WT and started their business by using the rest of the government financial assistance for initial operating costs. Meanwhile, the Argorejo IRSAM was able to source funding aid from the village government to start their initial operation. Both IRSAMs demonstrated the critical role of financial assistance in the start up of their business operations. This finding is consistent

with the results of Takeshima et al. (2014) who revealed that government subsidy is likely to be substantial for many small-scale tractor owners in Kaduna and Nasarawa States, Nigeria, particularly to overcome investment constraints.

Furthermore, with the ability to develop the business to earn more profits from farmers, the Tirta Sari IRSAM was able to expand their assets since 2003 by sourcing more financial support, from either the government or the private sector. It has been suggested that when the business is profitable, the IRSAMs tend to source more funding to extend their assets. The findings are in agreement with a study by Miah and Haque (2015) in selected sites in Bangladesh, who revealed that there was an increase in access to institutional credit facility by the service providers of PTOS after the business is proven to be profitable at the farm level. This research shows that the availability of financial support from the government and or private sector is essential to the IRSAMs. However, the support should be targeted to stimulate the mechanisation process and based on the demand (Sims & Kienzle, 2016). Additionally, financial support should be kept relatively small to avoid rent-seeking behaviour (Takeshima et al., 2014).

7.3.4.2 The availability of accessible spare parts

Both IRSAMs were able to access machinery components essential for maintaining farm machinery fleets. The availability of accessible spare parts is necessary to ensure an extended productive life of agricultural machinery. If machinery components are unavailable and cannot be accessed by the IRSAMs, it would influence the efficiency of farm machinery operations, which affects services delivered by the units. Many studies, especially in developing countries, have shown the crucial role of available spare parts in supporting the operation of farm machinery (Houssou et al., 2013; Miah & Haque, 2015; Paman, Inaba, et al., 2012a). These authors agreed that inability to access spare parts is a contributing factor to delays in repair causing frequent tractor breakdowns and causing tractors to sit idle.

The proximity of their location to several spare part depots located in the Regency capital and the road networks infrastructure enhanced the accessibility of both IRSAMs to machinery components. Both IRSAMs are situated relatively close to the Regency capital where the road networks are good. However, in some parts of the Republic of Indonesia,

it may be a challenge for IRSAMs to access machinery spare parts because they are far from spare parts depots and/or their road infrastructures are poor. A study by Paman, Uchida, et al. (2012) in Riau Province, found that because many spare parts depots are located in the Regency capital, many machinery service providers had trouble in accessing machinery components. Furthermore, due to lack of spare parts depots and maintenance and repair facilities in the survey areas, there are delays in repair work of tractors and the price of components are raised (Paman, Uchida, et al., 2012).

Additionally, the service provided by the government and private sector affects both IRSAMs in accessing machinery components. Local governments are reasonably supportive in facilitating the IRSAMs to contact the private sector (a local machinery producer) as the supplier of spare parts. Suppliers are important, especially when the IRSAM is looking for specific components, which may not be available in the local market. This essential role of the government in providing access to components is evidenced in Iraq. A study by Bishay (2003) in southern and central Iraq reported that government intervention by the private sector had resolved the problems of machinery service providers in accessing spare parts. By importing machinery components and distributing it through warehouse systems, the public and private sector ensured many machinery service providers access to spare parts, which was previously one of the biggest problems of many old tractor fleets in the surveyed areas (Bishay, 2003).

7.3.4.3 Agricultural extension services

The presence of agricultural extension services in the Argorejo village, and the Karangrejek village affected the operation of both IRSAMs. In both cases, extension agents were active participants in disseminating information and assisting the units to grow by facilitating them in accessing government programmes. In the Tirta Sari IRSAM case, the extension agents have been able to facilitate the IRSAM in accessing financial support. Moreover, the extension agents frequently visit the IRSAM and Tirta Sari farmer group. Similarly, to assist the Argorejo IRSAM to develop the business, extension agents have facilitated the Argorejo IRSAM through training programmes, numerous meetings, and visits. Furthermore, because the extension agent lives in the Argorejo village, it adds to the frequency of contact.

As evidenced by many scholars, contact with extension agents and vice versa is essential in influencing the adoption of technology (Bagheri & Ghorbani, 2011; Folefack, 2015; Ghosh, 2010; Miah et al., 2016; Owombo et al., 2012). The extension agents and the IRSAM employees have regular interaction at least once a month, and the proximity of the IRSAMs and farmer groups with the extension office leads to frequent contact between farmers and the extension agents. In the Republic of Indonesia, the agricultural extension services are under the responsibility of the government (Herianto et al., 2010). With the decentralisation policy, agricultural extension offices are established in almost every district in the country. In both cases, there is one extension office in each district (Sedayu District and Wonosari District). This explains the frequent contact of the extension agents to both farmer groups and the IRSAMs.

Additionally, the excellent condition of rural road networks around the IRSAMs allows them easy access to agricultural extension services. The availability of the road networks enables farmers to meet the extension agents at their office easily, and the extension agents can visit the farmers regularly. The results are in agreement with a study by Mottaleb et al. (2014) in Bangladesh. As reported by Mottaleb et al. (2014), the condition of rural road infrastructure augments the flow of information between farmers and agricultural extension officers who can frequently visit farmers. This explains the frequent visits of the extension officers of Wonosari District to TSFG and the extension officers of Sedayu District to AFGA.

7.3.4.4 Training for the IRSAM employees

The results show that training for the IRSAM employees is a major factor affecting the performance of both IRSAMs. The managers and operators of both IRSAMs have received numerous types of training from the government and private sectors. These training programmes include business and technical aspects of the IRSAM management (MoA, 2011). One of the most significant training programmes in strengthening the skills of the managers and operators was the first training they have to undertake at the point of the establishment of the IRSAMs. This first training session delivered by government is part of the IRSAM programme in strengthening the skills of the programme recipients (MoA, 2011). From this first training programme, the managers and operators of both IRSAMs gained knowledge in business and technical aspects required to run a machinery

service business. Many scholars agreed that training is essential to enhance knowledge of managers and operators in operating the machine hire business, which influences the performance of delivered services (Akinfiresoye & Agbetoye, 2013; Miah & Haque, 2015; Paman et al., 2014; Paman, Uchida, et al., 2012; Yogatama et al., 2002). Furthermore, knowledge and technical skills that they have gained will make them more competitive, as clients will regard them as competent in their work (Sims et al., 2011). This explains why most of the farmers in both IRSAMs are satisfied with their services resulting in good relationships between the managers and farmers.

7.3.4.5 Rural infrastructure

Rural infrastructure, including road and irrigation networks, is an essential factor positively affecting the performance of both IRSAMs. Rural infrastructure in both IRSAMs is in excellent condition. For instance, optimal rural networks have supported the Tirta Sari IRSAM to migrate across districts to serve non-member farmers. Similarly, the good condition of road networks around the Argorejo village allows the Argorejo IRSAM to have easy access to serve the eight farmer groups under AFGA. As highlighted by Sims et al. (2011), excellent condition of rural road networks can reduce fuel consumption and time required when moving from one field to another. In contrast, poor condition of road networks negatively influences the time required and fuel consumption of the agricultural machinery (Sharma et al., 1998; Sims & Kienzle, 2009). A study in Riau Province revealed that poor condition of road infrastructure affected tractor service providers to reach fragmented fields, which affects the annual use of machinery services of the vendors (Paman et al., 2010). In contrast, excellent condition of rural networks has enabled some hire providers to travel a long distance, ranging from 3 km to 5 km to neighbouring villages to provide services to farmers (Paman et al., 2010).

Although both farmer groups have significant differences in the way they access water for irrigation, relatively good irrigation infrastructure exists around them, which has positively affected the performance of both IRSAMs. This irrigation infrastructure has been able to provide a sufficient amount of water to irrigate paddy fields, especially during the dry season, which affects the use of farm machinery, such as land preparation. As evidenced in Kampar Regency, Riau Province, poor irrigation infrastructure in the

paddy irrigated fields has caused farmers to suffer from water shortage and were unable to grow paddy during the dry season (Paman et al., 2014).

