Bachelor of Science Programme in Development Studies

From traditional to modern rice farming methods: A case study on smallholder farmers in the subaks of Gunung Sari village, Bali, Indonesia

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Abstract

Historically, smallholder farmers have dominated rice production in the Global South, typically cultivating rice on less than one hectare of land. In Indonesia, rice is the staple crop and is both a political and cultural commodity. The 1970s Green Revolution aimed at decreasing world hunger through the implementation of new agricultural innovations in the form of new technologies and HYV seeds. This contributed to increasing food supply and security. However, it also further marginalised traditional agricultural knowledge, rural poor and women. This study is centered on the case of the subak- Bali’s traditional irrigation management system- in the village of Gunung Sari, Bali, Indonesia. A combination of concepts: agricultural innovations, gendered division of labour as well as livelihoods are used as a framework to discuss the implications new agricultural technologies, such as the hand-held tractor and HYV rice seeds, has had on the livelihoods of smallholder farmers and on the gendered division of agricultural labour. Data was collected through qualitative and quantitative methods during an eight week field study. The findings reveal that male smallholder farmers are increasingly adopting new agricultural machinery because it results in more time saved to diversify income. While farming activities were once dominated by women this is now changing. Furthermore findings show that there is a gap between ownership and access to resources (land, agricultural machinery and livestock) which are essential to smallholder farmers livelihoods.

Keywords: rice, smallholder, gender, livelihood, technology, traditional, subak, Indonesia

Word count: 17,626
Acronyms

GDoL          Gendered Division of Labour
HA            Hectare
HYV           High Yielding Varieties (seeds)
NGO           Non Governmental Organisation
PRA           Participatory Rural Appraisal
UNESCO        United National Educational and Scientific Cultural Organisation

Translations

*Angota Subak* - Smallholder farmers that cultivate rice in the subak system.

*Ani-ani* - Hand knife used to harvest rice.

*Awig-awig* - Rules and regulations of the Subak system.

*Subak* - Farmer’s irrigation society.
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1 Introduction

1.1 Problem Formulation
Throughout history, agriculture - the cultivation of food - has been and continues to be the most important source of livelihood and economic stability for households in rural areas (Shiva, 2016). The increase in global population trends and income has been accompanied by a rapid increase in the global demand for food. The increase in rural-to-urban migration has resulted in people transitioning away from the agricultural sector despite its importance; people living in urban areas depend on farmers in rural areas to produce food to feed the growing population. In Southeast Asia, smallholder farming continues to dominate agricultural production, where food is predominantly produced on less than one hectare (ha) of land (FAO, 2012).

Rice is one of the world’s staple crops, providing approximately three billion people with food worldwide (Maclean, Hardy & Hettel, 2013). In Southeast Asia, it plays an important role economically, politically and socially and is a vital commodity (Mariyono, 2014). In Indonesia, smallholder farmers depend heavily on rice as a major source of food and livelihood (Redfern, Azzu & Binamira, 2012). Indonesia plays an important role in the global production of rice as it is the world’s third largest producer after China and India (IRRI, 2016). Rice production contributes significantly to both the national income and to employment in Indonesia where 77% of farmers produce in semi-commercial conditions (Mariyono, 2014). Trends show that women’s roles in rice farming typically include transplanting rice, weeding, applying fertiliser, harvesting, selecting, saving seeds and cooking the rice. Men’s activities include ploughing the land, control over irrigation, applying fertiliser and selling the rice (Paris, 2009). These socially constructed roles in rice farming have been changing constantly over the years due to external inputs such as agricultural technology.
The top-down policies of the 1970s Green Revolution driven by capitalism and globalisation aimed at maximising yield outputs with the introduction of new agricultural technologies such as tractors, HYV rice seeds (high yielding variety) and chemical fertilisers (Sepe, 2000). In Indonesia, the change to modern rice farming methods was introduced during President Suharto’s New Order in the 1970s (Timmer, 2004); after widespread starvation between the 1950s and 1960s due to the low supply of rice and the increasing demand (Djurfeldt & Jirström 2005; Timmer, 2004). There was an initial success of an increase in grain supply, where food security was increased. However, such success was accompanied by an increase in rice prices that affected the rural poor, further amplifying disparities between rich and the poor (Paris, 1998; Timmer, 2004).

This study uses the case of the subak system - a locally managed irrigation system in which farmers organise equal water distribution to rice fields - in Bali. In the case of Bali, new agricultural methods were implemented during the 1970s that disregarded traditional rice farming methods and endangered the traditional system. The top-down state driven policies of Suharto’s era introduced new agricultural technologies that have marginalised traditional farming methods (Kusujiarti & Tickamyer, 2000). An input in new technologies has also changed the agricultural division of labour; women and men’s roles in rice farming are socially constructed and change over time and in relation to external factors. Activities which were once dominated by women are now being replaced by technology and men (Paris, 1998).

Although Bali is rapidly moving into the tourism industry, agriculture has historically been the mainstay of rural livelihoods and still makes up 20% of the island’s Gross Regional Domestic Product, while tourism amounts to 32% (Arthawiguna, Lorenzen & Lorenzen, 2005). Despite agriculture being the backbone of rural livelihoods, the sector has decreased in Bali; a trend seen in many countries due to globalisation and rapid economic expansion (ibid). Globalisation and infrastructure development are the biggest threat to traditional
farming systems in Bali. Both the implementation of new agricultural technologies and the rapid expansion of the tourism sector has marginalised and threatened the traditional rice farming system (Ramalingam, 2015). Smallholder farmers and traditional agricultural methods are being excluded from changes and implementation of new technologies in the agricultural sector.

There is a gap in the previous literature addressing the implications of a change from traditional to modern farming due to external state factors. State driven policies have pushed towards maximising yields and outputs, disregarding traditional agricultural methods. This is the guiding reason of this study and why it has taken an approach to analysing the implications on both women and men smallholder farmers in the village of Gunung Sari, located in Bali’s UNESCO (United Nations Educational and Scientific Cultural Organisation) world heritage site in the region of Jatiluwih.

1.2 Research Aim and Motivation of Study

The aim of this study is to 1) analyse the shift in rice farming from traditional to modern methods and to investigate what changes this has brought to smallholder farmers division of agricultural labour; and 2) explore how ownership of resources such as land agricultural machinery and livestock affects smallholder farmers livelihoods.

This study is motivated by the fact that irrigated rice farming remains a main source of economic income and livelihood for rural areas in Bali (Arthawiguna, Lorenzen & Lorenzen, 2005). However, land prices and lucrative work in the tourism sector have put rice farming in great threat (ibid). This study focuses on one village in the region of Jatiluwih, the grain basket of Bali, producing and providing rice supplies to urban parts of the island. The region of Jatiluwih has received significant attention since it has been named a UNESCO world heritage, thereby implying that strict measures have been taken to protect the subak from infrastructure development. However, the Indonesian state has provided little to no support or incentives to smallholder farmers, who are now guarding the
rice-fields from development and attracting millions of tourists annually to the picturesque landscapes of Jatiluwih (Salamanca et al, 2015). If smallholder farmers are to continue “protecting the ricefields, more research needs to be conducted to analyse the implications agricultural machinery has on smallholder farmers at the village level.

1.3 Research Questions
The following two questions will guide this research:

1) How has the rise of agricultural technology and the use of hand-held tractors influenced traditional farming methods and the range of women and men’s activities in rice cultivation in the village of Gunung Sari?

2) In what way does the distribution in ownership of resources such as land, livestock and agricultural machinery affect smallholder rice farmers and their livelihoods?

1.4 Delimitations
The geographic focus of this study is on one of the UNESCO world heritage villages, Gunung Sari, because rice farming is still considered a main source of economic activity and is thus relevant to studying smallholder farmers who depend on rice farming for their livelihoods. The implementation of new agricultural technology has had various of effects on societies; this study will focus on the division of labour and livelihoods. This study will focus on the gendered division of labour (GDoL) in agriculture, and hence not within the households. Although smallholder farmers use numerous amounts of resources to ensure livelihoods, this study has limited the resources to land, agricultural machinery and livestock.

1.5 Thesis Outline
The first chapter provides an introduction to the thesis. The following chapters are outlined as such: Chapter 2 provides the background and context to the study. The chapter
commences with an introduction to rice and irrigated rice in Southeast Asia. It then moves on to an overview of smallholder farmers in rice cultivation starting on the broader level of Southeast Asia and culminating in the study conducted in Bali. Following that is a description of the study area and a map of the village. Finally, the chapter describes the subak system and the role of religion in rice farming as well as the meaning behind Jatiluwih being a UNESCO world heritage site. Chapter 3 presents an ensemble of definitions, concepts and a literature review to all together compose the analytical framework. Included in this chapter: smallholder farmers, the subak system, gender and the subaks, gender and agricultural technology, gendered division of labour, livelihoods, agricultural innovations and traditional/indigenous knowledge. Chapter 4 outlines the methodologies and methods used to conduct this study. The methods are divided into qualitative and quantitative. Chapter 5 provides the findings of this study. Finally, Chapter 6 provides a discussion on the findings as well as concluding remarks and suggestion for future study.
2 Background and Context

The following chapter will discuss the background and context to the study. Firstly rice and irrigated rice, smallholder farmers and cultural significance of rice will be presented. This will be followed by a discussion on the social importance of rice in Balinese society, then a description of the village and a map of the study area. Finally, the chapter will provide a description of the Balinese subaks, the irrigation system, the role of religion, and what it means to be a UNESCO world heritage site.

2.1 Rice and Irrigated Rice in Southeast Asia

Half the world’s rice fields are used to plant irrigated rice, amounting to 75% of total rice production (FAO, 2014). Irrigated rice cultivation, or paddy, produces the highest levels of yields. It is a very intensified production system and typically more than one crop is grown per year. In Indonesia, paddy can yield up to three harvests per year (Redfern, Azzu & Binamira, 2012). Irrigated rice is the most important crop in Southeast Asia, providing millions of farmers with food, employment and economic stability. Approximately 45% of rice in Southeast Asia is irrigated, with the largest areas found in Indonesia, Vietnam, the Philippines and Thailand (ibid). Irrigated rice has changed drastically over the past 50 years due to a change in intensification methods supported by government policies (Djurfeldt & Jirström, 2005).

