Potential of the Green Way application for data collection on crop economics in the Gulf of Mottama, Myanmar

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List of Abbreviations

App Application
ASEAN Association of South East Asian Nations
AVRDC Asian Vegetable Research and Development Centre
CBA Cost-Benefit Analysis
CFDA Coastal Farmer Development Association
DoA Department of Agriculture
FB Facebook
FFS Farmer Field Schools
FGD Focus Group Discussions
FYM Farm Yard Manure
GAP Good Agricultural Practices
GoM Gulf of Mottama
GoMP Gulf of Mottama Project
HIS Helvetas Swiss Intercooperation
ICT Information and Communication Technology
MADB Myanmar Agricultural Development Bank
MIMU Myanmar Information Management Unit
MMK Myanmar Kyat
PDAs Personal Digital Assistants
PP Plant Protection
PPC Plant Protecting Chemicals
RQ Research Question
SDC Swiss Agency for Development and Cooperation
SRP Sustainable Rice Platform
ToT Training of Trainers
USDA United States Department of Agriculture

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Abstract

BRAUN, Anna. Potential of the Green Way application for data collection on crop economics in the Gulf of Mottama, Myanmar.

This Bachelor Thesis addresses the potential of the Green Way mobile application (app) to record economic data on crop production from farmers in the Gulf of Mottama, Myanmar. The paper aims first at identifying farmers' topics of highest interest and the main sources of information used. Second, the potentials and challenges of the Green Way app for data collection are summarized. The third aim is to study farmers' willingness to share and record economic data. Fourth, a Cost-Benefit Analysis (CBA) on the Gulf of Mottama Project (GoMP) conducted in 2018, is updated with economic data from a household survey. A comparison of economic performance indicators of trained and non-trained farmers was conducted. Trained farmers were educated on how to record data with Green Way app, whereas non-trained farmers did not receive any direct training. The survey as well as key informant interviews and focus group discussions were carried out between May and October 2019 in Bilin and Kyaikhto Townships, Mon State. Literature, amongst others on crop economics, the use of smartphones and applications, provides important background information.

Farmers in the area are interested in cropping techniques, weather conditions, market prices, fertilizer and its application, seeds and its prices as well as pests and diseases. Mass media, especially the TV and the radio, as well as personal communication with other farmers or neighbours and extension services are the most important sources used. The digital knowledge and use of smartphones and mobile applications for agricultural information is still relatively low. At the time of the survey, the Green Way app was known by 33% and used by 13% of all farmers. The app could be used as information source for several topics of interest mentioned above.

The farming record feature has been incorporated into the Green Way to simplify the collection of economic data on crop economics. Farmers can easily record data through this feature and therefore better manage their farming activities. As a challenge, this farming record feature requires precise recording of economic data by the farmers in order to achieve a good sample of data for calculations on crop economics, including CBA, within the GoMP. Farmers are generally willing to share economic data. They wish for training on the use of smartphones and advice on farming practices in exchange for their data. However, data privacy is an issue, which should be included in the policy of the app and trainings of GoMP also in regard to other apps and digitalisation in general.

Concerning the update of the CBA done in 2018, the biggest difference has been found regarding income from green gram production. However, the sample of farmers producing green gram was small, which indicates that further research is needed.

The economic indicators of trained and non-trained farmers are significantly different concerning yield and net-income in paddy production. As it is unclear which farmers will use the farming record and share their data in the future, additional research on the users and non-users of the farming record is needed at the end of 2020. Since the collected data may not be representative of the farmers in the area, additional ways of data collection need to be found.

There is a big potential in the use of mobile applications like Green Way for information sharing and data collection in the Gulf of Mottama. Regular recording of crop economics could bring many advantages for farmers, reaching from less barriers for certification (e.g. GAP, Sustaintable Rice Platform) to a better overview of production branches and therefore improved farm management. Withal, the recording of data needs to be monitored closely in order to develop the app and the recording in a farmer-friendly and effective way. Such a digital change requires time for adaptation to the new technologies and training in order to educate farmers on the purpose and benefits of data recording.