Irrigation infrastructure is interlinked with cropping pattern. As stated by Takeshima (2015) and Paman et al. (2010), improving the condition of irrigation infrastructure would increase cropping intensity, such as paddy, which affects the propensity to hire tractor services because in using tractors, farmers are combining irrigation with mechanised land preparation. With excellent irrigation infrastructure, the AFGA farmers have been able to maintain cropping intensity on paddy three times a year and create a high demand for machinery services. Meanwhile, in the case of the Tirta Sari IRSAM, the good condition of irrigation infrastructure has been able to support farmers in developing three cropping patterns (paddy, maize and groundnuts, and vegetables). However, the implementation of this different crop rotation is not automatically creating high demand for machinery services in a year. It is because the TSFG farmers are still using hand tools in producing maize, groundnuts and vegetables. The TSFG farmers tend only to use tractors for land preparation for growing paddy.

Farmers are reported as using machinery to land preparation in conjunction with low-cost irrigation (Takeshima, 2015). However, in this research, farmers use machinery irrespective of irrigation costs. In the case of TSFG, even though farmers have to pay for irrigation, higher costs to access water did not seem to influence them in water use. This situation might have a connection with their status as full-time farmers and their cropping pattern, where productive farm activity exists in TSFG farmers, and they have no issues in investing their money to increase farm output.

7.4 Summary

In this chapter, there were multiple factors that affect the operation of both IRSAMs and they were interlinked. These factors were discussed and compared to the literature to show the relationships between these factors on the operation of the IRSAMs. Four key factors have been identified in shaping the functioning of both IRSAMs. These are 1) managers with good administrative and finance skills, 2) the availability of capable operators, 3) demand for machinery services from farmers, and 4) the availability of

institutional support from the public and private sectors that enable the IRSAM to flourish.

Although most of these factors have been identified in other literature, significantly, this research highlights one factor that have previously not been identified. This factor was the availability of alternative private providers/other IRSAMs around the selected IRSAMs. This factor affected the demand for machinery services from farmers as it created competition among vendors. This study highlighted that the amount of other machinery service providers around the IRSAMs is affecting the growth of the IRSAMs. Furthermore, the formal organisation structure of the IRSAM seems only to exist in the Republic of Indonesia, which makes the defined roles of people in the management positions important in shaping the operation of the IRSAMs.

This research also highlighted that the role of the government and the private sectors was important in providing essential institutional support to create an enabling environment for the IRSAM to grow. The institutional support has enabled the IRSAM to access financial aid, spare parts, agricultural extension services, and training so that they were able to develop their business. The role of the government in providing rural infrastructure (road networks and irrigation networks) was also significant in shaping the operation of the IRSAM.

From the discussion, it seems that the local circumstances and the unique characteristics of the cases have contributed to the emerging factors influencing the performance of both IRSAMs. Moreover, as stated by Bigot and Binswanger (1987), the characteristics of mechanical technology is sensitive to agro-climatic factors and economic factors. Therefore, different circumstances and conditions of agro-ecological and social-economy in a particular area are going to mean that factors influencing the operation of an IRSAM will vary, be interrelated, and dynamic. Public interventions with a goal of promoting agricultural mechanisation at the farm level, such as the IRSAM programme need to consider the different circumstances and local characteristics to make the programme sustainable. Failure to consider local customs and economic conditions is likely to result in ineffective introduction of mechanisation on small farms (Sutter, 1974).

CHAPTER EIGHT: CONCLUSION

8.1 Conclusion

This research seeks to understand how the IRSAM programme is applied across different areas of the Republic of Indonesia. In particular, the research is focussed on understanding the various factors that shape the operation of the IRSAMs. It aims to provide recommendations and some insight as to how the MoA may be able to improve the IRSAM programme. By questioning “What factors shape the operation of the IRSAM and how these factors affect the operation of the IRSAM”, the research sets three objectives. First, to identify and describe the functioning of the IRSAMs in the Special Region of Yogyakarta. The second and third objectives were to identify factors, which shape the operation of the selected IRSAMs, and to explore how the factors influence the activities of the IRSAMs. A multiple case studies approach has been used to achieve these objectives.

The research has identified four key factors that shape the operation of both IRSAMs. These were: 1) managers with good administrative and finance skills, 2) the availability of capable machinery operators, 3) demand for machinery services from farmers, and 4) the availability of institutional support from the public and private sectors that enable the IRSAM to flourish. Other interrelated factors supported these key factors.

The research has identified that the formal organisation structure of the IRSAM seems only to exist in the Republic of Indonesia. The formal structure has made the roles of the manager and operators important in influencing the operation of the IRSAM. The research highlights the significance of having skilled managers, who have good administrative and finance skills to lead the IRSAM so that the business can earn profits. Furthermore, capable operators are needed to operate farm machinery and to deliver services to farmers. Moreover, the availability of capable operators is also essential to ensure that the IRSAM can provide timely machinery services. Various training programmes provided by the government and private sector have enabled the manager and operators to become competent IRSAM employees, which affects the operation of the business.

Demand for machinery services from farmers has been identified as being vital in shaping the operation of the IRSAM. Consistent with other literature, some supporting factors influenced this factor, including the characteristics of the seasonality of agriculture (influenced by cropping patterns, farming systems, and agro-ecological conditions), the availability of agricultural labour, and the extended migration of IRSAM to other areas. Additionally, this research highlights the impact on IRSAM performance of the availability of alternative private providers. Having to compete with other providers contribute to better performance of the IRSAMs.

The study has shown that the role of the government and the private sectors is important in providing essential institutional support to create an enabling environment for the IRSAM to flourish. The institutional support enabled the IRSAM to access financial assistance, spare parts, agricultural extension services, and training programmes in order to develop their business. In addition, the role of the government in providing rural infrastructure (road networks and irrigation networks) is also significant in shaping the operation of the IRSAM.

8.2 Policy implication of the research findings

This research has illustrated that there are local circumstances and unique characteristics of the business environment that are going to mean that the specific factors and circumstances that are shaping the performance of small-scale machinery hiring groups will vary. Moreover, the circumstances are complex and interrelated. Furthermore, the characteristics of mechanical technology, which are sensitive to agro-ecological or environmental conditions and socio-economic conditions, are also taking part in influencing the operation of the hiring groups.

Rather than arguing for context-specific policy for machinery hire, this research suggests that the existing blanket policy enables IRSAMs with varied characteristics and local circumstances to perform well. However, aspects of the policy have been highlighted as having potential for improvement. Targeting types of machinery to match specific needs of farmers in different areas could lead to more efficiencies in the performance of the IRSAMs.

In addition, this research provides two interesting examples of the different conditions of the off-farm employment opportunities that influence the farm labour availability around the IRSAM, which affects the operation of both IRSAMs. The presence of off-farm alternative sources of income in their areas has influenced farmers' decisions in selecting an off-farm job compared to a farm job. In this situation, some dynamics may occur including labour substitution, labour shifting, and labour displacement, where all of these will influence the particular impact that contract machinery has on labour within the community. Therefore, as mentioned earlier, that with the complex and dynamic situations, which will vary in other parts of the Republic of Indonesia, the government could consider different local circumstances and settings in implementing agricultural mechanisation interventions.

8.3 Recommendations

The research has put forward two recommendations for improving the IRSAM programme implementation.

1. The government could pay more attention to the local circumstances and unique characteristics of the situation across the country, because specific factors and circumstances that are shaping the performance of machinery hiring group will vary. By better targeting the IRSAM programme to meet the local circumstances, there is a possibility that the implementation of the IRSAM programme will be able to promote the utilisation of machinery at the farm level. This may contribute to the desired level of increase in agricultural production and productivity, as part of the critical role of agricultural mechanisation in the Republic of Indonesia.
2. The government should obtain information from the farmers (the IRSAM) and private providers regarding the total number of operating machinery service providers in the region, so that the government will be able to understand the real supply and demand of machinery services. The figure will assist government to promote new IRSAMs in a particular area, or to mobilise underutilised machinery hire providers to migrate to other districts that lack providers. Therefore, this study suggests the government establish a database management system of public and private machinery hire services.