The village of Gunung Sari, focused on in this study, provides a particularly significant case noteworthy of study because it continues to cultivate a local red rice variety which is indigenous to the region. The seeds of the local red rice variety are commonly stored in household rice barns and are used the following season. This differs to the white HYV seeds which are not kept as they are hybrid and do not reproduce the next season. Instead, HYV seeds are bought annually.
2.2 Contextualising Smallholder Rice Farmers

Smallholder farmers dominate rice production in Southeast Asia, typically defined as producing on less than one hectare of land, commonly with diversified crops (Thapa & Gaiha, 2011). On the island of Bali, smallholder farmers dominate rice production and cultivate rice on small farms with an average size of 0.35 ha (Arthawiguna, Lorenzen & Lorenzen, 2005). Smallholder farmers face many challenges in food production, with lack of access to services and credit hindering them from increasing or diversifying food production. Furthermore, when new agricultural technologies are introduced they lack capital inputs such as machinery, which are generally costly. Weather variations and prolonged dry seasons have contributed to water shortages and the expansion of irrigation systems. Water shortages have made working conditions difficult and contributed to water insecurity in many Southeast Asian countries (ibid).

In Southeast Asia women are an indispensable part of rice production. However, activities and roles vary from country to country and are dependent on social and cultural norms. Women have always played an important role in rice cultivation, in Indonesia they contribute to 40% of the total labour force (FAO, 2004; Paris 1998). This is comparable to 46% in Cambodia, 48% in Laos and 17% in the Philippines (IRRI, 2008). Women’s labour is unpaid in their own rice fields, and paid daily for labour on neighbouring rice fields (Paris, 2009). Approximately half the labour associated with rice farming is done by women in Southeast Asia; these roles tend to be constructed by sociocultural norms. Despite the fact that women contribute significantly to rice cultivation, it is proven that they lack access to resources such as agricultural extensions, land, credit and education (Paris, 1998). In Southeast Asia, land ownership is dominated by men, with women in Indonesia, Vietnam and Laos owning less agricultural land than their counterparts in Malaysia, Myanmar and Thailand (see figure 2.1). Thailand is generally slightly higher because women have cultural authority to own land (IRRI, 2008).
2.3 Social and Cultural Significance of Rice in Balinese Society

It can be argued that rice cultivation in Bali is more than just a commodity and a source of economic activity, it is embedded in the social and religious life of the island’s society. Mariyono (2014) claims that the role of rice as Indonesia’s staple crop results in rich social culture and emotional bonds further to its utility as a commodity. Speaking the Indonesian language, I was able to observe that there are numerous words used to describe rice. There is a different word used to describe rice in each growing phase. During the first phase, when the rice is still in seed and up to the point where it has been milled, it is called padi. During the second phase, rice is referred to as raw, or uncooked rice, typically after it has been pounded or milled: it is called beras. The third phase refers to when the rice is cooked and ready to eat, it is called nasi. The differentiation between these three words could show the significance rice holds in Indonesia and how it is embedded in the everyday life of people.

Typically, rice in Balinese society is stored in a rice barn, called a lumbung. In the village of Gunung Sari, where rice has been cultivated for centuries, the rice barn is strategically located in the middle of a home’s courtyard, in front of the kitchen, and next to the

![Figure 2.1: Women and men’s agricultural land holdings in South/S.E Asia](image)

Source: IRRI, 2008; FAO, 2004
household temple. Rice barns will typically also house a temple. This connection between rice and religion, and the clear centrality of rice in family life, showcases the importance of rice in Balinese culture and society and highlights how it is embedded in society and the everyday life of Balinese society.

2.4 Study Area Description

The study area is the village of Gunung Sari, located 700 metres above sea level in the Central-Northern part of the island of Bali, Indonesia, with a population of 1043 people in 2014 (Potensi Desa Gunung Sari, 2013). The village is nestled below three religiously significant volcanos which provide heavy rainfall during monsoon season and natural fertilisers such as ash seep down to the rice terraces. There is a total of 83 hectares of irrigated rice fields in the village. Typically there are two harvests per year; local red rice and HYV white rice. However, between July and December, it is also common to plant other crops such as garlic, chilies and red onions. The village consists of 334 households, most of which are farming households that depend primarily on rice to feed the household and to provide it with economic stability. The village of Gunung Sari plays an important role in the production of rice on the island of Bali, Indonesia because it grows a local red rice variety which is extremely valuable and prized on the market. The picturesque landscape of the region of Jatiluwih was named a UNESCO world heritage site in 2012. The site includes two villages:

Figure 2.2: Study area village and hamlet
Source: Author’s elaboration from village information
Jatiluwih and Gunung Sari. This study will focus on the latter village and its three hamlets: Desa, Kelod and Umakayu (figure 2.2). The reason for this is Jatiluwih is moving from farming into the tourism industry, while this study focuses on smallholder farmers that currently rely on rice farming as their primary source of income. This continues to be the case for the village of Gunung Sari.

2.5 Maps of Study Area

Map 2.1 below shows the geographic location of the village of Gunung Sari on the island of Bali. Map 2.2 is a detailed map of the village. The hamlets of Desa and Kelod are located to the center of Gunung Sari, while the hamlet of Umakayu is located to the North-East.

Map 2.1: Map of Gunung Sari Village, Bali, Indonesia
Source: Author’s elaboration using ArcGIS
Map 2.2: Map of the village of Gunung Sari
Source: Author’s elaboration from map by Jatiluwih Organic Red Rice Farmers Association
2.6 The Subaks of Bali and the Irrigation System

The Balinese subak is local farmer’s organisation that works to organise and manage water distribution and the irrigation system used in rice farming. Evidence of its existence dates back to the ninth century (Geertz, 1972; Lansing, 2006). Ostrom (1992:10) defines the subak as a “self-governing irrigation system”. This irrigation society is locally organised and has been managed bottom-up for centuries without government intervention (Ostrom, 1992). Subaks are embedded in cultural and social rituals and are a prime example of locally contained methods of establishing rice cultivation based on local knowledge (MacRae & Arthawiguna, 2011). It has been estimated that there are approximately 1200-1800 subaks in Bali (Jha & Schoenfelder, 2011). In the village of study, there are two subak systems. The subaks are spread throughout the island, with each village typically managing its own system. This system is managed by a set of rules and regulations called the awig-awig which ensure the equal distribution of water to all smallholder farmers that have a plot of land for rice farming. From a spatial geographical perspective, the water that irrigates the rice terraces originates from four main lakes in Bali: Lake Tamblingan, Lake Beratan, Lake Buyan and Lake Batur. These lakes fill up the spring water sources and canals which then flood the rice terraces (Geertz, 1972).

The subak system is rooted in Balinese society and cannot be disconnected from the religious and philosophical nature behind it, the Tri Hitha Karana philosophy which emphasizes a harmonious relationship between the people and the realms of the spirit: human to God (parahyangan), human to nature (paleman) and human to the community (pawongan) (Lansing & Watson, 2012). From a socio-anthropological perspective, the subaks are defined as an irrigation group which manage natural resources and ensure adequate water distribution which are closely embedded in religious rituals (Jha & Schoenfelder, 2011; Mariyono, 2014). Religion and self-governance are the defining aspects which differentiate this rice farming system from other irrigation societies.
2.6.1 The Role of Religion

The religion of Bali is predominantly Hindu, with 93.8% of the population of 4.2 million adhering to the main religion (BPS Bali, 2014). Religion is embedded in the everyday life of Balinese society; social structure is closely tied to religious rituals, ranging from personal to social relationships (Geertz & Geertz, 1975). The subaks have commonly been labelled a “socio-religious organisation” because the importance of religion is mirrored in the cultivation of rice (Lansing, 2006:20). Ceremonies are of utmost importance in the cultivation of rice in the subak system and are closely linked to the different growth stages of rice (Lansing, 2006). Ceremony days are selected by priests to ensure the right timing to grow rice and yield an abundant harvest. In this particular case study and context of research of the subaks of Gunung Sari, 15 ceremonies are held in one rice cultivation period. Each one of these steps is tied to a specific religious ceremony; a brief and simplified overview of the ceremonies and steps: 1) opening of the water source; 2) opening of the rice terraces for the new season; 3) seeding the paddy; 4) planting of the paddy seedlings; 5) after planting; 6) 12 day old paddy; 7) 1 month old paddy; 8) 1 month 7 day old paddy; 9) nyepi, the day of rest; 10) 2 month old paddy; 11) 3 month old paddy; 12) for good yield; 13) harvest; 14) moving the rice to the rice barn; 15) to rest in the rice barn. There are appointed village priests who conduct ceremonies in the local temples (Geertz, 1972). Women are typically in charge of preparing the offerings and conducting the ceremonies on individual rice fields (Lorenzen & Lorenzen, 2010).

The rapid infrastructure development in Bali to accommodate tourists has had devastating effects on the society and the environment, both of which are rarely taken into consideration and studied. Despite the drastic changes in infrastructure development on the island, religion plays an important role in preservation; it is an integral part to containing Balinese society, rice cultivation and traditions. Rituals and religious practices are crucial to sustaining Balinese society and maintaining rice cultivation.
2.6.2 *A UNESCO World Heritage Site*

In 2012, the *subak* system of the region of Jatiluwih was named a UNESCO world heritage site. The reason behind it becoming a UNESCO world heritage site was to apply strict measures to protect the *subak* system from infrastructure development (Salamanca et al, 2015). The region is a popular tourist destination and many land owners have converted their rice-terraces into restaurants and guest houses to accommodate tourists. Although in practice, it is forbidden to build on the rice terraces, the region has seen several land conflicts due to land conversion (ibid). Presently, the land cannot be used or sold for purposes other than the cultivation of rice. Local village residents have varied opinions on this topic.

“The natural environment needs to be protected. For example, the natural flows of the rivers cannot be changed. It is not allowed to transform the place to concrete. But other than that not much has changed. Other than building a cement wall around the river, which has damaged the flow of the water and now there’s hardly any water flowing through” (Interview 8, 2016).

“It’s worse now. Because before it was easier to get water, the irrigation was good. Now they have made the irrigation from cement. Before, it was still made from dirt, it never flooded. Now, because they tried to make things better, it looks like it’s worse. Now, a lot of rice fields are dry, mine is also dry” (Interview 12, 2016).