Keywords: Data collection, mobile application, paddy, green gram, Myanmar

1 Introduction

This Bachelor Thesis has been written while staying in the Gulf of Mottama, Myanmar for a field assignment of six months. Understanding the region and the Gulf of Mottama project is crucial, as this research is imbedded in the project logframe.

1.1 Background and problem identification

1.1.1 The Gulf of Mottama, Myanmar

Myanmar is located in Southeast Asia and bordered by China, India, Bangladesh, Thailand and Laos. The country covers an area of almost 700'000 km^2 and counts a population of 54.6 Million inhabitants, of which 66 % live in rural areas. Myanmar's economy is one of the least developed in the world. But, GDP has increased by approximately 10% since the governmental change in 2010 (CIA 2011, cited in NECC and MoECAF 2012, 17). It is a fertile and agro-based country with 12 million hectares (ha) of sown land, mostly cultivated by smallholder farmers. The country has a remaining area of 0.24 million ha of fallow land, which could be used for agricultural activities (Swe 2012, 1). Myanmar can be divided into three agro-ecological zones; hilly zone, central dry zone and coastal zone, and eight physiogeographical zones (figure 1).

The Gulf of Mottama (GoM) is ocated in the coastal agro-ecological zone, in the geographical region of Southern Myanmar coastal. The gulf is the biggest intertidal mudflat in Southeast Asia, covering an area of 42'500 ha (Jungblut 2017, 9; RSIS 2017). This mudflat builds an important ecosystem for rare wildlife and is a source of livelihoods for about 1'500'000 people living in the coastal areas of the gulf (Embassy of Switzerland 2018, 1). Important ecosystem services provided by the GoM are: Food for humans, pollution control and detoxification, recreation and tourism, biodiversity and nutrient cycling (RISI 2017, 4). One of the up to 1'500 migratory water birds, wintering in the GoM, is the critically endangered spoon-billed sandpiper. More than half of the global population of this species stays in the GoM over winter. However, the population of wintering birds is declining. Further, fish population has declined over the past few years due to overfishing and the use of illegal fishing nets (Helvetas et al. 2018, 7). As a result, fish catch has declined by 50-90% in the past 10 years, leading to a migration of small-scale fishermen to other sectors and regions in the country or abroad (IUCN 2017). According to Swe (2012,4) 5-6% of Myanmar's total population works abroad.

Most people living in the gulf depend on agricultural production, especially on rice production during monsoon season, lasting from April to November. A lack of coordination in governance and insufficient management lead to an overexploitation, habitat destruction and salt intrusion, which make the coastal communities in the GoM suffer (Jungblut 2017, 9). Climate change will have further effects on the coastal regions in the future, which increases the vulnerability of coastal communities further.

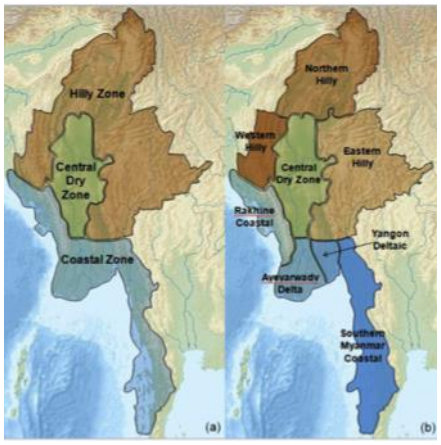

Figure 1: Myanmar's three agro-ecological zones (a) and eight physiogeographical regions (b ; Source: NECC and MoECAF 2012, 19)