8.4 Evaluation of the research design

This section provides an assessment of the research design that was used to answer the research question. The assessment includes the appropriateness of the research design and aspects that could be improved. The case study approach was found to be appropriate for identifying and exploring the factors that shape the operation of the IRSAM in the Special Region of Yogyakarta. Using case studies as a research strategy was appropriate because this research was looking for an in-depth understanding of various factors and the local settings in both IRSAMs located in two different districts with different agro-ecological conditions.

During the process of data collection, some challenges occurred. It was difficult for the researcher to interview the elites (high-rank officials); they were very busy, and it was hard for the researcher to coordinate with their schedules. However, this challenge was resolved by contacting the high-rank officials in advance of the interviews. The researcher also encountered some of the participants who seemed to be very careful in conveying their perspectives, and this may have affected the depth of information that the researcher obtained.

The combination of using semi-structured interviews, FGDs and document analysis was found to be appropriate and useful to help the researcher to capture the situation and the nature of the IRSAM programme implementation, starting from the national level down to the villages. Purposive and snowballed sampling was appropriate and useful in helping the researcher to identify major participants to participate in the research. Furthermore, the application of the voice recorder was vital to record extensive information conveyed by the participants during interviews and FGDs. It also helped the researcher to focus on establishing eye contact with the participants, which was important rather than writing the relevant information provided by the participants. Furthermore, with the voice recorder, the researcher was able to revisit the essential information to confirm the summary of data. Data analysis was conducted by implementing the qualitative data analysis (QDA). QDA was crucial and appropriate to find categories and emerging themes. It also allowed the researcher to identify relationships or influences between categories and topics.

8.5 Further research

From the findings, this research raises other areas worth exploring as future studies.

1. The samples of this research were two well-performing IRSAMs in two different regencies with various agro-ecological conditions. Expanding the size of samples in both regencies by looking at underdeveloped IRSAMs, would be ideal in capturing other critical factors that shape the operation of the units, along with identifying the disabling environment that contributes to the low performance of the units. The findings of this future research could be significantly useful for the government in preparing countermeasures.
2. In this research, the characteristics of the household were not rigorously investigated. There is a need to explore further the influence of various household characteristics on demand for machinery services and the availability of farm labour. Understanding the characteristics of the household would be essential in explaining the level of mechanisation in a particular area. This information could assist the government in improving the IRSAM programme.

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APPENDICES

Appendix 1: List of Interviewed Participants

Table 15. List of interviewed participants

No	Name of Organisation	Interviewee's Position	Role of organisation	Level of Administrative and Group Representation
1.	The Indonesian Centre for Agricultural Engineering Research and Development (ICAERD), Indonesian Agency for Agricultural Research and Development (IAARD) – the Ministry of Agriculture (MoA)	A senior researcher	To conduct research and development about agricultural machinery	National level / public sector
2.	The Directorate of Agricultural Tools and Machinery (DTM), Directorate General of Agricultural Infrastructure MoA	A section head of the Sub-directorate of Estate Crops and Livestock Machinery	To roll out the national policy of agricultural machinery, including the IRSAM programme	National level / public sector
3.	The National Centre for Agricultural Training (NCAT) MoA	A section head of the Sub-Directorate of Training Organizer	To provide training and extension services to farmers	National level / public sector
4.	The Department of Agriculture of the Special Region of Yogyakarta (DAY)	Head of the Division of the Agricultural Infrastructure for Food Crops	Executing agency of the agricultural machinery policy	Provincial level / public sector
5.	CV. QUICK Karya Hidup Sentosa	A sales manager	Local agricultural machinery producer	Provincial level / private sector
6.	The Department of Agricultural Engineering and Biosystems (DAEB), Gadjah Mada University	A senior lecturer of farm management and agricultural engineering	Academic	Provincial level / public sector
7.	The Regency Office of Food Crops and Horticulture of Gunungkidul Regency	Staff of the Division of the Agricultural Infrastructure for Food Crops	Executing agency of the agricultural machinery policy	Regional level / public sector

No	Name of Organisation	Interviewee's Position	Role of organisation	Level of Administrative and Group Representation
8.	The Regency Office of Agriculture and Forestry of Bantul Regency	A section head of the infrastructure for agricultural production and statistics	Executing agency of the agricultural machinery policy	Regional level / public sector
9.	Tirto Sari IRSAM in Wonosari District, Gunungkidul Regency	A manager and operators	Machinery hire service provider	Village level / private sector
10.	Tirto Sari Farmer Group in Wonosari District, Gunungkidul Regency associated with Tirto Sari IRSAM	Head of the farmer group and its members	Users of machinery hire service	Village level / private sector
11.	Agricultural Extension Agency in Wonosari District, Gunungkidul Regency	An extension officer	To provide training and extension services to farmers	Village level / public sector
12.	Argorejo IRSAM in Sedayu District, Bantul Regency	A manager and operators	Machinery hire service provider	Village level / private sector
13.	Argorejo Farmer Group Association (AFGA) in Sedayu District, Bantul Regency associated with Argorejo IRSAM	Head of the farmer group and its members	Users of machinery hire service	Village level / private sector
14.	Agricultural Extension Agency in Sedayu District, Bantul Regency	An extension officer	To provide training and extension services to farmers	Village level / public sector
15.	An individual entrepreneur who hires agricultural machinery in Argorejo Village, Sedayu District, Bantul Regency	An owner and an operator of machine hire service provider	An individual machinery hire services provider	Village level / private sector
16.	A farmer who is not a member of AFGA in Argorejo Village, Sedayu District, Bantul Regency	A farmer	Users of machinery hire service	Village level / private sector

Appendix 2: Interview Guidance

INTERVIEW GUIDANCE

THE AIM OF THE RESEARCH

The research is interested in understanding the implementation of the IRSAM programme that has been applied to different areas of the Republic of Indonesia to highlight the different factors that are shaping the outcome of the programme implementation.

THE OBJECTIVES

The research focuses on gaining insights of the different circumstances that had changed over a decade in shaping the contribution of particular IRSAMs and how they were working on those factors. By understanding the different factors that shape the operation of the IRSAMs, there would be a possibility for the research to provide recommendations and some insights on how the MoA will be able to improve the IRSAM programme.

Kind of information the researcher wants to find:

- a. How does the government at the national, provincial and regional levels roll out the programme? This question can be answered by understanding:
 - The broader government agenda about the IRSAM programme.
 - Some assumptions the government used to determine the classification of the IRSAMs and the goal of creating the classification.
 - Some of the benefits and constraints the government is currently facing about the programme implementation.
- b. How do the IRSAMs and farmer groups view the programme? This question can be answered by understanding:
 - Some of the motivations that make farmers have an interest in running the IRSAMs and in using the service of the unit.
 - Some of the benefits and constraints the farmers are facing in running the IRSAMs and using the service of this unit.

Some of the interview questions for the participants are presented below. The researcher will use these questions to guide the interviews. However, the researcher will be open to relevant information generated by each participant during the interviews.