“After Jatiluwih was named a UNESCO world heritage, two years ago, things have changed, people are making money through tourism. Things became better and work quicker because people started using tractors which make work quicker” (Interview 7, 2016).
In sum, irrigated rice proves to be a labour intensive production method which has been constantly changing over the years. The driving forces behind rice production in Southeast Asia, Indonesia and Bali included; where women amount to more than half of the labour. This study uses the case of the subak system to analyse changes from traditional to modern agricultural methods, in the village of Gunung Sari, part of the UNESCO world heritage site.
3 Analytical Framework

The following chapter will present concepts and a literature review which together will be used as the analytical framework guiding this study. First, the units of analysis and smallholder farmers will be defined and placed contextually. This is followed by a literature review and, because literature on the Balinese *subak* system is abundant, this section focuses on significant research by Geertz, as well as research by Jha on gender and the *subaks*. This will be followed by a literature review on gender and agricultural technology by Paris. Then the chapter will present the concepts of: GDoL, livelihoods, agricultural innovation, and traditional/indigenous agricultural knowledge.

3.1 Smallholder Farmers

In this study, the units of analysis are the smallholder farmers in the village. Agriculture is dominated by smallholder farmers in the Global South, where smallholder farmers are the driving sources of production. There are various definitions of smallholder farmers, for the purpose of this study smallholder farmers will be defined as farmers who cultivate rice and subsidiary crops on a plot of land less than two hectares. The land is mainly used for farming, where most of the food cultivated is used within households and any surplus is sold on the market to as income for the household (Thapa & Gaiha, 2011).

In the village of Gunung Sari, all smallholder farmers that own land used to cultivate rice become part of the *angoita subak*, or *subak* members, consequently becoming part of the local irrigation system, the *subaks*, that together manages the irrigation system. This is primarily dominated by men, as it is they who own land. In special cases, when women have inherited or the male is absent, women may be part of the *subak* system. Smallholder farmers pay an annual fee to the *subak* and the *subak* system ensures equal distribution of water to all smallholder farmers and their rice-field plot.
3.2 The Subak System
Clifford Geertz, an American anthropologist, has contributed significantly to anthropological research on Bali. In his paper entitled ‘The Wet and the Dry: Traditional Irrigation in Bali and Morocco’ in 1972 is noteworthy because it provides a basis for understanding the structure of the subak system. His analysis is based on a human ecology perspective, looking at the cultural and ecological factors defining the subak system. Geertz (1972) defined the irrigation system as being homogenous, well organised and effective:

“A subak is a differentiated, corporate, self-contained social organisation, devoted specifically and exclusively to irrigated farming, mainly (though not exclusively) of paddy - a kind of “wet village” as opposed to the “dry” one in which people reside” (Geertz, 1972: 27).

The structure of the subak is as follows: the subak body, which consists of farmer members that organise the rules and regulations, and the subak mechanism, which is irrigation used to transfer water from lakes to rivers. The irrigation system is a matter for each and every member, that is the defining factor which makes the subaks a local farmer managed irrigation system. Geertz has contributed importantly to research on the subaks of Bali, as provides a basis on defining the subak system.

3.3 Gender and the Subak
Due to a perceived male bias in literature on the subaks and noting that women's roles were not being addressed, Jha's(2004) research approaches the subaks through a gendered perspective. The research bases the foundation of discussion on the task of decision making as a gendered activity. Jha affirms that although studies have cast women in the back-light of decision making, they play a vital role in all activities related to the subak: growing crops, pest control, applying fertilisers, harvesting, and making offerings for religious ceremonies. The household and women and men are used units of analysis to determine the
ability they have in making agricultural decisions. In the *subak*, women have an indirect voice; they can usually only voice their opinions through their husband as women are seen complementary to men. Concluding remarks show that the patriarchal society enforces women’s restricted participation; men are the head of households and dominate agricultural decision making. This research has claimed that although women have a fundamental position in rice farming, they remain in the back seat (ibid).

### 3.4 Gender and Agricultural Technology

With the Green Revolution came the introduction of new HYV seeds, chemical fertilisers and new irrigation systems. The immediate result was an increase in grain supply. However, it has been affirmed that this was not the only result, as the green revolution also increased the inequalities between smallholder farmers and large scale farmers. The Green Revolution has also brought with it an increase in technological use and new labour saving technologies, which has resulted in changes the GDoL smallholder farmers. On one hand, an increase in agricultural technology has given women more time. On the other hand, tasks which were once dominated by women are now being taken over by men and technologies are becoming more lucrative (Paris, 1998). In rice farming, women typically dominate activities such as planting, applying fertilisers, weeding, tending rice, and harvesting.

Research done by Paris (1998) paves the path to understanding the shift from traditional to modern agricultural technologies and the implications this has on female and male smallholder farmers in the village of Gunung Sari. Trends show that similar patterns can be seen in various Southeast Asian countries which, through policy implementations, aimed at intensifying crop production during the Green Revolution. In this study, traditional agricultural methods are defined as local methods used in rice cultivation such as local seeds varieties, and ploughing with a wooden ard with cows or buffalos, while modern agricultural methods refer to those which have been introduced post the Green Revolution to maximise yields, such as HYV seeds and the hand-held tractor.
3.5 Gendered Division of Labour

Gender differences in agriculture are socially constructed and defined culturally and socially (Quisumbing, 1996). Kerstan (1994) builds upon the Moser and Harvard Framework on GDoL specifically applied to gender and development in Indonesia, hence will be used in this study. The gendered division of labour (GDoL) looks at the socially and economically constructed ideas of activities women and men participate in (Kerstan, 1994).

With any analysis of the GDoL in a given community, it is important to define the roles both women and men have. A person’s role is defined as their behaviour dependent on a specific socio-cultural background. This is fluid as women and men’s roles are impacted socially and culturally, and gender roles are identified “by the virtue of being female or male” (Kerstan, 1994:53). Gender roles are linked to social values and are socially, rather than biologically, constructed. When livelihoods change, gender roles may also change (Kerstan, 1994; Quisumbing et al., 2015). Economic and political setting, social norms, cultural norms and values are all factors that affect gender roles, which are thus dynamic and change with time (Kerstan, 1994). Labour tends to be constructed around gender, and is dependent on factors such as the economic and political structure of a given society (Quisumbing et al, 2015). While both women and men take on different activities, the GDoL looks at the values behind the division of activities. In relation to the specific context of this study, Boserup (1970) describes three different kinds of agricultural communities and the GDoL: a woman system, a man system and a mixed system. The case used in this study can be defined as a mixed farming system due to the interplay between women and men in rice cultivation activities. Common to all three of Boserup’s concepts is that the introduction of new technologies, which increase men’s power (Boserup, 2007). This notion has been criticised for oversimplifying to a technological shift (Kusujiarti & Tickamyer, 2000).

The rationale behind using a gender analysis in this study is to open up the discussion to understanding the division of labour in an agricultural technological shift. A gender role in
agriculture looks at how socially constructed roles construct decision making in agricultural production (Doss, 2013). In agriculture, there is an interplay between women and men and the gender gap exists in relation to many resources, such as land, livestock, education, wages and technology (ibid). This interplay is precisely the reason why it is relevant to study both women and men in agriculture, and women’s positions relative to men. In many parts of the world women drive agricultural production - in developing countries they add up to 40% of labour force - and their roles are inadequately recognised (Quisumbing, 2015). Gender affects people’s access to resources and livelihoods (Hill, 2011). Critique of the GDoL framework is that it tends to naturalise gender by simplifying livelihoods as simply roles that women and men take on, instead of activities that comprise social change (Hill, 2011).

3.6 Livelihoods

Literature on livelihoods is abundant, and in the past decade has become a popular framework with which to study rural development. This section will analyse only a few approaches towards using livelihoods as a concept. Central to understanding livelihoods is the concept of how people and communities in different places and spaces use resources (both material and social) around them to make a living (Scoones, 2009). The definition of livelihood has been taken from Chambers and Conway (1991): “a livelihood comprises people, their capabilities, and their means of living including food, incomes and assets”. Assets are divided into tangible, such as physical resources, and intangible, such as access. These resources are used to ensure livelihoods. Agarwal (1994) states that access to resources can be through ownership as well as use. Resources can also be accessed through informal agreements through networks. For example, women may have access to resources such as land, but may not always have land rights. Scholars have proclaimed that ownership is rooted in cultural and historical contexts; although there might be ownership of resources, this does not always mean there is access (Galie et al., 2015). Definitions and debates on ownership are vast, and to discuss ownership livelihoods will be used.
From the concept of livelihoods emerged the notion of sustainable livelihoods, which has been used to define access to various livelihood methods such as agricultural intensification and extensification, livelihood diversification, and migration (Scoones, 1998). The framework is intended to be used at different levels, from the individual to the household, to analyse how people make their living and what the factors are impeding this. A sustainable livelihood has been defined by Chambers (1991) as a livelihood that can recover from changes that trigger stress in a community. In recent years, livelihood discussions have moved towards integrating the environment with social and economic factors, and changing the definition of assets towards tools used to make a living (ibid). In different contexts, sustainable livelihoods are realised through the access to resources; the access is dependent on social, economic and environmental factors (Scoones, 1998).

Criticism towards the sustainable livelihood framework is that it simplifies concepts to economic terms such as quantifiable resources and access and does not look into the social issues and power relations behind livelihoods (Scoones, 2009). In this study, this framework is intended to discuss how smallholder farmers in the village utilise resources (land, agricultural machinery and livestock) to ensure livelihoods.

3.7 Agricultural Innovation and Traditional Agricultural Knowledge

The aim of agricultural development, has over the past years, been to increase production and yields to meet the demand from a growing population. Thus, agricultural development has been the result of the introduction of new innovation, methods and materials into production (Hillbur, 1998). Klerkx, Van Mierlo and Leeuwis (2012) affirm that agricultural innovation is due to the interconnection between different factors in the farming system, and is driven by institutional, economic, social and technological changes. Shaw (1987) proclaims that agricultural innovations can benefit rural communities. However, the success of the adoption of innovation occurs when farmers are provided with the means to benefit from said innovations. However, it is not merely about using new technologies. Instead, it is about how new technologies are integrated and used within societies (Klerkx, Van Mierlo & Leeuwis, 2012). The diffusion process passes through four
stages: commenced by the innovation, it is then diffused to society through communication, which occurs in time and, finally, amongst members of society. This subsequently leads to social changes as well as to the diffusion of technologies (ibid). Rogers (1995) defines social change as a process of invention which triggers diffusion. Ruttan and Hayami’s (1984) Induced Innovation theory, affirms that technological innovations are a result of a demand-based need. With an attempt to understand how new technical innovations are available, a technical change is defined as a change in production methods driven by resources aimed at developing new technologies (Ruttan & Hayami, 1984).