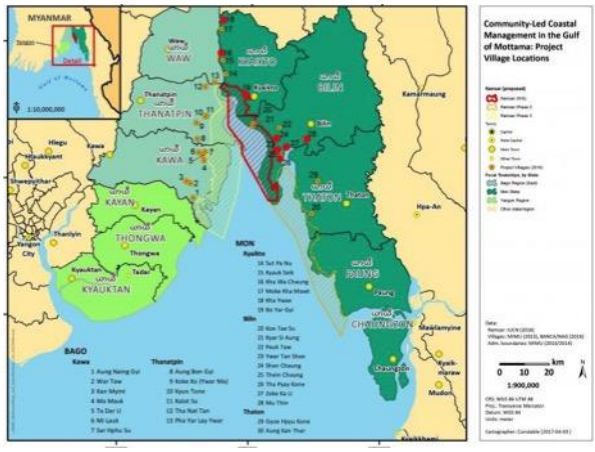

Figure 2: GoMP area (Source: IUCN 2017)

1.1.2 Relation to the Gulf of Mottama Project (GoMP)

The context described above is where the GoMP joins in. The project contributes to the Swiss Agency for Development and Cooperation (SDC)'s Agriculture and Food Security overall goal aiming at: "*Smallholder farmers, including women and men of all ethnicities, have increased food security, access to livelihood assets, productivity and income".* The implementing agency Helvetas Swiss Intercooperation (HSI) has been working in Myanmar since 2014. Four projects fall under the implementation of HSI in Myanmar: Skills for Employment in the dry zone; Participatory, equitable and accountable civil engagement (PEACE); the Biotrade project and the GoMP (Schmidt 2019, personal communication).

The community-led coastal Management in the GoMP tries to address the issues in the GoM with a multi-stakeholder approach (Jungblut 2017, 1). The implementing agencies of HSI, Networks Activity Group (NAG) and the International Union for Conservation of Nature (IUCN) cooperate since 2015 until 2021, in order to achieve their development goal: "The unique biodiversity of the GoM is conserved and sustainably developed in order to benefit human communities that depend on it." The project targets coastal inhabitants in Mon State and Bago Region (figure 2). A Gulf of Mottama Coastal Natural Resource Plan (CNRMP) has been elaborated during phase one from September 2015 until April 2018. The entire coast of Kyaikhto Township and most of Bilin Township in Mon State has been acknowledged as a Ramsar site in order to protect the ecosystem (figure 2). In the second phase of the project the specific project objective is: "The implementation of the GoM Coastal Resources Management Plan is supported and results in improved livelihood security for vulnerable women and men in targeted coastal areas of the GoM." The **three outcomes** of the second phase are:

- **Outcome 1:** Livelihoods are secured and diversified to build communities' resilience**.**
- **Outcome 2**: Coastal Natural Resource use is sustainable and well-managed, and biodiversity is conserved.
- **Outcome 3:** Coastal Natural Resources Governance is coordinated and effective, and awareness on the GoM values is raised" (Embassy of Switzerland 2018, 2).

This Thesis will contribute to outcome 1 and output 1.1 of the project (figure 3). Its main objective is to "assess the potential of the Green Way app to collect economic data". In the scope of output 1.1, activity 1.1.2 "Facilitate applied agricultural research, assess and test value chain opportunities in fisheries and farming livelihoods" is implemented, which is where this Bachelor Thesis is imbedded in. However, this thesis looks at the Green Way app which belongs also to activity 1.1.3 "Disseminate and promote implementation of successful approaches".