Table 16. Interview guidance

No	Actors	Theme	Topic	Information to be covered by the interviewee	Possible questions
1.	<p>The MoA at the national level</p> <ul style="list-style-type: none"> - A senior researcher at the Indonesian Centre for Agricultural Engineering Research and Development (ICAERD) - A section head of the Sub-directorate of Estate Crops and Livestock Machinery - A section head of the Sub-Directorate of Training Organiser 	<p>a. Background and history of the IRSAM programme</p>	<p>Circumstances under which the IRSAM programme was introduced</p>	<ul style="list-style-type: none"> • The reasons why the IRSAM programme was established. • The relationship of IRSAM programme with the broader agenda of agricultural development strategy set by the MoA and what are their goals (improve production and productivity, secure food supply. • Some assumptions used in the IRSAM programme, such as the IRSAM classifications and farmer's criteria as the programme recipient. Does the national MoA coordinate with the MoA at the provincial and the district? • The reasons the government determines the farm machinery specification (types and units) to be given to farmers and how this machinery is purchased and delivered to farmers. What is the procurement procedure for purchasing agricultural machinery? • The way the government assesses the ability of farmers and the IRSAMs to manage the subsidised machinery 	<ul style="list-style-type: none"> • From your perspectives, when was the programme started? • Who is involved? • How are they involved? • Why are they involved? • What do they do?
		<p>b. Process of the IRSAM Development</p>	<p>The way government rolls out the IRSAM programme</p>	<ul style="list-style-type: none"> • How has the IRSAM programme been developed since 1998? • The benefits and constraints of the implementation of IRSAM programme. 	<ul style="list-style-type: none"> • How is the programme being rolled out? Was rolled out?

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<p>2.</p> <p>The MoA at the provincial level</p> <ul style="list-style-type: none"> - Head of the Division of the Agricultural Infrastructure for Food Crops of the Special Region of Yogyakarta 	<p>a. Process of the IRSAM Development</p>	<p>The way the provincial government translates the national IRSAM programme</p>	<ul style="list-style-type: none"> • The translation of the IRSAM programme into the provincial programme and the relationship of IRSAM programme with the provincial agenda of agricultural development strategy and what are their goals (improve production and productivity, secure food supply at the regional level?) • The coordination process of the MoA at the provincial level with the district. • Supervision, monitoring, and evaluation activity conducted by the MoA at the provincial level. • The benefits and constraints of the IRSAM implementation. 	<ul style="list-style-type: none"> • How is the programme being rolled out at the provincial level?
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Appendices

3.	<p>The MoA at the regional level</p> <ul style="list-style-type: none"> - Staff of the Division of the Agricultural Infrastructure for Food Crops) of the Regency Office of Food Crops and Horticulture of Gunungkidul Regency - A section head of the infrastructure for agricultural production and statistics of The Regency Office of Agriculture and Forestry of Bantul Regency 	a.	Process of the IRSAM Development	The way district government translates the IRSAM programme	<ul style="list-style-type: none"> • The translation of the IRSAM programme in the district agenda of agricultural development strategy, what are the district goals (improve production and productivity, secure food supply at the regional level?) • Supervision, monitoring, and evaluation activity conducted by the MoA at the district level. • The benefits and constraints of the IRSAM implementation. • How does the district office coordinate with the farmers and IRSAMs regarding rolling out the programme? What kind of activity (training, workshops, or what?) • How does the district office assess the farm machinery requirement and assess the development of each IRSAM at the district level? 	<ul style="list-style-type: none"> • How is the programme rolled out at the provincial level?
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Appendices

4.	<p>IRSAMs</p> <p>- A Manager of the IRSAM</p>	a. Background and history of an IRSAM	Formation of IRSAMs	<ul style="list-style-type: none"> • The reason why this IRSAM was established (farmer's or farmer group's motivation). • What drives farmers to accept a machinery subsidy from the government? • How long have the manager and operators been involved in the IRSAM business? 	<ul style="list-style-type: none"> • Can you tell me about the formation of this IRSAM?
		b. The development of an IRSAM	Organisational aspects	<ul style="list-style-type: none"> • Does the IRSAM have a complete organisational structure, such as a manager, a secretary, a treasurer, operators, and mechanics? If it is not, why? • How long have these individuals been running the IRSAM business? 	<ul style="list-style-type: none"> • Can you tell me about the organisational structure and the role of each personnel of this IRSAM?

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			<p>Technical and Business Aspects</p>	<ul style="list-style-type: none"> • How many machines and types managed by this IRSAM? What is the total capacity of each farm machinery? Moreover, what are the types? How do you obtain this machinery? Are these machines meeting your expectations? Was this machinery what the IRSAM wanted? Is there any additional farm machinery bought by the IRSAM? If yes, why? • How has this IRSAM run their daily services? How large is the service area of the IRSAM? • How long does the farm machinery run its service during planting season or per year of operation? • How much does the user pay for a farm machinery service? • How much are the maintenance costs and repair cost of each piece of farm machinery? • What other means and infrastructure are there to support the operation of IRSAM, such as road infrastructure, irrigation networks, repair workshops, warehouse, tools and other implements? 	<ul style="list-style-type: none"> • Can you tell me about the services provided by this IRSAM? • Who is your client? Individual farmer or farmer groups? Are there any differences in delivering services to non-member farmers? • What are the benefits of running this business? • Are there any constraints in running this business? • What do you think about farmers' opinions regarding your service? • What kind of training programme have the managers and operators had participated? Who runs the training?
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Appendices

5.	Farmer groups - Head of a farmer group	<p>a. Background and history of farmer groups</p> <p>b. The process of using the service of an IRSAM</p>	Formation of farmer groups	<ul style="list-style-type: none"> What is the motivation of forming a farmer group? Benefits of becoming a farmer group. 	<ul style="list-style-type: none"> Can you tell me about the formation of this group?
				<ul style="list-style-type: none"> What is the motivation of accessing a machine hire service? Who is influencing you in accessing the IRSAM service? Who do you get information from? Benefits (improve production, improve income or anything else?) 	<ul style="list-style-type: none"> Can you tell me what makes you or your group access the IRSAM services? What are the benefits you receive from using the IRSAM services? Whom do you have a relationship with? What is your relationship with the other actors, such as a rural bank, provincial and district officials, universities, and extension?
6.	Individual farmers (non-members of a farmer group)	a. Farming system	The nature of farming system	<ul style="list-style-type: none"> What is influencing the farmer in engaging with a farmer group? What is the benefit of becoming part of a farmer group? Farm operation: land preparation, planting, spraying, threshing, or transportation. 	<ul style="list-style-type: none"> What are your farm operations? Do you engage with a farmer group? If yes, why?

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		b. The process of using the service of an IRSAM		<ul style="list-style-type: none"> The motivation of using farm machinery to assist farmers in their farm practices (the history) The reason for accessing the IRSAM services (cheap access to farm machinery?) What are the challenges for farmers regarding the use of machinery? 	<ul style="list-style-type: none"> What type of machinery do you currently use? Do you access machinery services from the IRSAM unit? If yes, why? If not, why not? Who fixes this piece of machinery if it needs repairing?
7.	A sales manager of a local machinery producer	a. The process of implementing the IRSAM programme	Supplying farm machinery	<ul style="list-style-type: none"> The role of a local machinery producer, such as supplying machinery, providing spare parts, delivering technical training to managers and operators of IRSAMs, providing after sales service or credit scheme to farmers. 	<ul style="list-style-type: none"> What do you think about the IRSAM programme? What is the contribution of a local machinery producer except supplying the machinery to the IRSAMs?
8.	The agricultural extension officers in both regencies	a. The process of implementing the IRSAM programme	The way government rolls out the IRSAM programme	<ul style="list-style-type: none"> The role of the agricultural extension agency in supervising the programme, such as conducting monitoring and evaluation, training, workshops, or coordination activity with other actors? 	<ul style="list-style-type: none"> How is the programme being rolled out at the regional level?
9.	A senior lecturer of farm management and agricultural engineering in the Department of Agricultural Engineering, Gadjah Mada University	a. The process of implementing the IRSAM programme	The way government rolls out the IRSAM programme	<ul style="list-style-type: none"> Contribution: training, workshops, demonstration in operating machinery and supervision of the programme. 	<ul style="list-style-type: none"> Can you tell me about the IRSAM programme? What is the contribution of your department in this programme?