In the mainstream debate of agricultural development, traditional agricultural knowledge is not always treated as knowledge (Norgaard, 1984). To understand the central idea of traditional knowledge, it must be contextualised. The aim of agriculture development has been to increase production and this is subsequently an outcome of new innovations, ideas and materials (Hillbur, 1998). Traditional/indigenous in an agricultural context is highly dependent on the local context and has developed through time and institutions. It is defined as “an outcome of interactions between actors within a particular context” (Hillbur 1998:42). As a result, traditional knowledge is embedded in social norms and ecological systems which evolve over time (Norgaard, 1984).

This study uses the aforementioned literature review, definitions and concepts to build its analytical framework. Starting with a definition of smallholder farmers, the units of analysis in this study. Followed by a literature review on Geertz (1972) which provides a theoretical definition of the subak system. Jha (2004) contributed to research on gender and decision making in the subak system. Paris (1998) shows trends on the effects of modern agricultural technology on rural smallholder women and men; agricultural technology has given women more time, however it has also taken jobs away from women. The livelihoods framework will be used to discuss how smallholder farmers use tangible resources to make their living (Chambers & Conway, 1991). The notions of access and ownership are relevant as they determine how resources are used. Agricultural Innovation is a diffusion process
and is not solely about implementing new technologies, it is also about use (Klerkx, Van Mierlo & Leeuwis, 2012). Traditional/indigenous agricultural knowledge is dependent on social and cultural norms and changes over time. This study has chosen to merge a literature review along with concepts to discuss the multi-faceted issue on agricultural technological changes and smallholder farmers. Moving beyond the household level, there is a gap in the literature looking at the implications external factors such as agricultural technology has on the livelihoods and activities of male and female smallholder farmers in the subak system.
4 Methodologies and Methods

The following chapter will discuss the methodologies and methods used in this study. It will start by describing the research design and the initiation of field work. This is followed by the qualitative methods used which contains: an ethnographic approach and participatory rural appraisal methods, semi-structured interviews, sampling in qualitative data collection, and challenges and limitations in qualitative data. It then moves onto the quantitative methods used: household survey, quantitative surveys and sampling, and challenges and limitations in quantitative data collection. Finally, the chapter ends with ethical considerations and reflections on positionality during field work.

4.1 Research Design

This study uses a case study approach because it aims at analysing and understanding the complexity of a setting and a specific context, in this case, the village of Gunung Sari (Punch, 2014). A triangulation of mixed methods was used: qualitative semi-structured interviews as well as observations on the gendered division of agricultural labour and quantitative household survey. The semi-structured interviews paved the road to developing a survey to analyse household demographics and ownership of resources such as land, livestock and agriculture machinery.

The field study proved that research is not a linear process and that in the field realities may highlight important factors which could have been neglected during initial desk study research (Scheyvens & Storey, 2003). The initial aim was to conduct a qualitative case study and the research question was ‘How are smallholder women farmers constrained in rice cultivation?’ The aim was to solely interview women smallholder farmers, but in order to have an entire spectrum of the activities men and women partake in, it proved to be crucial to include both (Chant & Gutmann, 2000; Doss, 2013). However, after entering the
field and commencing semi-structured interviews, the field realities proved to be different; being a woman per se did not hinder participation, in fact, women were the driving forces in rice farming. This also meant that the initial framework on women’s empowerment was no longer applicable when the focus of the study changed to analysing traditional and modern agricultural methods in rice farming and the implications it has on male and female smallholder farmers. This study has allowed theory to evolve during the process (Bryman, 2012).

4.2 Initiation of Fieldwork

The study entailed an eight week field study in the village of Gunung Sari, where I was primarily located. Contact to the village was gained through two gatekeepers: NGO Samdhana and a smallholder farmer. The NGO facilitated contact with a smallholder farmer in the village, a member of the village board, whose home I resided at during the length of the field study. Many conversations on cultural and social aspects of the village were discussed with the smallholder farmer, which were very useful in developing an understanding of the context and taking field study notes on observations.

The gatekeeper to the village facilitated my initial meeting with the village priest, where the field study was discussed and oral consent was given for me to pursue the study. This key moment played an important role in gaining trust when interviewing smallholder farmers. The aim was initially to use a translator that spoke the local language: Balinese. However, after acquainting myself with the village and engaging in unstructured talks, I realised that smallholder farmers working in the rice-fields spoke fluent Indonesian, a language in which I too am fluent. Therefore, I went ahead with the study without using a translator. I did not rely on the gatekeeper to connect me to respondents, instead I did the sampling on my own terms by personally introducing myself in different social settings both within the rice fields and in households, this will further be discussed in section 4.3.3, dedicated to sampling in qualitative research.
4.3 Qualitative Methods Used

4.3.1 Ethnographic Approach and Participant Observation

Throughout the field study, an ethnographic approach was used to submerge myself into the social setting and to observe, experience and listen to the realities of the smallholder farmers (Bryman, 2012). This was done by participating in their daily village activities such as planting rice, weeding the rice-fields, and attending village ceremonies. All these activities allowed me to move beyond the colloquial level and into deeper conversations (Cotterill, 1992). This was particularly evident when I started to work with the women smallholder farmers weeding in the rice-fields, engaging into personal conversations about the organisation of agricultural activities and decision-making in rice farming.

Participatory Rural Appraisal (PRA) was used to put the smallholder farmers in the knowing field, especially during the semi-structured interviews (Chambers, 2008; Cotterill, 1992). During observation, detailed notes were kept on how women and men used public spaces such as rice fields and temples in the village of Gunung Sari. Furthermore, observation was used to plot down every agricultural activity done by men and women which was observed in the rice fields.

4.3.2 Semi-structured Interviews

Semi-structured interviews were used to collect qualitative data on how smallholder rice farmers in the village constructed the GDoL and how agricultural decisions were made (Hammet, Twyman & Graham, 2014). Semi-structured interviews provided a way to look deeper into the constructed reality of male and female smallholder farmers. Initially, I misunderstood different perspectives of individuals. As narratives were often different, especially amongst women and men and in different households, there was no right or wrong. It was necessary to observe who was saying what and in which context. The semi-structured interviews were used to create a narrative around how people constructed
their reality on the gendered division of agricultural labour and ownership of resources (Punch, 2014).

There were a number of predetermined questions asked in the interviews, but the semi-structured interviews were open-ended so there was a space for discussions and an opportunity to explore evolving matters (Hammet, Twyman & Graham, 2014). To commence the interviews, a general question was asked: “What activities have you performed today?” This was a way to ease into the interview. The following questions asked were on the agricultural division of labour, such as: “What are women's tasks in rice cultivation?”, “What are men's tasks in rice cultivation?”, “How are tasks in rice cultivation divided between men and women, who makes these decisions?”. Following questions were asked on traditional methods and knowledge: “Why/not do you use a hand-held tractor/wooden ard to plough?”. Further questions were asked on the challenges faced in rice cultivation as well as changes in traditional and modern farming practices that have occurred over time in the village. Finally, questions were asked on the role of the subak system in rice farming.

When oral consent was gained, the interview was recorded and then transcribed. In some situations, respondents felt uncomfortable with being recorded so detailed notes were taken during the interview and then transcribed (Bryman, 2012). Additionally, I kept a field diary on observations and findings during the course of the field study. Important to qualitative data is the validity of the data collected. After each interview, I summarised the response to ensure an accurate understanding in an attempt to achieve internal validity. Although argued to be a weak format in validity, this was a way to minimise miscommunications and increase credibility (Punch, 2014). To code the data, firstly open coding was used to put labels on the data. Once labels were put, thematic coding was used to identify recurring themes in the qualitative data such as: women's roles, men's roles, traditional agricultural methods and modern agricultural methods and changes in these factors (Bryman, 2012).
4.3.3 Sampling in Semi-structured Interviews

Purposive sampling was used to initially sample adult female and male smallholder farmers that are engaged in rice farming. A total of 20 semi-structured interviews were conducted with smallholder farmers, out of which 11 were female, and 9 were male. The respondents were spread out across all three hamlets in the village. I took with me a hand-drawn map of the area to ask the respondents to map out where they lived and where their plot of rice field was to ensure that the sample covered all hamlets. Further snowball sampling was used to find subsequent respondents (Bryman, 2012). As mentioned previously, I did not depend on the gatekeeper; instead, I initiated the interviews which occurred directly in the rice-fields during the noon lunch-break, which proved to be a good time to interview smallholder farmers. Out of the 20 semi-structured interviews conducted, three interviews were conducted with key respondents: the head of the subak, the secretary of the subak and a village board member. These were key respondents because they provided me with information on the structure, history and changes of the subak system. Follow-up interviews were conducted with 11 out of the 20 semi-structured interviews. The reason for this was to move beyond the colloquial conversation and into deeper personal experiences (Cotterill, 1992).

4.3.4 Challenges and Limitations in Qualitative Data Collection

During the two-month stay in the village, I was faced with various challenges: at times the line between respondents and friendships was blurred, which points towards ethical concerns which will be further discussed in section 4.5. Although there was a gatekeeper to the village, the sampling and interviewing was done primarily alone, which required more time to gain trust from the participants due to my position as an outsider. It was not uncommon that it was difficult to interview women at the start, as they often shied away stating they did not know how to answer. Interviews were conducted during lunch times or during evenings in private homes, which posed some challenges as being a female out after dark was not completely socially acceptable. Other challenges included a seasonal
challenge, research was conducted during the heavy monsoon season which hindered access to respondents. As data was gathered on observing the gender division of agricultural labour, the limitation to this is that I was located in the field for eight weeks. In order to develop a comprehensive understanding of all the activities conducted in rice cultivation, it is necessary to spend twelve months in the field.