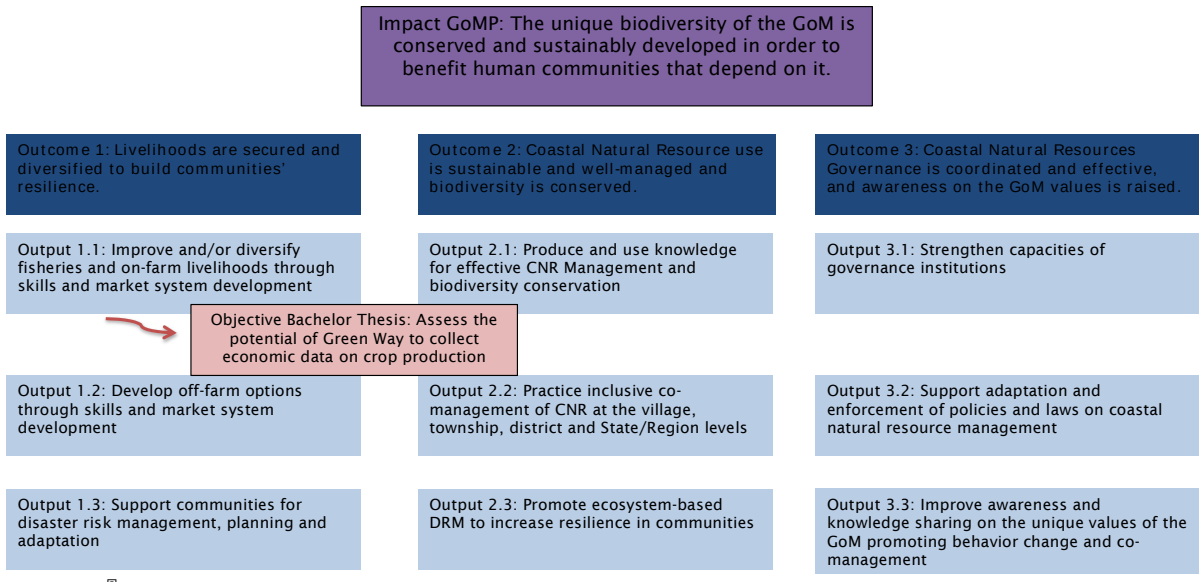

Figure 3: Relation logframe of GoMP and objective Bachelor Thesis (Source: Adapted from Embassy of Switzerland 2018, 2)

On the one hand, the Green Way app provides information on crop production, weather forecasts and daily market prices. Such apps are very inexpensive extension tools compared with classic, face to face extension approaches (Guenat 2019, personal communication). According to No No Aung (2019, 49): "The support of government organizations seems to be weak because of these reasons; first, the extension services are not effective to impact the technology and knowledge to the farmers; second, the extension agents have not enough funds to keep contact with the farmers and check the fields; third, there is no effective collaboration among government organizations." This statement shows the importance of the implementation of mobile apps like the Green Way app in order to improve and facilitate knowledge transfer, to establish regular contact between farmers, extensionists and government organizations.
The present Bachelor Thesis looks at the topics of highest interest to farmers and the main sources of information farmers use. On the other hand, a farming record feature has been developed recently. This can potentially be used as a tool to collect economic data on rice and green gram production from farmers in the GoM. The Bachelor Thesis will look at the willingness of farmers to share economic data through this farming record tool. Potential incentives will be discussed in order to enhance the willingness to share data. This data would be of highest interest for the project to assess its impact on farmers' performance in rice and green gram production. It could further be used to update the ex-ante CBA calculated in 2018. Therefore, the assumptions made in 2018 will be revised if necessary. This verification of assumptions is also an important step towards the ex-post analysis which will be carried out at the end of phase 2 (end of 2021; Boukhali and Guenat 2018, 6).

1.2 Research questions and hypotheses

The following four main research questions will provide direction to reach the objective of this thesis mentioned above.

Research question 1: What information on rice and green gram production and value chains are of highest interest to farmers in the GoM and what are the main sources of information that they use?

- **Hypothesis 1.1**: Farmers in the GoM are using different sources of information for different topics.
- **Hypothesis 1.2:** The Green Way app is potentially a major source of information for farmers.

Research Question 2: What are the prerequisites, potentials and challenges of the Green Way app for economic data collection in terms of data quality?

- **Hypothesis 2.1:** Not all farmers fulfil the prerequisites for using the Green Way app.
- **Hypothesis 2.2:** Most farmers do not use the farming record feature yet and they will need specific training before they can use it.