Appendices

10.	An individual entrepreneur who hires agricultural machinery	<p>a. Background and history of an individual machinery service provider</p> <p>b. The development of an IRSAM</p>	Formation of an individual machinery service provider	<ul style="list-style-type: none"> The reason why this business unit was established (motivation of the individual entrepreneur) How long have you been involved in the machinery hire services business? 	<ul style="list-style-type: none"> Can you tell me about the formation of your business unit?
			Technical and Business Aspects	<ul style="list-style-type: none"> How many machines and types managed by this unit? What is the total capacity of each farm machinery? Moreover, what are the types? How do you obtain this machinery? Are these machines meeting your expectation? Is there any additional farm machinery bought by your unit? If yes, why? How do this unit run their daily services? How large is the service area of your business unit? How long does the farm machinery run its service during planting season or per year of operation? How much does the user pay for a farm machinery service? How much are the maintenance costs and repair costs of each piece of farm machinery? What other means and infrastructure are there to support the operation of IRSAM, such as road infrastructure, irrigation networks, repair workshops, warehouse, tools and other implements? 	<ul style="list-style-type: none"> Can you tell me about the services provided by your unit? Who is your client? Individual farmer or farmer groups? Are there any differences in delivering services to farmers who live far from your location? What are the benefits of running this business? Are there any constraints in running this business? What do you think about farmers' opinions regarding your service?

Appendix 3: Research Permit

1. Research permit from the Government of Gunungkidul Regency in the local language (Bahasa Indonesia)


PEMERINTAH KABUPATEN GUNUNGKIDUL
KANTOR PENANAMAN MODAL DAN PELAYANAN TERPADU
Alamat : Jl. Brigjen. Katamsa No.1 Wonosari Telp. 391942 Kode Pos : 55812

SURAT KETERANGAN / IJIN
Nomor : 610/KPTS/VI/2016


Membaca : Surat dari SEKOLAH TINGGI PENYULUHAN PERTANIAN MAGELANG, Nomor : 841/KP.320/I.3.9/6/2016, hal : Izin Penelitian

Mengingat : 1. Keputusan Menteri dalam Negeri Nomor 9 Tahun 1983 tentang Pedoman Pendataan Sumber dan Potensi Daerah;
2. Keputusan Menteri dalam Negeri Nomor 61 Tahun 1983 tentang Pedoman Penyelenggaraan Pelaksanaan Penelitian dan Pengembangan di lingkungan Departemen Dalam Negeri;
3. Surat Keputusan Gubernur Daerah Istimewa Yogyakarta Nomor 38/12/2004 tentang Pemberian Izin Penelitian di Provinsi Daerah Istimewa Yogyakarta;

Dijijinkan kepada :
Nama : Kodrad Winarno, STP NIP : 19820804 201101 1 008
Instansi : SEKOLAH TINGGI PENYULUHAN PERTANIAN MAGELANG
Alamat Instansi : Jl. Kusumanegara No.2, Tahunan, Umbulharjo, Yogyakarta
Alamat Rumah : Dongkelan, Panggungharjo, Sewon, Bantul
Keperluan : Izin penelitian dengan judul: "PENYEWAAN ALAT DAN MESIN PERTANIAN DILIHAT DARI SUDUT PANDANG SISTEM INOVASI PERTANIAN"
Lokasi Penelitian : Dinas Tanaman Pangan dan Holtikultura dan Desa Karangrejek, Kec. Wonosari, Kab. Gunungkidul
Waktunya : Mulai tanggal : 27/06/2016 sd. 30/08/2016
Dengan ketentuan :

Terlebih dahulu memenuhi/melaporkan diri kepada Pejabat setempat (Camat, Lurah/Kepala Desa, Kepala Instansi) untuk mendapat petunjuk seperlunya.

1. Wajib menjaga tata tertib dan mentaati ketentuan-ketentuan yang berlaku setempat
2. Wajib memberi laporan hasil penelitiannya kepada Bupati Gunungkidul (cq. BAPPEDA Kab. Gunungkidul) dalam bentuk softcopy format pdf yang disimpan dalam keeping compact disk (CD) dan dalam bentuk data yang dikirim via email ke alamat : litbangbappeda.gk@gmail.com dengan tembusan ke kantor Perpustakaan dan Arsip Daerah dengan alamat email : kpadgunungkidul@gmail.com
3. Ijin ini tidak disalahgunakan untuk tujuan tertentu yang dapat mengganggu kestabilan pemerintah dan hanya diperlukan untuk keperluan ilmiah.
4. Surat ijin ini dapat diajukan lagi untuk mendapat perpanjangan bila diperlukan.
5. Surat ijin ini dibatalkan sewaktu-waktu apabila tidak dipenuhi ketentuan-ketentuan tersebut diatas. Kemudian kepada para Pejabat Pemerintah setempat diharapkan dapat memberikan bantuan seperlunya.

Dikeluarkan di : Wonosari
Pada Tanggal 27 Juni 2016
BUPATI GUNUNGKIDUL
KANTOR PENANAMAN MODAL DAN PELAYANAN TERPADU

Dr. AZIS SALEH
NIP. 19660603 198602 1 002

Tembusan disampaikan kepada Yth.

1. Bupati Kab. Gunungkidul (Sebagai Laporan) ;
2. Kepala BAPPEDA Kab. Gunungkidul ;
3. Kepala Kantor KESBANGPOL Kab. Gunungkidul ;
4. Kepala Dinas Tanaman Pangan dan Holtikultura Kab. Gunungkidul ;
5. Camat Wonosari Kab. Gunungkidul ;
6. Kepala Desa Karangrejek, Kec. Wonosari, Kab. Gunungkidul ;
7. Arsip.

2. Research permit from the Government of Bantul Regency in the local language (Bahasa Indonesia)



**PEMERINTAH KABUPATEN BANTUL
BADAN PERENCANAAN PEMBANGUNAN DAERAH
(B A P P E D A)**

Jln. Robert Wolter Monginsidi No. 1 Bantul 55711, Telp. 367533, Fax. (0274) 367796
Website: bappeda.bantulkab.go.id Webmail: bappeda@bantulkab.go.id

SURAT KETERANGAN/IZIN

Nomor : 070 / Reg / 2808 / DSN / 2016

Menunjuk Surat	:	Dari :	STPP JURUSAN PENYULUHAN PERTANIAN YOGYAKARTA	Nomor : 841/KP.320/I.3.9/6/2016
		Tanggal :	14 Juni 2016	Perihal : Permohonan Rekomendasi Ijin Penelitian
Mengingat	:	a. Peraturan Daerah Nomor 17 Tahun 2007 tentang Pembentukan Organisasi Lembaga Teknis Daerah Di Lingkungan Pemerintah Kabupaten Bantul sebagaimana telah diubah dengan Peraturan Daerah Kabupaten Bantul Nomor 16 Tahun 2009 tentang Perubahan Atas Peraturan Daerah Nomor 17 Tahun 2007 tentang Pembentukan Organisasi Lembaga Teknis Daerah Di Lingkungan Pemerintah Kabupaten Bantul; b. Peraturan Gubernur Daerah Istimewa Yogyakarta Nomor 18 Tahun 2009 tentang Pedoman Pelayanan Perijinan, Rekomendasi Pelaksanaan Survei, Penelitian, Pengembangan, Pengkajian, dan Studi Lapangan di Daerah Istimewa Yogyakarta; c. Peraturan Bupati Bantul Nomor 17 Tahun 2011 tentang Ijin Kuliah Kerja Nyata (KKN) dan Praktek Lapangan (PL) Perguruan Tinggi di Kabupaten Bantul.		
Diizinkan kepada				
Nama	:	KODRAD WINARNO		
P. T / Alamat	:	STPP JURUSAN PENYULUHAN PERTANIAN YOGYAKARTA STPP MAGELANG		
NIP/NIM/No. KTP	:	3402150408820002		
Nomor Telp./HP	:	087838555787		
Tema/Judul Kegiatan	:	CUSTOM HIRING OF MACHINERY: AGRICULTURAL INNOVATION SYSTEM PERSPECTIVE / PENYEWAAN ALAT DAN MESIN PERTANIAN DILIHAT DARI SUDUT PANDANG SISTEM INOVASI PERTANIAN		
Lokasi	:	Kabupaten Bantul (Dinas Pertanian Kabupaten Bantul) Dan Kecamatan Sedayu Desa Argorejo, Desa Argodadi		
Waktu	:	20 Juni 2016 s/d 20 September 2016		