4.4 Quantitative Methods Used

4.4.1 Household Survey
The semi-structured interviews provided a foundation for the household survey. As a result, the quantitative data collected is ample. The objective behind conducting the survey was to collect data on how resources such as land, livestock and agricultural machinery are owned and who made the decisions behind buying agricultural machinery. The questions in the survey on ownership of agricultural machinery aims at looking at how technologies and managed and owned between women and men smallholder farmers. Questions were asked on who owned the livestock both internally and externally of the household, and who was tending it. Basic demographic data was collected on; age, education level and number of family members. This data will be used to discuss smallholder farmer livelihoods, the resources smallholder farmers use to make a living, as well as discussing the difference between agricultural activities and owning and tending livestock as data from women and men vary greatly.

In hindsight, the survey has several limitations which will be discussed in section 4.4.3. The survey was conducted in the sixth week of the eight weeks of field study, to ensure that I was orientated around the field site and had familiarised myself in the three hamlets. This helped households accept me into their homes to be surveyed.
4.4.2 Quantitative Survey and Sampling

A pilot household survey was conducted with nine households to test the comprehensiveness of the questionnaire. The intention of the survey was to be simple and straightforward. Changes were made to survey. I conducted all the surveys, and the questions were asked in the same way to all respondents in an attempt to ensure an equal understanding of the questions amongst all respondents.

The units of analysis for the quantitative surveys were the head of household and spouse in every household. A total of 50 quantitative surveys were conducted spread out over 33 households. Out of which 31 were male and 19 were female respondents. The sample represents 10% of the total 334 household in the village of Gunung Sari. The surveys were spread out evenly across the three hamlets: Desa, Kelod and Umakayu. I was faced by time and resource limitations, and decided to use different sampling methods.1

Criteria sampling was used, the first criteria was to sample households involved in rice farming, either owning rice field land, or working as daily paid labour. The second criteria was to survey the the head of household and spouse. Then systematic sampling was applied to equally divide the surveys between all three hamlets in the study village (De Vaus, 2002; Bryman, 2012). In an attempt to use a systematic sampling method, the starting point for the hamlet of Desa and Kelod was at the crossroad of the main road, commencing with the first house on the right-hand side. While for the hamlet of Umakayu, the starting point was at the rice mill, also using the right hand rule. Because housing complexes usually comprised of extended families, the surveys were spread out evenly amongst different housing complexes in each hamlet. The sample group allowed for at least one more follow-up visits if the households were vacant or had missing members (Fink, 2003).

1 A list of the village households was not available, initially I planned to use the right-hand rule, and every n=10th household would be interviewed. However, due to the village structure, this would have resulted in a cluster of households and a bias in the data.
Because the study was focused in one village, relatively small, it was inevitable to have overlapping respondents in the qualitative and quantitative interviews, a total number of four respondents overlapped in the semi-structured interviews and household survey.

4.4.3 Challenges and Limitations in Quantitative Data Collection

It was essential to have separate data on women and men, where ideally the head of household and spouse in each household would be interviewed independently (Doss, 2013). The household survey was conducted in the evenings, after farmers had returned home from the fields, this usually meant that women and men were home together, hence both were mostly present during the household surveys. Similar challenges as the qualitative sampling occurred during the quantitative sampling, women turned away. Also, at times I did not have consent to interview the wife of the household. However, when possible, both respondents were interviewed separately. It proved to be rather difficult to explain the survey to each and every household as households were doubtful and at times reluctant. Households in the hamlets of Desa and Kelod were generally open to be surveyed after providing an explanation of the survey and who I was. However, households in the northern remote hamlet of Umakayu seemed to be quite perplexed with the survey, and it was not uncommon that household rejected to participate in the survey. Challenges were faced in the power imbalances created simply by my presence of having a pen and paper. Particular power imbalances were seen when a household asked to be helped because they were poor. I attempted to explain in the best way that this was not possible and did not promise or provide false ideas (Scheyvens & Storey, 2003; Sultana, 2007).

Although, the aim was to survey both the head of household and spouse in every household, as mentioned above in section 4.4.2 this proved to not be possible. Finally, a total of 31 men and 19 women were surveyed. The survey itself has various limitations, and need to be mentioned before analysing the data. Firstly, the validity of the findings; the aforementioned sampling method does have limitations, as it was not able to follow a thorough simple random sampling hence uses a combination of sampling methods. The
results from the survey highlights trends in the village. Second, as questions were focused on ownership of land, livestock and agricultural machinery, it was not always clear what defined ownership, and it should not be generalised that everyone has the same view on ownership. Hence in an attempt to differentiate this, questions were asked on owning and tending and decision making to buy agricultural machinery. In question 16 (see appendices C), although the wooden ard is not an agricultural machinery, rather a tool, it has been classified as an “agricultural machinery” in this survey. Furthermore, there is a limitation in question 17 as it does not differentiate between who made the decision regarding which agriculture machinery, instead groups all machines together. Limitations of time restricted the study from widening the sample group and using thorough random sampling methods, however the survey provides an overview of village demographics as well as ownership of resources amongst households.

4.5 Ethical Considerations and Positionality in the Field

Oral consent was gained for all interviews and household surveys, and all interviews relied on voluntary participation. In addition to this, a clear explanation of the study was given and I left space for questions. Because of the extended stay in the village, I was engaged in many informal conversations with people, and several conversations moved beyond the informal and towards deeper personal experiences. I was faced with the ethical dilemma of treating this personal information, the data collected intends to not endanger any participant in this study and hence have kept the anonymity of respondents. Ethical concerns also came up with the observation method used. Data was collected on the GDoL and type of work activities conducted: gender, time and location of activity. It was particularly difficult to gain consent from each and every member observed. Other data was collected by observing how public space was used by both men and women; within the household, the temples and the rice-fields. By observing people’s work patterns and taking notes on this, this has put me in the position of an observer, and hence created a power imbalance. (Hammet, Twyman & Graham, 2014). Data collected through observation is subjective, as this is personal notes that I collected on the gendered division of agricultural labour.
Though I was raised in Bali, Indonesia, returning to conduct a field study did not mean coming back home. The village of Gunung Sari is located in the Northern part of the island and the village is rural and strikingly different to the now-industrialised Southern part, where I grew up. Though, having done previous work for an NGO in Bali and having been to rural areas, this has allowed me to be acquainted with local villages. The farmers of the village of Gunung Sari were extremely welcoming as well as hospitable and willing to share personal experiences. Throughout the fieldwork, I was constantly aware of my positionality. This was frequently brought up when discussing my educational background, at times created a hierarchical difference, where at times, I had to discuss my positionality (Sultana, 2007). It was particularly perplexing to farmers, that I had come alone to the village, without a friend or chaperone. There were certain similarities such as speaking the common language Indonesian, clothes and at times and the same gender allowed for a common ground for understanding and discussion. However, it would be inaccurate to say that I was accepted as an insider, due to these similarities (ibid). Sultana (2007) expressively describes this complex position as “an insider, outsider, both and neither”.
5 Findings

The following section presents the findings of the qualitative and quantitative data collected. It begins with an overview of the village (demographics, land use and labour), followed by findings on agricultural technologies (the traditional wooden ard plough, hand-held tractors and HYV seeds). Findings on the gendered division of agricultural labour are then presented, followed by findings on ownership of resources. In favour of understanding the implications that a shift from traditional to modern rice farming methods has had on smallholder farmers in the study village, this section will present a narrative analysis on how modern agricultural machinery affects the gendered division of agricultural labour and how ownership of resources influences livelihoods.

5.1 Village Overview: Demographics, Land Use and Labour

The village of study has since long been an agricultural village dependent on rice farming as a primary source of income and livelihood. On average, households have between four to six members. Respondents ages varied between 26-70 years old, with the most active smallholder farmers between the ages of 30-60. The average schooling level completed was elementary school. Houses are typically made out of bricks with tiled roofs, organised in clusters with courtyards which usually belong to one extended family. Each of these clusters can have between seven to fifteen households. Central to the clusters is the family temple, large in structure and of great importance as it is given to ceremonies and rituals. Balinese Hinduism is suffused with numerous ceremonies, and with these come the high costs of offerings, which become a financial burden on families (Salamanca et al., 2015).

Agriculture in the village of Gunung Sari is dominated by smallholder farmers. It is common that on plots of rice field, diversified crops such as banana trees, jackfruit trees and coconut trees are planted to prevent soil erosion as well as contribute to an additional
source of food. The surplus is sold on the market as income for the household. The size of rice fields varies between 0.1 ha to 1.5 ha, on average the size is 0.2 ha. The patriarchal structure of society enforces male land ownership (figure 5.1); heritage flows down the male family line, and land is commonly divided amongst male offspring. 82% of land is owned by men, 14% do not own land, and 4% of the land is owned by women. Although some do not own land, survey data show that these farmers are participating in farming activities as daily paid labour.

Figure 5.1: Female and male land ownership
Source: Author’s elaboration using survey data from question 10

Rice field land is used to plant two types of rice: the local red rice which is highly lucrative and costs approximately three times more on the market, and a HYV white rice, namely R64, introduced during the Green Revolution. From January to June, this land is solely used to plant red rice, the local rules and regulations of the subaks, the awig-awig, enforces this practice to protect the local red rice variety which is native to the region. Climate variations have put strains on smallholder farmers, as was observed during the past season of 2015-2016. The delayed monsoon season resulted in severe water shortages. The lack of water obstructed farming patterns and smallholder farmers had to resort to planting other crops such as red onions, chilis and garlic. For households which depend on rice for food and economic income, such changes increase food insecurity. The market prices of non-rice crops fluctuate heavily, compared to the somewhat more stable market price of rice.
Therefore, not only does it become unsafe but also expensive to plant solely other crops, the following interview expresses this notion:

“It's more expensive to only plant other crops instead of rice. If paddy is planted we don't go to the fields everyday, for example, now we plough, in two days we plant, then we're free. We can search for other work. That's the deal. But in planting vegetables you can't work like that. You can't work like that with chilis and tomatoes. During the dry season you need to water the fields everyday. If there's no water the land will be empty” (Interview 15, 2016).