Research Question 3: Are farmers willing to share their economic data via the Green Way application and what incentives are needed to enhance their willingness to share?

- **Hypothesis 3.1:** Without incentives, farmers are not likely to share their economic information.

Research Question 4: How realistic are the assumptions made for the CBA of the rice and green gram production and value chains in 2018? Can the CBA update at the end of GoMP phase two rely on the data collected through the Green Way app?

- **Hypothesis 4.1:** Some of the assumptions made during the CBA 2018 need revision.
- **Hypothesis 4.2:** Assuming that the farmers are willing to share their economic information, the quality of the collected data will determine whether this data can be used to update the CBA.

2 State of research

In the scope of this paper, literature review helps to understand the technological changes towards using mobile apps for accessing agricultural information and collect economic data from farm households. The target crops, paddy and green gram, are described in a second step.

2.1 Mobile applications (apps) for agricultural extension

Agricultural extension has played an important role in achieving higher crop yields during the Green Revolution in Asia. According to Baing and Aldosari (2013, 619): "Agricultural extension is known to offer technical guidance, provide information, help farmers to identify their problems and organize themselves in the farmer groups." Nowadays, in almost every developing country, public, non-governmental and private extension services are provided (Baing and Aldosari 2013, 619). According to Akker (2011, 636): "While infrastructure investments still remain low in many developing countries, one of the most dramatic changes over the past decade has been an increase in mobile phone coverage and adoption." In many countries sources of information were mainly personal exchanges, radio, landlines and newspapers (ibid.). Nowadays, mobile phones have overtaken fixed line internet in many developing countries (Qiang 2012, 1). Information and Communication Technology (ICT) consists of many techniques evolved through the revolution of the information age. Devices and tools used in ICT are computers, books, personal digital assistants (PDAs), digital and non-digital libraries. Communication channels include telephone, mobile phone, instant messaging and others (Baing and Aldosari 2013, 627). According to Qiang (2012, v), such apps for rural development and agriculture …"could provide the most affordable ways for millions of people to access information, markets, finance and governance systems previously unavailable to them."

37% of the population in Myanmar had a mobile phone in 2015. This percentage was expected to rise to 50% in 2018. It has to be considered that only 10 years ago, internet access was restricted and unaffordable for most people (Einzenberger 2016, 302). People had to pay 1'500'000 Myanmar Kyat (MMK; equal to 2'000 USD) for one SIM card in 2009. In 2012 the price dropped to 200'000 MMK (equal to 200 USD), whereas today a SIM card can be bought for about 1'500 MMK equal to one USD (Chipchase et al. 2015, 132). Today, the internet is mainly used through mobile phones (Einzenberger 2016, 302). According to Aker (2011, 636): "(…) mobile phones can significantly reduce the costs of obtaining agricultural information". They are said to bring together farmers, extensionists and research centres. As stated by Aker (2011, 633): "In some cases, it has also sought to connect researchers directly to the farmers in order to ensure that new technologies are better targeted to the specific conditions of agricultural communities." This is valuable since in many developing countries a trend towards disconnected agents has been observed (ibid., 639). Aker (2011, 636) specifies: "The reduction in search costs associated with mobile phones could increase farmers' access to information via their private sources, such as members of their social network."

The example of MERGDATA in Ghana has shown that agricultural ICTs can help to empower female farmers through information sharing (Willmott-Harrop 2017, 29). Agricultural advisory services including weather information, market prices and advice on Good Agricultural Practices (GAP) are provided in three local languages. According to Willmott-Harrop (2017, 30) a female farmer's statement on this is: "I get all my seeds ready, and then when I get a weather message on my phone saying the rains are about to happen I can quickly rush out to plant." According to Qiang (2012, 14): "The largest number of mobile apps for agricultural and rural development (m-ARD apps) involve improving supply chain integration and likely have the greatest impact on agricultural and rural development." Since the agricultural sector is crucial for economic development, improvements in this sector are expected to lead to development growth (ibid.).