Dengan ketentuan sebagai berikut :

1. Dalam melaksanakan kegiatan tersebut harus selalu berkoordinasi (menyampaikan maksud dan tujuan) dengan institusi Pemerintah Desa setempat serta dinas atau instansi terkait untuk mendapatkan petunjuk seperlunya;
2. Wajib menjaga ketertiban dan mematuhi peraturan perundangan yang berlaku;
3. Izin hanya digunakan untuk kegiatan sesuai izin yang diberikan;
4. Pemegang izin wajib melaporkan pelaksanaan kegiatan bentuk *softcopy* (CD) dan *hardcopy* kepada Pemerintah Kabupaten Bantul c.q Dappeda Kabupaten Bantul setelah selesai melaksanakan kegiatan;
5. Izin dapat dibatalkan sewaktu-waktu apabila tidak memenuhi ketentuan tersebut di atas;
6. Memenuhi ketentuan, etika dan norma yang berlaku di lokasi kegiatan; dan
7. Izin ini tidak boleh disalahgunakan untuk tujuan tertentu yang dapat mengganggu ketertiban umum dan kestabilan pemerintah.

Dikeluarkan di : B a n t u l
Pada tanggal : 20 Juni 2016

A.n. Kepala,
Kepala Bidang Data Penelitian dan
Pengembangan, Sub. Kasubbid,
Litbang
BAPPEDA
Heny Endrawati, S.P., M.P.
NIP: 197106081998032004

Tembusan disampaikan kepada Yth.

1. Bupati Kab. Bantul (sebagai laporan)
2. Kantor Kesatuan Bangsa dan Politik Kab. Bantul
3. Ka. Dinas Pertanian dan Kehutanan Kab. Bantul
4. Camat Sedayu
5. Lurah Desa Argodadi, Kec. Sedayu
6. Lurah Desa Argorejo, Kec. Sedayu
7. Ka. Sekolah Tinggi Penyuluh Pertanian (STPP) Yogyakarta
8. Yang Bersangkutan (Pemohon)

Appendix 4: Participants' Information Sheet

1. Participants' Information Sheet in English



Department of Agribusiness
Institute of Agriculture & Environment
Massey University
PO Box 11 222
Palmerston North 4442
New Zealand

**Factors Shaping the Operation of Machinery Hire Services, Case Studies on the
Implementation of the Institution for Rental Service of Agricultural Machinery (IRSAM)
Programme in the Special Region of Yogyakarta, the Republic of Indonesia
INFORMATION SHEET**

Dear Sir/Madam,

My name is Kodrad Winarno, and I am from Bantul District, the Special Region of Yogyakarta, the Republic of Indonesia. I am working for the Agricultural Extension College of Yogyakarta, Ministry of Agriculture of the Republic of Indonesia. I am an AgriCommerce Masters candidate in the Institute of Agriculture and Environment at Massey University in Palmerston North, New Zealand. I am currently conducting a research of the government programme on agricultural machinery hire services, initiated by the Ministry of Agriculture of the Republic of Indonesia. In particular, I am studying the Institution for Rental Service of Agricultural Machinery (IRSAM) scheme implemented in the Special Region of Yogyakarta. As part of the study, I am conducting fieldwork in Gunungkidul Regency and Bantul Regency and Jakarta.

Description of study and invitation to participants of this study

As part of the government initiative to improve the production of agricultural commodities, particularly for the five main staples – rice, maize, soybeans, sugar and beef, the Ministry of Agriculture (MoA) of the Republic of Indonesia launched the IRSAM programme in 1998. The programme aims to promote the use of farm machinery at the farm level to improve the agricultural production and to promote farmers to develop a rural business unit by providing farm machinery services to other farmers. The MoA has implemented the IRSAM programme in collaboration with the provincial and regional governments and other actors, such as the local agricultural machinery producers, universities, and other related parties. However, the programme has experienced a slow development until 2008. From that point forward, the MoA was trying to accelerate the programme implementation by issuing a Ministerial Decree Number 25/Permentan/PL.130/5/2008. Currently, the IRSAM programme has been rolled out for more than 18 years, and many farmers have received these machines and started to provide services to other farmers. Nevertheless, the implementation of the IRSAM programme that has been applied to different areas of the Republic of Indonesia showed various outputs. Furthermore, many IRSAMs are not becoming an autonomous rural business entity as designed in the Ministerial Decree. The research is interested in gaining insights on the different factors that are shaping the operation of particular IRSAMs, especially in the Special Region of Yogyakarta and how they are working on those factors. By understanding the various factors, there would be a possibility for this research to provide recommendations and some insights on how the MoA will be able to improve the implementation of the IRSAM programme.

To obtain data and information as stated above, I would like to conduct interviews with people with knowledge of and/or involvement in the programme at the national, provincial, district and farm levels. Participants will be drawn from both the public and the private sector. In relation to this, I would like to invite you to participate in this study because you are in a position relevant to the administration of the programme or have been identified as having knowledge about the programme relevant to the research. If you decide to participate in this study, I would like to ask your permission to audiotape our one-on-one interview session. Your rights as a participant in this study are listed below.

Participant rights:

- Decline to answer any particular question.
- Withdraw from the study at any time during participation.
- Ask any questions about the study at any time during participation.
- Provide information on the understanding that your name will not be used unless you give permission to the researcher.
- Be given access to a summary of the project findings when it is concluded.
- Ask for the voice recorder to be turned off at any time during the interview.

Data management

In this study, the confidentiality of all participants will be kept assured by anonymizing all respondents' identity. However, for those who are in the position of responsibilities or in a specific role related to this, it is likely that your identity may be able to be ascertained because the district is going to be identified. The interviews will be protected under lock at Massey University, and I can only access it. Data will be stored for five years and then destroyed. The final published thesis will be available at the Massey University library and can be accessed through the online catalogue.

Project contacts

To provide you with information regarding the contact persons of this study, below is my full contact along with the contact of two supervisors of this study.

Name	Position	Organisation	Contact
Kodrad Winarno	Researcher	Institute of Agriculture & Environment, College of Sciences, Massey University	453/1 Ferguson Street Palmerston North Telephone: +64 22 6508806 Email: wiwindkln@gmail.com
Dr Peter Tozer	Chief Supervisor	Institute of Agriculture & Environment, College of Sciences, Massey University	Palmerston North Telephone: +64 (06) 356 9099 ext 84793 Email: P.Tozer@massey.ac.nz
Dr Janet Reid	Second Supervisor	Institute of Agriculture & Environment, College of Sciences, Massey University	Palmerston North Telephone: +64 (06) 356 9099 ext 84812 Email: J.I.Reid@massey.ac.nz

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named in this document is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher, please contact Dr Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz.