Although rice is the main source of economic stability amongst households in the village, narratives show that being a farmer also implies to diversify income:

“Farmer does not mean only working in the rice-fields. Farmers take up lots of work as daily paid labour, in construction, some farmers here are even teachers. For example, some farmers also work in offices, they come home and work in the rice-fields. There is no one here that's just a farmer. That's why people rarely use cows to plough now, people use machines. Because it's quicker” (Interview 15, 2016).

Presently, smallholder farmers are commencing to diversify income with daily paid labour. Once male farmers complete activities such as planting and ploughing, they typically mobilise in search of work in neighbouring villages in construction or migrate to urban areas to work in the booming tourism industry. Women commonly work in construction sites nearby, however they are less likely to migrate for work. Amongst women, it is common to generate income by selling hand-made coconut leaf offerings as well as vegetables harvested from family gardens. When farmers were asked what their primary activity is, males regularly stated farming, while most women responded non-farm
activities, such as household chores. Once household activities were completed, they moved to the rice fields.

5.2 Traditional and Modern Rice Farming Methods

Previously, farmers only harvested the local red rice variety once a year. With the introduction of the HYV seeds came two harvests per year. This subsequently increased the supply of rice in households. One narrative reveals that times were difficult before; one harvest per year did not yield enough rice supply for the household and there was no surplus to sell on the market. After the introduction of white rice, there has been an increase in food security (Interview 19, 2016). Another narrative shows that although there was only one rice harvest per year, generally there was a small surplus to sell on the market and trade for other goods. Since approximately 2008, the village has experienced a rapid increase in agricultural machinery resulting in a change in ploughing methods from the traditional wooden ard plough commonly pulled by two cows or one buffalo (figure 5.3), to using a hand-held tractor fueled by petrol (figure 5.2).

**Figure 5.2:** The hand-held tractor  
Source: Author’s image, 2016

**Figure 5.3:** The traditional wooden ard  
Source: Author’s image, 2016
Although becoming an increasingly popular way to plough rice fields, not all smallholder farmers in the village have made the shift to the hand-held tractor. There are various reasons suggesting why, one being that the steep inclination of rice terraces make it difficult to plough with hand-held tractors compared to ploughing with cows. Another reason is the high prices of purchasing a tractor, making it difficult for smallholder farmers to access this agricultural machinery. Smallholder farmers also felt the importance of maintaining traditional ploughing methods to preserve traditional agricultural knowledge. The following expresses this: “I prefer to use cows, the traditional way, we can still preserve traditional knowledge. Using a tractor is the national way” (Interview 17, 2016).

Thus, farmers who are not able to plough with hand-held tractors due to health reasons, old age, inability, financial reasons or do not own a hand-held tractor, hire a member from the village to plough their rice fields. Survey data shows that 8% own hand held tractors (figure 5.6), farmers who do not own a tractor either continue ploughing the traditional way with cows, or hire labour and machine, or labour and animal draught. The following farmer amongst others states his preference of ploughing with cows:

“I plough with cows. I don't like to plough with a tractor. With a tractor I would spend money. If I were to use a hired labour, I have to spend money, I'm old, I don't have money.” (Interview 17, 2016).

While the above narrative shares one side of the story, the following are contrasting reasons why farmers are ploughing with hand-held tractors. Factors include social norms, increase in time and religious reasons:

“It’s rare to use cows to plough now. It's common to use a machine/tractor. Now the times are modern, one needs to know how to plough with a tractor. With cows for, example it's not possible to plough everyday, there are certain days when it's not allowed due to the Hindu religious calendar. With
tractors, it can all be done by one person. Before with cows, no, you couldn't do it all in one day” (Interview 11, 2016).

“Because I am following my friends. Because they're all changing and going modern. They use it now because it's quicker. Because ploughing with a cow, you can only do it on certain days. For example on respati\(^2\), you are not allowed to work with your cow. Also for example on galungan\(^3\) you are not allowed to work with the cow” (Interview 7, 2016)

“Maybe because people find non-farm work as well as daily paid labour work. If people have time, when the paddy has just been planted, two weeks old, you apply fertiliser, after two weeks there is free time, then one can look for other work. That's why people use machines now - so the work in the rice fields can be done quickly. If traditional machinery is used, it needs three days, using a machine takes one day, that gives two days to find non-farm work. It's rare to plough with cows now, it's rare. It's rare” (Interview 14, 2016).

Initially, the trade-off with using hand-held tractors shows that it is beneficial in terms of saving time and labour. Ploughing can be done in approximately 50% less time. It can also be done on all days of the week, unlike ploughing with cows or buffalos when it may not be done on special days, due to the Balinese religious calendar. With a change from using hand-held tractors to plough, male farmers have experienced an increase in available time and are thus working in neighbouring rice fields as daily paid labour. In the meantime, female farmers have expressed that for some activities they now work alone in their rice field, without their husbands. Furthermore, the change from traditional to modern ploughing methods has changed the activities women and men are involved in.

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\(^2\) Traditional Hindu holiday.
\(^3\) Traditional Hindu holiday when the ancestral spirits visit the Earth.
5.3 Gendered Division of Agricultural Labour

Data on the agricultural division of labour has been collected through survey data, observations, and semi-structured interviews. Figure 5.4 shows how the gendered division of agricultural labour is divided between women and men in rice farming activities, from planting to selling. Although it is common for women and men to work together in rice farming activities, there are striking divisions in the role each gender plays in rice farming. Trends show that this division is a fluid construct of society.

Ploughing with a hand-held tractor is a male dominated activity, this can be seen in figure 5.4. When asked whose role ploughing was, both women and men agreed that using a tractor was a male activity. The survey data show that planting and weeding is a male activity, although women also participate (figure 5.4). There is a contradiction: survey data reveal that weeding is a male dominated activity while qualitative interviews as well as field observations show that weeding is a female dominated activity. Furthermore, in the qualitative data almost all men acknowledged that weeding was a female activity. Women typically work in weeding and harvesting as daily paid labour in other people’s rice fields within the village. It is common to firstly find paid work in other rice fields, and then complete work in private rice fields. This is also apparent in answers given from men in the semi-structured interviews; men tend to plough other farmer’s rice fields first to get paid, and plough their own afterwards.

Cutting grass along the rice-fields is a male dominated activity, presently this activity is done by men using a hand-held grass cutting machine. Previously, this was performed by women using a sickle. Applying fertilisers, mostly chemical, has equal male and female participation (figure 5.4). Respondents associated tending to rice fields through care of the water and irrigation system as a male dominated activity. In qualitative interviews, farmers stated that in the subak system it was the male’s duty to ensure the irrigation was tended. Harvesting has both male and female farmers performing the activity, although data show
more women than men. Qualitative interviews reveal that harvesting of the red rice is done by women by hand, with a traditional knife called the *ani-ani*, and is also pounded by women. Men tie the bundles together, while women carry the rice on their head. The harvesting of the HYV white rice, on the other hand, is primarily done by men with a sickle, and threshed (loosening the rice grains) directly in the rice-fields.

![Figure 5.4: Gendered Division of Agricultural Labour](image)

**Figure 5.4 : Gendered Division of Agricultural Labour**
Source: Author’s elaboration using survey data from question 14

Qualitative data show that although ploughing with a hand-held tractor is presently a male dominated activity, ploughing by traditional methods used to be actively performed by women. When women farmers were asked what the reasons behind this were, responses included: “I can’t yet. If I learn and understand, then I’ll do it. If I knew how to, I would. Like a motorbike, where the brakes and gears are, I need to know where” (Interview 11, 2016). Women reveal that they want to learn. Another respondent expressed: “Because I am not brave enough” (Interview 5, 2016). In one case, a woman in the village had a tractor and was able to plough. When she was asked what her reasons where to plough with a tractor, she responded:
“Because I like it, I wanted to try. Until my husband bought me a small tractor. My husband has two tractors, one with a big body and one with a small body that has been recently bought so that I can use it. It's lighter than that one, to use in the rice-fields” (Interview 14, 2016).

Presently, there is a clear disparity between women and men’s wages in rice farming activities. Survey data reveals that weeding is dominated by men, however qualitative data show that this activity is dominated by women. Female associated labour such as weeding (see figure 5.5), planting and harvesting paid on average five times less than the amount men are paid for ploughing or with hand-held tractors or the traditional wooden ard.

![Women smallholder farmers weeding](source: Author’s image, 2016)

**Figure 5.5:** Women smallholder farmers weeding

In an attempt to understand how rice farming decisions are made, this study explored the role of the *subak* system in the community. Once a month, the village holds a *subak* meeting where all smallholder farmers in the village who own a plot of rice are present. It was apparent that because land ownership was under the name of the male in the household, it was mostly only men attending the meetings. These meetings are used to
ensure equal distribution of water as well as synchronicity in planting and harvesting. They also discuss financial and religious matters. On extraordinary occasions when the man cannot attend, the female in the household may attend. When asked what the role of male farmers in the subak is, respondents answered that it was to keep the irrigation system intact. It was also males who made the decisions in the monthly meetings, and women could voice their opinions through the men.

5.4 Ownership of Land, Agricultural Machinery and Livestock

There has been an increasing trend that villagers are adopting modern agricultural methods to plough their rice fields. Survey data show that 8% of farmers own a hand-held tractor, while a mere 2% own a traditional wooden ard plough (figure 5.6). One respondent states that approximately 60% of smallholder farmers are ploughing with tractors, while 40% are ploughing with cows. These numbers are not backed-up by survey data, and there is no further proof on this topic. The highest percentage of ownership is with the grass cutting machine at 41%, while 37% do not own any type of agricultural machinery, and 12% own a pump sprayer used to spray fertiliser on the rice (figure 5.6). When exploring who owned the agricultural machinery, all respondents stated that it was the male in the household that owned the machinery. A difference can be seen in trends between owning and making decisions, when female farmers were asked who made the decisions to buy the agricultural machinery, trends show that men make decisions, however in some cases it was apparent that decisions were made collectively. Responses from women in qualitative data show that agricultural decisions needed to be made collectively as that was the only way to work harmoniously in rice farming. Through qualitative data both women and men have stated that it is commonly the man in the household that made the decision to buy the agricultural machinery, because they had more information on where to buy it and how to use it from other farmers in the village.
The next resource is land. Figure 5.7 shows that 86% of smallholder farmers own farmland, of which 82% is owned by men (see figure 5.1). While 14% were landless, it is uncommon to rent land. Instead landless people either work as daily paid labour in rice farming or in construction. In the 4% of households were women owned land, it was either because they did not have male siblings or they were unmarried. Farmers were asked through qualitative interviews who made the agricultural decisions in rice farming: “The one who has the role is the man, he follows the planning of the awig-awig. If the dates are passed - you pay a fine. It's the husband that has the role to make sure it's all finished on time” (Interview 1, 2016).
The third resource, livestock, proved to be an essential resource to own within households in the village, where 96% owned livestock. The types of livestock are divided between internal and external of the housing compound. Chickens, ducks and pigs are kept internally, while cows are kept externally in the rice fields. Cows and pigs are typically bought and kept as an investment: cows are used to graze the rice fields and plough and can also be sold on the market. Chickens are kept for food, while pigs are kept as additional source of income and are sold during religious holidays.