Nowadays, data on farms is usually collected through household surveys. There has been a limited number of studies on the potential of smartphones for data collection (Daum et al. 2018, 144). Data can potentially be collected more frequently and more accurately through mobile applications than through annual agricultural surveys. Further, data collection through smartphones can be more accurate since the farmer himself enters the data in real time (ibid.).

Peoples' digital literacy is one major challenge (Aker et al. 2016, cited in Daum et al. 2018, 145). According to Einzenberger (2016, 302):"(…) women face more barriers in using mobile phones." The ownership of mobile phones by women is still lower than the ownership by men. Rural areas have a penetration of internet access of 27% compared to 65% in cities, which is another constraint for rural app users. The content of the developed apps is mostly in Myanmar language, which shows that the over 100 different languages spoken in the country are not taken into account so far (Einzenberger 2016, 303). There are issues of data privacy, which have to be kept in mind when talking about smart phones as research tools. In addition to confirming anonymity, the safety of the data has to be guaranteed (Daum et al. 2018, 149-150).

2.1.1 Green Way app

Since operating systems like Android and stores like the App store allowed third party providers to create mobile apps, mobile networks have been evolving and facilitating the process of creating apps (Qiang 2012, 3).

The Green Way app (https://www.mmgreenovator.com/greenway-app) has been developed by Greenovator, an agricultural technology and service social enterprise based in Yangon. The app is termed as the digital linkage between farmers and technicians across the country. Greenovator was co-funded by two agronomists in 2011 and has received the Myanmar Young Social Entrepreneur Runner Up Award in 2016. In 2017, the two co-founders were awarded the most Outstanding Agricultural Alumni.

The Green Way agricultural mobile app has been launched in 2016. Nowadays it has reached over 100'000 downloads by farmers and agricultural technicians from 329 Townships in Myanmar (Yin Yin Phyu 2019, personal communication). UNESCO has collaborated with the company to adapt the app to the information needs of the people working in the agricultural sector in Myanmar. There have been several restrictions on the access to information in Myanmar (UNESCO 2017). However, according to UNESCO (2017) "In collaboration with the Myanmar Book Aid and Preservation Foundation, more than 1'000 agricultural extension workers, NGO-staff and farmers have been empowered to use digital technologies, including the upgraded Greenway mobile app, to improve their livelihoods." The company has signed an agreement with the Department of Agriculture (DoA) in order to use the Green Way app as an extension tool. This milestone means that extensionists can collaborate with the Green Way app Farmers Care Team if needed (Yin Yin Phyu 2019). Green Way app provides the following features (figure 4):

Figure 4: Features of the Green Way app (Source: Greenovator 2019)

- Knowledge sharing on agricultural technique
- Knowledge sharing on Livestock technique
- Questions and answer section
- Daily market price
- Weather forecasts
- Agricultural knowledge
- Agricultural news
- Data collection through farming record
- Information about partners
- Information on TV program

Green Way incorporated information on GAP, post-harvest technologies, Sustainable Rice Platform Standards (SRP) into their features (Yin Yin Phyu 2019, personal communication). According to Yin Yin Phyo (2019, personal communication), farmers are asked randomly in order to get feedback every day. A newly introduced feature will focus on traceability and food safety by allowing users to trace back products. For the Question and Answer section, it is important to know that not the Greenovator team themselves will reply but experts on the specific questions. The app is further used as extension tool by extensionists across Myanmar (Yin Yin Phyo 2019, personal communication).

2.1.2 The collaboration of GoMP and Greenovator for the farming record feature

The GoMP has been working with Greenovator since November 2018. The partnership is aiming at providing mobile farm income record books to the farmers (Yin Yin Phyu 2019). Logbooks on paper have been distributed in 2018, with the aim that farmers practice how to record their incomes and expenses (Tun Zaw Htay 2019, personal communication). However, the data collected through them was lacking quality (No No Aung 2019, personal communication).