2. Participants' Information Sheet in the local language (Bahasa Indonesia)



Massey University

Department of Agribusiness
Institute of Agriculture & Environment
Massey University
PO Box 11 222
Palmerston North 4442
New Zealand

*Faktor yang Mempengaruhi Pengoperasian Usaha Penyewaan Jasa Alat Mesin Pertanian,
Studi Kasus Implementasi Program Usaha Penyewaan Jasa Alsintan (UPJA) di Provinsi
Daerah Istimewa Yogyakarta, Republik Indonesia*

LEMBAR INFORMASI

Salam,

Nama saya Kodrad Winarno dan saya berasal dari Kabupaten Bantul, Provinsi Yogyakarta, Republik Indonesia. Saya bekerja pada Sekolah Tinggi Penyuluhan Pertanian Magelang Jurusan Penyuluhan Pertanian di Yogyakarta, Kementerian Pertanian Republik Indonesia. Saya adalah seorang kandidat Master dibidang AgriCommerce pada Institut Pertanian dan Lingkungan di Universitas Massey, Palmerston North, Selandia Baru. Saat ini saya sedang melakukan penelitian mengenai program pemerintah terkait penyewaan alat dan mesin pertanian yang diinisiasi oleh Kementerian Pertanian Republik Indonesia. Dalam studi ini, saya meneliti mengenai program Usaha Pelayanan Jasa Alat dan Mesin Pertanian (UPJA) di Provinsi Daerah Istimewa Yogyakarta. Sebagai bagian dari studi ini, saat ini saya sedang melaksanakan pengambilan data di Kabupaten Gunungkidul, Kabupaten Bantul dan juga di Jakarta.

Deskripsi studi dan undangan kepada calon peserta studi

Sebagai bagian dari inisiatif pemerintah untuk meningkatkan produksi pertanian, khususnya pada lima komoditas utama – beras, jagung, kedelai, gula dan daging sapi, Kementerian Pertanian Republik Indonesia telah memperkenalkan program UPJA pada tahun 1998. Program ini bertujuan untuk mendorong penggunaan alat dan mesin pertanian di tingkat petani guna meningkatkan produksi pertanian dan juga untuk mendorong petani dalam mengembangkan unit bisnis melalui usaha penyewaan alat dan mesin pertanian ke petani lain. Program UPJA dilaksanakan oleh Kementerian Pertanian bekerjasama dengan Dinas Pertanian baik provinsi maupun kabupaten, dan stakeholder lain seperti produsen lokal alat dan mesin pertanian, universitas, dan stakeholder terkait lainnya. Namun demikian, program UPJA menunjukkan perkembangan yang lambat sampai dengan tahun 2008. Semenjak itu, Kementerian Pertanian berusaha untuk meningkatkan implementasi program UPJA dengan menerbitkan Peraturan Menteri Pertanian Nomor 25/Permentan/PL.130/5/2008. Saat ini, program UPJA telah berjalan selama 18 tahun dan banyak petani yang telah menerima bantuan alat dan mesin pertanian dan mulai memberikan pelayanan alat dan mesin pertanian kepada sesama petani. Namun demikian, implementasi program UPJA di berbagai daerah di Republik Indonesia menunjukkan hasil yang bervariasi. Terlebih lagi masih banyak UPJA yang tidak berkembang menjadi sebuah unit bisnis di pedesaan sebagaimana yang diharapkan sesuai ketentuan dalam Peraturan Menteri Pertanian tersebut. Oleh karena itu, penelitian ini tertarik untuk mengetahui lebih mendalam mengenai berbagai faktor yang mempengaruhi operasi UPJA terutama di Provinsi Daerah Istimewa Yogyakarta dan bagaimana mereka berinteraksi dengan factor tersebut. Dengan mengetahui berbagai factor yang mempengaruhi bagaimana UPJA beroperasi, penelitian ini berpeluang untuk memberikan rekomendasi dan informasi mendetail bagi Kementerian Pertanian mengenai bagaimana implementasi program UPJA dapat ditingkatkan.

Dalam rangka memperoleh data dan informasi sebagaimana disampaikan diatas, saya bermaksud untuk menyelenggarakan wawancara dengan orang-orang yang memiliki pengetahuan dan atau terlibat dalam program UPJA di tingkat nasional, provinsi, kabupaten dan tingkat petani. Peserta studi akan diambil dari sektor publik dan sektor swasta. Sehubungan dengan hal tersebut, saya bermaksud untuk mengundang Bapak/Ibu untuk berpartisipasi dalam studi ini karena posisi atau kedudukan Bapak/Ibu saat ini terkait dengan implementasi program UPJA atau Bapak/Ibu telah diidentifikasi memiliki pengetahuan tentang program UPJA yang relevan dengan penelitian ini. Apabila Bapak/Ibu menyatakan berpartisipasi dalam studi ini, saya akan meminta izin untuk merekam wawancara yang akan kita laksanakan. Berikut dibawah ini adalah hak-hak Bapak/Ibu sebagai peserta studi ini.

Hak peserta penelitian:

- *Berhak untuk menolak menjawab pertanyaan.*
- *Berhak untuk mengundurkan diri sebagai peserta selama penelitian berlangsung.*
- *Berhak untuk mengajukan pertanyaan terkait dengan penelitian selama kegiatan penelitian berlangsung.*
- *Memberikan informasi dengan catatan nama Bapak/Ibu tidak akan dicantumkan kecuali Bapak/Ibu memberikan persetujuan.*
- *Berhak untuk mendapatkan akses terhadap ringkasan hasil penelitian.*
- *Berhak untuk meminta peneliti mematikan alat perekam selama proses wawancara.*

Data management

Dalam studi ini, kerahasiaan seluruh peserta akan dijamin dengan tidak mencantumkan nama/identitas peserta. Namun, untuk Bapak/Ibu yang memiliki jabatan terkait dengan implementasi program UPJA, ada kemungkinan bahwa jabatan Bapak/Ibu akan dicantumkan mengingat nama kabupaten dalam studi ini akan ditampilkan. Data wawancara akan disimpan ditempat yang aman di Universitas Massey dan hanya dapat diakses oleh saya. Data hanya akan disimpan dalam jangka waktu 5 tahun dan setelah itu akan dihancurkan. Publikasi final tesis ini dapat dijumpai di perpustakaan Universitas Massey dan dapat diakses melalui katalog online.

Kontak yang dapat dihubungi

Dalam rangka untuk menyediakan informasi lengkap mengenai kontak saya dan dosen pembimbing saya di studi ini, berikut adalah kontak kami:

Nama	Posisi	Organisasi	Kontak
Kodrad Winarno	Peneliti	Institute of Agriculture & Environment, College of Sciences, Massey University	453/1 Ferguson Street Palmerston North Telephone: +64 22 6508806 Email: wiwindkln@gmail.com
Dr. Peter Tozer	Dosen Pembimbing Pertama	Institute of Agriculture & Environment, College of Sciences, Massey University	Palmerston North Telephone: +64 (06) 356 9099 ext 84793 Email: P.Tozer@massey.ac.nz
Dr. Janet Reid	Dosen Pembimbing Kedua	Institute of Agriculture & Environment, College of Sciences, Massey University	Palmerston North Telephone: +64 (06) 356 9099 ext 84812 Email: J.I.Reid@massey.ac.nz

Studi ini telah direview dan dinilai sebagai studi beresiko rendah. Oleh karena itu, studi ini tidak dievaluasi oleh komite etika universitas. Peneliti yang namanya tertera diatas bertanggung jawab terkait dengan etika dalam studi ini. Jika Bapak/Ibu ada pertanyaan terkait dengan pelaksanaan studi ini yang ingin disampaikan selain kepada peneliti, Bapak/Ibu dapat menghubungi Dr Brian Finch, Direktur Etika, email humanethics@massey.ac.nz.

Appendix 5: Ethics Approval



Date: 12 May 2016

Dear Kodrad Winarno

Re: Ethics Notification - 4000016095 - Custom Hiring of Machinery: Agricultural Innovation Systems Perspective

Thank you for your notification which you have assessed as Low Risk.

Your project has been recorded in our system which is reported in the Annual Report of the Massey University Human Ethics Committee.

The low risk notification for this project is valid for a maximum of three years.

If situations subsequently occur which cause you to reconsider your ethical analysis, please go to <http://rims.massey.ac.nz> and register the changes in order that they be assessed as safe to proceed.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named in this document are responsible for the ethical conduct of this research."

If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director - Ethics, telephone 06 3569099 ext 86015, email humanethics@massey.ac.nz.