![Figure 5.8: Type of livestock ownership](image)

Source: Author’s elaboration using survey data from question 20

The distribution of ownership of livestock between women and men can be seen in figure 5.9. Cows are primarily owned by men, while the percentage of women owning cows is extremely low. Although trends show that there is an increase of ownership of pigs, chickens and ducks by women, ownership is still dominated by men. Trends show a division in ownership, either owned by men or by women. Thus, household ownerships was not common. Figure 5.10 show data on tending livestock. Tending cows is dominated by men, qualitative data states, “because taking care of cows is heavier work” (Interview 1, 2016). While tending pigs, chickens and ducks is a female dominated activity, even though it is mostly owned by men.
There were apparent differences between male and female responses. Men commonly claimed to own livestock, while women responded there was joint ownership, as it belonged to the household. Quantitative data highlights that ownership of livestock is dominated by men, while farmers differentiated that tending livestock within the housing compound was a women’s role. This was furthermore confirmed through qualitative interviews, the following quotation reveals this: “Pigs are usually belonged to the man and the woman tends them” (Interview 18, 2016). Data reveals that ownership of livestock is dominated by male, particularly cows, while women have increasingly access to tending livestock within the housing compound.
6 Discussion and Concluding Remarks

This section discusses the aforementioned findings in relation to the research questions by using the analytical framework and literature. Firstly, changes in traditional rice farming methods will be discussed using the agricultural innovation and traditional/indigenous agricultural knowledge literature. Then, a discussion on the gendered division of agricultural labour and technology using the GDoL framework. This will be followed by a discussion on the ownership of resources using the livelihoods framework. Finally, this chapter presents concluding remarks as well as suggestion for future research.

6.1 Changes in Traditional Rice Farming Methods

Recent years have seen a change in agricultural technology in Bali. This has, in many ways, impacted the traditional subak system (Arthawiguna, Lorenzen & Lorenzen, 2005). Famed for being a bottom-up “self governing irrigation system” (Ostrom, 1992:10), the implementation of new agricultural technologies has, amongst other factors, resulted in changes in rice farming methods and the organisation of labour in rice farming activities. Theoretical evidence shows that agricultural development programs during the 1970s Green Revolution contributed significantly to decreasing world hunger (Paris, 1998). The Indonesian government imposed HYV rice seeds as well as labour saving technologies. In the case of Bali, the implementation of modern agricultural technologies disregarded traditional agricultural knowledge such as the subak system (Kusujiarti & Tickamyer, 2000; Sepe, 2000). Traditional agricultural knowledge in Bali is deeply rooted in religious rituals which are interconnected to rice cultivation. Disconnecting the cultivation of rice from religion and traditional methods has, in the past, lead the subak system to a point of breaking (Ramalingam, 2013). One of the many roles of Bali’s subak system is to preserve traditional agricultural knowledge through a locally managed irrigation society which ensures uniform rice cultivation patterns.
Changes in Bali since the Green Revolution can be seen in the adoption of HYV rice seeds as well as a shift to ploughing with a hand-held tractor. This is becoming an increasingly popular way to prepare rice fields. In the qualitative data collected, smallholder male farmers have stated that the main reason for changing methods is because it is time efficient and they can furthermore outsource work in other sectors. This trend is also common in other Southeast Asian countries such as Vietnam, Thailand and the Philippines, where women are left in rice cultivation because of male outmigration (Paris, 2009).

Hillbur (1998) affirms that agricultural development, in the past years, has pushed to increase production yields to meet demand. This has been made possible through new innovations. Similar trends are seen in the village of study with the adoption of new agricultural innovation. Affirmed by Shaw (1987), agricultural innovations can be successful and beneficial if all farmers are provided with the means to access and make use of the innovation. Although male farmers in the village have benefited from excess time through the introduction of agricultural innovation, not all women have benefited. This theory is further supported by Paris (2009); whether women can benefit depends on their access and control over resources. Although many male farmers have made the shift to using hand-held tractors, some still lack access to and knowledge of this agricultural innovation, especially women.

The Induced Innovation Theory by Ruttan and Hayami (1984), previously mentioned in the analytical framework (chapter 3.7), affirms that agricultural innovations are driven by a demand-based need. Findings in the village show that there is an increase in the use of agricultural machinery, and smallholder farmers have adopted agricultural innovations in the form of HYV seeds and agricultural machinery. Data show that demand by smallholder farmers was also driven to adhere to societal norms. Trends in the data reveal that albeit the community adhering to societal changes and adopting new agricultural innovation, the subak system enforces to preserve traditional rice varieties and methods. Smallholder farmers attempt to conserve traditional agricultural methods by continuing to plough with
the wooden ard. Traditional knowledge is embedded in social norms that, with the introduction of new innovations and knowledge, change over time (Norgaard, 1984). Similarly, in traditional agricultural knowledge the introduction of new innovations have changed agricultural methods in the village. Although the subak system attempts to maintain local knowledge, the implementation of new agricultural machinery has resulted in changes in rice farming methods. It is not merely about innovation but about the practicality of such innovation and how it is integrated into the everyday life of smallholder farmers (Klerkx, Van Mierlo and Leeuwis, 2012). Cases in the village prove that not all farmers have made the shift due to financial reasons as well as accessibility and the desire to preserve traditional agricultural knowledge. The adoption of modern agricultural methods by smallholder farmers has contributed to changes in the gendered division of agricultural labour.

6.2 Gendered Division of Agricultural Labour and Technology

Boserup differentiates between three agricultural systems, significant to this study is the mixed farming system where the interplay between women and men farmers is crucial (Boserup, 2007). Such mixed farming systems are typical to Southeast Asia, Indonesia, and the village of study. Departing from the GDoL framework, gender roles are defined as being socially and economically constructed (Kerstan, 1994). Modern agricultural methods driven by economic development have brought with them an increase in technological use. These new labour saving technologies have resulted in changes in the gendered division of labour in rice farming activities.

Harvesting and weeding are important sources of income for women in the village of study; traditional harvesting of red rice is done by women by hand using the ani-ani. However, with new HYV white rice this activity is now dominated by men who use the sickle. Studies undertaken by Kusujiarti and Tickamyer (2000) explain that women in Java, Indonesia, are typically employed in paid labour in activities such as weeding and planting, this trend can be seen in the village as women work as daily paid labour in weeding and
harvesting. Other trends in the qualitative data unveil that traditionally cutting grass was performed with a sickle. Presently this method continues to be used, but a change in the division of labour is occurring as male farmers are increasingly using a grass cutting machine to perform this task. Ploughing with the traditional wooden ard was previously performed by women, however with the introduction of the hand-held tractor, this activity is now dominated by men and paid more. Studies by Paris (1998) support this trend in other Southeast Asian countries; rice farming activities which were once dominated by women are being taken over by men and machinery. The perception behind ploughing being coded as a male activity has, to a certain extent, been constructed by societal norms as to what is a male and female’s role in rice farming.

If diffused and adopted, agricultural technologies can benefit rural smallholder farmers livelihoods as well as women, if they have access to these resources. This study shows that hand-held tractors have consequently increased men’s wages in this activity, while women farmers lack access and knowledge to this machinery. Paris (1998) suggests that agricultural innovations may increase women’s surplus time. However in this study, agricultural machinery has increased male’s excess time and hence men are able to migrate in search of other work while women are left to complete all the tasks in rice cultivation. Although male smallholder farmers have adopted this modern trend of ploughing, studies by Klerkx, Van Mierlo and Leeuwis (2012), prove that it is not merely about the innovation, but about the adoption. Data reveal that men have more access to agricultural machinery and make the decisions. Women have stated that although they want to adopt agricultural machinery, they lack knowledge and access. With the introduction of new technologies, gender roles change as a result of social and economic factors; these roles are socially constructed (Hill, 2011).
6.3 Resources, Ownership and Livelihoods

The resources chosen to analyse in the village of Gunung Sari, according to the livelihood framework presented in chapter 3.6, are tangible resources that smallholder farmers use to make their living. In this study these resources have been limited to land, livestock and agricultural machinery, these are fundamental and are a form of capital to livelihoods in rural areas (Agarwal, 1994; Galie et al., 2015).

Resources are used to ensure livelihoods. Access can occur through informal ways such as kin networks, through ownership and use, or through informal agreements in the form of networks (Agarwal, 1994). For example, women may have access to resources such as land, however they may not always share the same rights as men. Scholars have argued that ownership is rooted in cultural and historical contexts and means the right to benefit, while access suggests the ability to benefit (Galie et al, 2015). Defining ownership of livestock in the qualitative data collection proved to be difficult, unlike land, where ownership is evident. Literature and debates on ownership are vast, and exploring notions of ownership is beyond the scope of this study. The livelihoods framework by Chambers and Conway(1991) defined as the assets people use to make their living, provides a basis for discussion on ownership of resources.

In the first resource, land, survey data reveals that it is predominantly owned by men. Although women may legally and culturally own land, it is not common. In the village, a mere 4% of land was owned by women. This is linked to the patriarchal structure of Balinese society as it is males who inherit land (Jha, 2004). Attending the monthly subak meeting is an activity performed by men, and decisions regarding rice farming, water and irrigation are dominated by men. Although women do not typically own land, they have access as they participate in nearly all activities related to rice farming one. Jha (2004) suggests that women appear to be subsidiary in decision-making in rice farming. However, qualitative data reveals that decision-making in rice farming was a joint activity.
Furthermore, Jha (2004) affirms that women have an indirect voice in decision making, a voice through their husbands. This proved to be apparent in decision making within the subak meetings in the village.