On the one hand, Greenovator has a long-term goal to integrate SRP and GAP standards to the app. On the other hand, GoMP will provide background information on metrology, field conditions and so on (Yin Yin Phyu 2019). FGDs have been carried out by Greenovator staff in order to adapt the farming record feature to suggestions made by demonstration farmers and GoMP staff. As soon as the adapted version had been published, Trainings of Trainers (ToT) were conducted in Kyaikhto on July 2nd 2019.

On the one hand, the implementation of the farming record should help farmers to record expenses and incomes of different crops. Farmers' own records can help them to plan and manage farming activities, which could contribute to increased incomes of farmers. On the other hand, economic data from farmers is needed for economic calculations (CBA, gross-margin) on the project level. The long-term goal is that 5'000 GoMP beneficiaries register on the farming record (Yin Yin Phyu 2019). The target for 2019 is that 200-300 farmers in the GoMP area record their data on the farming record. This is achieved through direct trainings of GoMP beneficiaries with the help of five volunteers working for the GoMP. These trained farmers will then train more farmers in their villages, figure 5 (in totally 60 villages of the GoMP). The five farmers per village that get the training are mainly seed producers (F1 generation), seed multipliers (F2 generation and traditional varieties) or demonstrator farmers. They are chosen according to their integration in the project, mainly the ones that have good relations to the agricultural officer. These farmers are the ones expected to be using the farming record feature in 2019. Later, more farmers will be trained on how to use the app in order to increase the number of farmers using the farming record feature (Tun Zaw Htay 2019, personal communication).

According to Tun Zaw Htay (2019, personal communication), 20% of all farmers in the project area using the Green Way app for information will fill in the farming record feature. According to estimations of Greenovator, 50% of the farmers using Green Way will also use the farming record tool in the long-term because there seems to be a general interest in profitability and sustainability amongst farmers (Yin Yin Phyu 2019, personal communication).

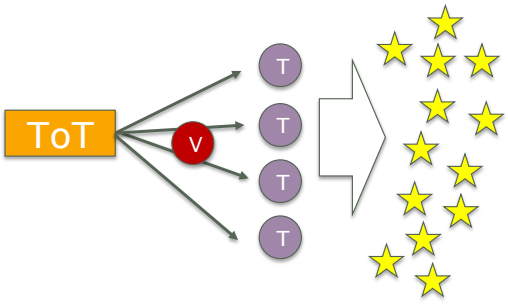

Figure 5: Training on the farming record ; Training of Trainers (ToT), Volunteers (V), Trained farmers (T), other farmers (stars)

2.1.3 Other mobile phone apps for agriculture

There are other mobile apps for agricultural information in Myanmar apart from the Green Way app. Golden Paddy developed by Impact Terra was founded in 2016. This app aims at knowledge sharing with a data analytics platform so they can create customised reports (Scandola 2019, personal communication). Key features of the Golden Paddy app are: Weather section, Market Price overview, Knowledge section, Pest & Water risk alarms, Buying & Selling, Shop profiles, timely alerts (ImpactTerra 2019). Plant Protection app was developed by the National Plant Protection Division of the DoA. Its focus is plant protection through the education of farmers (Plant Protection Division 2019). Htew Toe App is an app in Myanmar language developed by Awba group, which buys agricultural inputs from abroad in order to distribute them in rural Myanmar. The app has its focus on selling fertilizer but does also provide information on weather, market prices and

agricultural news. If farmers buy big amounts of fertilizer, they can join a lottery game in order to win prizes. Similar functions are provided on Armo app, which was developed by a fertilizer company (U Paw San 2019, personal communication). Another app called Site Pyoo was developed by ooredoo, one of Myanmar's leading telecommunication companies and Miaki, a telecommunication start-up. The app is supposed to improve farmers lives through providing weather and agricultural information (Darabian and Palmer 2017, 4).