Please note, if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to complete the application form again, answering "yes" to the publication question to provide more information for one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

Dr Brian Finch
Chair. Human Ethics Chairs' Committee and Director (Research Ethics)

Research Ethics Office, Research and Enterprise
Massey University, Private Bag 11 222, Palmerston North, 4442, New Zealand T 06 350 5573; 06 350 5575 F 06 355 7973
E humanethics@massey.ac.nz W <http://humanethics.massey.ac.nz>

Appendix 6: Participants' Consent Form in Bilingual



Department of Agribusiness
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PO Box 11 222
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New Zealand

**Factors Shaping the Operation of Machinery Hire Services, Case Studies on the
Implementation of the Institution for Rental Service of Agricultural Machinery (IRSAM)
Programme in the Special Region of Yogyakarta, the Republic of Indonesia**

*Faktor yang Mempengaruhi Pengoperasian Usaha Penyewaan Jasa Alat Mesin Pertanian,
Studi Kasus Implementasi Program Usaha Penyewaan Jasa Alsintan (UPJA) di Provinsi
Daerah Istimewa Yogyakarta, Republik Indonesia*

**PARTICIPANT CONSENT FORM-INDIVIDUAL
FORM PERSETUJUAN PESERTA**

I have read the information sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

Saya telah membaca lembaran informasi dan telah mendapatkan informasi lengkap yang sudah dijelaskan. Pertanyaan yang saya berikan telah dijawab dengan memuaskan dan saya mengerti bahwa saya dapat mengajukan pertanyaan kapan saja.

I agree/do not agree to the interview being audio taped.

Saya setuju/tidak setuju terhadap proses rekam suara selama wawancara.

I agree to participate in this study under the conditions set out in the information sheet.

Saya setuju untuk berpartisipasi dalam penelitian ini sesuai dengan kondisi yang disampaikan dalam lembaran informasi.

Signature

(Tandatangan)

Date

(Tanggal)

Full name-printed

(Nama lengkap)

Appendix 7: Farm Machinery owned by the Tirto Sari IRSAM



Figure 20. A Kubota MX 5000 4WT delivers land preparation in a dryland field in the Karang Rejek village



Figure 21. A Quick G-1000 2WT in the Tirto Sari IRSAM warehouse

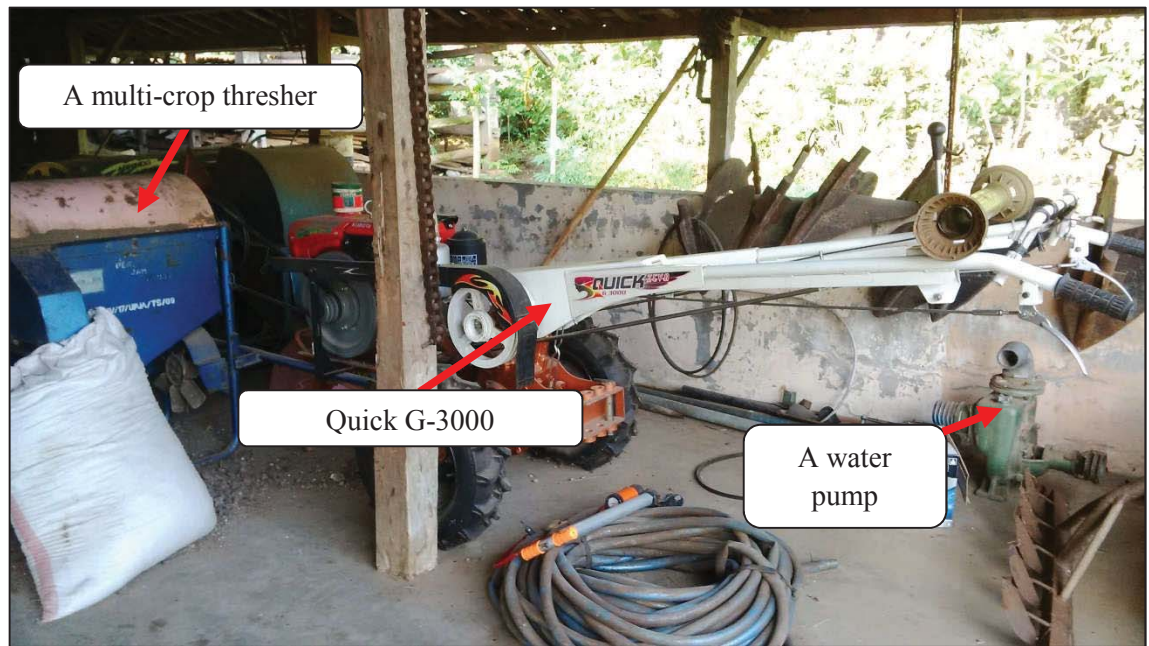


Figure 22. A multi-crop thresher, a Quick G-3000 2WT, and a water pump in the Tirto Sari IRSAM warehouse

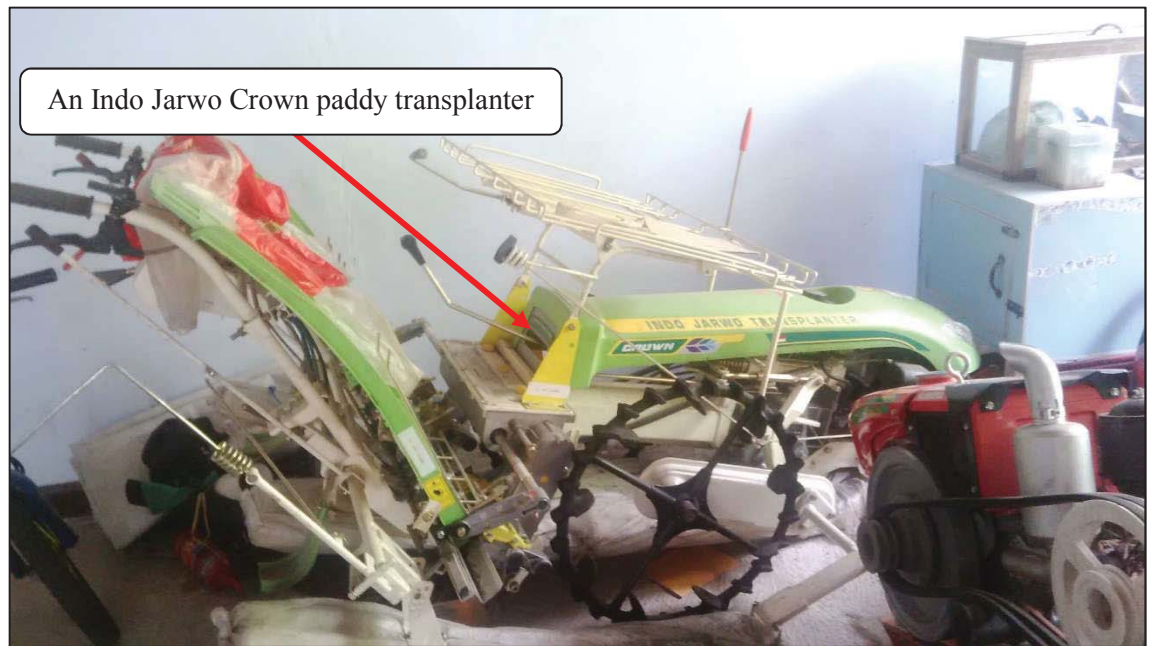
Appendix 8: Farm Machinery owned by the Argorejo IRSAM



Figure 23. A Yanmar EF 393T 4WT delivers land preparation in a paddy field in Argorejo village



Figure 24. A Quick G-3000 2WT delivers land preparation in a paddy field in the Argorejo village



An Indo Jarwo Crown paddy transplanter

Figure 25. An Indo Jarwo Crown paddy transplanter in the Argorejo IRSAM warehouse



A Quick H-140R combine harvester

Figure 26. A Quick H-140R combine harvester in the Argorejo IRSAM warehouse