The second resource is agricultural machinery. Survey data show that in almost all cases, it was the male in the household to make the decision to buy the agricultural machinery and subsequently also made decisions regarding rice farming activities. Women farmers who lived in households that owned agricultural machinery generally did not own the equipment. Agricultural machinery are tools which aid farmers in rice cultivation. In this case, women tend to have less access, this is apparent in agricultural machinery (Agarwal, 1994).

The third resource is livestock, an essential resource and capital to smallholder livelihoods in the village. Used for ploughing as well as a source of income to households, data reveal that livestock is primarily owned by men, especially livestock which are kept externally such as cows. There was an apparent difference between ownership and tending livestock. The survey data show that although men own livestock, it is mainly women tending livestock kept within the housing compound.

The differentiation between ownership, access and control are apparent and should not be interchanged. Trends show that it is mainly male smallholder farmers who have knowledge and gain access to these resources, and women have a secondary voice in decision making. Furthermore livelihood strategies have been shaped by social norms and gender ideals which have affected gender relations (Agarwal, 1994; Scoones, 2009). Agarwal (1994) affirms that there is a gap between ownership and access to resources and this is one of the factors contributing to gender gap in social status. In the village of study, an introduction of agricultural machinery has increased male ownership of this resource, and women tend to have less access and knowledge to resources which benefit men and increase their excess time.
6.4 Concluding Remarks

This study provides an insight on the implications a rise in agricultural machinery has on traditional rice farming methods and smallholder farmers. The first implementation of modern agricultural technologies came during the Green Revolution, driven by capitalist agricultural production methods in the form of HYV seeds and other agricultural technologies. This has had lasting effects on the livelihoods of smallholder farmers. Findings in this study are specific to this case. However, similar tendencies are occurring in other agricultural communities in Southeast Asia (Paris, 2009).

The first research question aims at analysing how the rise of agricultural technology has influenced traditional farming methods and women and men’s activities in rice farming. There has been a steady increase first in the use of HYV seeds, and then hand-held tractors in the village of study. Traditional rice farming methods are being taken over by labour saving technological methods. With increased access to agricultural technology, smallholder men have excess time to diversify income activities in other sectors, while activities which were traditionally performed by women are now being taken over by men and technologies. The introduction of new technological inputs such as HYV seeds, the hand-held tractor, and the grass cutting machine have contributed to changing the gendered division of agricultural labour. These gendered divisions are socially constructed and flexible, changing over time as social and economic conditions evolve.

The second research question is concerned with what ways the distribution in ownership of resources (land, agricultural machinery and livestock) affects smallholder rice farmers and their livelihoods. These resources proved to be essential to farmer’s livelihoods, and a divide in ownership between men and women is apparent. Land ownership is embedded in a patriarchal society, and the subak system enforces male management of the irrigation system and decision making. Smallholder male farmers have benefitted from the hand-held tractor, while women farmers reveal that they lack access and knowledge to agricultural machinery. Livestock also proves to be an essential form of capital to livelihoods. Findings
show there is a gap between ownership and access. Although women have access to resources, they are typically excluded from decision making.

Agricultural technologies are not being implemented in everyone’s interests; agricultural development innovations need to be inclusive to women as well as sensitive to traditional agricultural knowledge. NGO Samdhana has expressed an interest, as the result of the primary data collected in this study, in facilitating a women’s cooperative in Gunung Sari to ensure that women are not marginalised in the modernisation process of rice farming. Future research could be improved by expanding the scope to include the neighbouring village of Jatiluwih, which has been moving out of the agricultural sector and into the tourism sector. Expanding the research would allow for an assessment of the implications that this form of modernisation has had on traditional agricultural rice farming methods as well as the livelihoods and access to resources smallholder farmers have. Such work could be an important contribution to existing research aimed in protecting traditional farming methods as well as smallholder farmers livelihoods in Bali’s subak system.
7 Reference List


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Appendices

A. Semi-structured Interview Guide

Background Information:

Name: Marital Status:

Sex/Age: Family members:

Agricultural Activities:

1) When did you start rice farming?
2) Who did you learn from?
3) What rice farming activities do you/husband/wife partake in and why?
4) What is the role of women/men in rice farming?
5) How are agricultural tasks divided between you/your husband/wife?
6) Who makes decisions regarding rice farming activities?
7) How do you plough your rice fields now? Before?
8) Why do you plough with a tractor/with a wooden ard?
9) What are traditional rice farming methods?
10) What are modern rice farming methods?
11) Do you face any challenges in rice farming?

Community:

1) What is the role of the subak in the community?
2) What is the role of women/men in the subak?
3) What is the role of the subak in rice farming?
4) What is the role of religion in the subak/rice farming?
5) Who participates in the subak meetings and why?
6) What does it mean to you that the region of Jatiluwih is a UNESCO world heritage site?
B. Semi-structured Interview Respondents

<table>
<thead>
<tr>
<th>Respondent/Number</th>
<th>Gender</th>
<th>Occupation</th>
<th>Date</th>
</tr>
</thead>
<tbody>
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<td>Interview 1</td>
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<td>Smallholder Farmer</td>
<td>28 January 2016.</td>
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<tr>
<td>Interview 2</td>
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<td>29 January 2016.</td>
</tr>
<tr>
<td>Interview 3</td>
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<td>Smallholder Farmer</td>
<td>30 January 2016.</td>
</tr>
<tr>
<td>Interview 4</td>
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<td>Smallholder Farmer</td>
<td>30 January 2016.</td>
</tr>
<tr>
<td>Interview 5</td>
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</tr>
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<td>Interview 7</td>
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</tr>
<tr>
<td>Interview 8</td>
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<td>Interview 9</td>
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</tr>
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<td>18 February 2016.</td>
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</tr>
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</tr>
<tr>
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</tr>
<tr>
<td>Interview 17</td>
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<td>03 March 2016.</td>
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</tr>
<tr>
<td>Interview 20</td>
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C. Questionnaire: Household Survey

<table>
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<th>Question</th>
<th>Answer</th>
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<tbody>
<tr>
<td>1. Name/Age</td>
<td></td>
</tr>
<tr>
<td>2. Gender</td>
<td></td>
</tr>
<tr>
<td>3. Education</td>
<td></td>
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<tr>
<td>4. Hamlet</td>
<td></td>
</tr>
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<td>5. Number of household members?</td>
<td></td>
</tr>
<tr>
<td>6. Relation to HoHH</td>
<td>HoHH</td>
</tr>
<tr>
<td></td>
<td>Wife</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
<tr>
<td>7. Number of family members living at home?</td>
<td></td>
</tr>
<tr>
<td>8. Number of family members that work?</td>
<td>Farm</td>
</tr>
<tr>
<td></td>
<td>Non-farm</td>
</tr>
<tr>
<td>9. Primary Activity?</td>
<td></td>
</tr>
<tr>
<td>10. Who owns the land?</td>
<td>HoHH</td>
</tr>
<tr>
<td></td>
<td>Wife</td>
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<tr>
<td></td>
<td>Landless</td>
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<td></td>
<td>Other</td>
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<tr>
<td>11. Size of rice field</td>
<td>are =</td>
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<td></td>
<td>ha</td>
</tr>
<tr>
<td>12. Rice harvests per year?</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
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<td>13. Do you hire labour?</td>
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<td></td>
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<td>14. Agricultural activities</td>
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<td></td>
<td>2=Female</td>
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<tr>
<td></td>
<td>3=Both</td>
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<tr>
<td></td>
<td>4= other</td>
</tr>
<tr>
<td></td>
<td>5= don't sell</td>
</tr>
<tr>
<td>Plough</td>
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</tr>
<tr>
<td>Plant</td>
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</tr>
<tr>
<td>Weed</td>
<td></td>
</tr>
<tr>
<td>Cut grass</td>
<td></td>
</tr>
<tr>
<td>Apply fertiliser</td>
<td></td>
</tr>
<tr>
<td>Tend rice field</td>
<td></td>
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<tr>
<td>Tend field livestock</td>
<td></td>
</tr>
<tr>
<td>Harvest</td>
<td></td>
</tr>
<tr>
<td>Sell rice</td>
<td></td>
</tr>
<tr>
<td>15. Do you own agricultural machinery?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>16. What type?</td>
<td>1=Yes</td>
</tr>
<tr>
<td></td>
<td>2=No</td>
</tr>
<tr>
<td>Tractor</td>
<td></td>
</tr>
<tr>
<td>Wooden ard</td>
<td></td>
</tr>
<tr>
<td>Grass Cutter</td>
<td></td>
</tr>
<tr>
<td>Pump sprayer</td>
<td></td>
</tr>
<tr>
<td>17. Who decided to buy the agricultural machinery?</td>
<td>1= Husband</td>
</tr>
<tr>
<td></td>
<td>2= Wife</td>
</tr>
<tr>
<td></td>
<td>3= Both</td>
</tr>
<tr>
<td></td>
<td>4= other</td>
</tr>
<tr>
<td>18. Who owns the machinery?</td>
<td>1= Husband</td>
</tr>
<tr>
<td></td>
<td>2= Wife</td>
</tr>
<tr>
<td></td>
<td>3= Both</td>
</tr>
<tr>
<td>Tractor</td>
<td></td>
</tr>
<tr>
<td>Wooden ard</td>
<td></td>
</tr>
<tr>
<td>Grass cutter</td>
<td></td>
</tr>
<tr>
<td>Pump Sprayer</td>
<td></td>
</tr>
<tr>
<td>19. Do you own livestock?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>20. Type of livestock?</td>
<td>1=Husband</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Cow</td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
</tr>
<tr>
<td>Pig</td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
</tr>
<tr>
<td>Duck</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>21. Who owns livestock?</th>
<th>1=Husband</th>
<th>2=Wife</th>
<th>3=Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pig</td>
<td></td>
<td></td>
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</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duck</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>21. Who tends livestock?</th>
<th>1=Husband</th>
<th>2=Wife</th>
<th>3=Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buffalo</td>
<td></td>
<td></td>
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<tr>
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