According to Buerli (2019, personal communication), it is crucial to visit the farmers using these apps from time to time in order to guarantee that they know how to use the tool. Experience has shown further that such apps are more successful for crops with high demand of knowledge and skills (ibid.).

2.2 Economics of crop production

Most farmers in Myanmar cultivate two crops per year. The most common crop successions are: Rice-rice, rice-blackgram *(Vigna mungo L.)* and rice-green gram *(Vigna radiata L.;* Buerkert et al. 2008, 156). The focus within the scope of this paper is set on monsoon paddy and green gram production.

2.2.1 Paddy production in Myanmar

Rice is a major staple food for many people in Asia. It contributes up to 70% of people's daily calorie intake and is a major income and employment source for millions of farmers (FAO 2017, cited in Aung 2019, 12). Myanmar is the 7th biggest producer of rice worldwide (Faostat, 2016). 35% of the total crop area is used for paddy production (YuYu Tun and Hye-Jung Kang 2015, 168-169). According to Matsuda (2009, 14): "The previous governments devoted their attention to rice because of its economic importance." The government has been controlling rice production strictly since its independence in 1948. If there is a discussion on an economic, social or political issue in the country, rice is included (ibid.).

Most farmers produce paddy during the monsoon season (Open Development Myanmar, no date). In lower Myanmar, farmers start sowing in May and harvest from October until January (Wong and Wai 2013). Most paddy is harvested in November and December. Planting varieties with different durations of cultivation could release the pressure on paddy prices, because it would spread harvests more equally throughout the year. Such varieties with different crop duration are already successfully planted in other countries such as the Philippines and Vietnam (World Bank 2014, 20).

Myanmar has several rice ecosystems such as irrigated lowland, rain fed lowland, deep water and upland. Rain fed lowland and floodwater can be found in the delta regions, which includes the GoM. Main concerns for paddy production are floods, sometimes droughts and salinization (Boukhali and Guenat 2018, 10). On average, each farm household grows rice on 16 acres on an average farm size of 17 acres. According to No No Aung (2019, 31-48), rice production contributes on average 50-59% of the household's income. 64% of all farmers sell their paddy. According to World Bank (2016, 26): "The share of sales in production increases with farm size." In Bago region, small farms (0,1-4,5 acres) sell 50% of their production, whereas large farms (more than 9 acres) sell 67% of the rice (ibid.,22-26). There are contradictious figures about average paddy yields in Myanmar. Official statistics put Myanmar in the middle of average production in the region, whereas USDA reports lower yields in Myanmar compared to other countries in Asia (World Bank 2016, 23). The average yield in the country is 1'643 kg per acre, whereas China has reached 2'663 kg per acre (DAP 2012, cited in Aung 2019, 18)[1]. The World Bank reports an average yield of 1'274 kg per acre for monsoon paddy (Myanmar Agricultural survey; cited in World Bank 2016, 24). But the country is still lacking modern agricultural production, which could increase the productivity of the fields (YuYu Tun and Hye-Jung Kang 2015, 168-169).

Rice exports are increasing and exports are expected to raise considerably during the years to come. This is confirmed by World Bank (2016, 26) which accounts an export rate of 15% of production. This increase in exports will hopefully lead to the establishment of a stable rice industry by investments in infrastructure, technology and knowledge (World Bank 2014, cited in Shwebo et al. 2016, 25). The Department of Agriculture (DOA) is the main source of certified rice seeds in Myanmar (World Bank 2014, 22). However, most farmers use their own seeds, due to the low supply and the costs of certified

[1] Converted: http://www.kylesconverter.com/area-density/kilograms-per-acre-to-tonnes-per-hectare

seeds. The current supply satisfies less than 1% of the total demand in the areas. There was no significant difference between farm sizes and adoption rate of certified seeds (World Bank 2016, 29).

According to the World Bank (2014, 20): "There is an acute need for a public-private effort to identify a limited number of rice varieties (both fragrant and non-fragrant) whose planting should be encouraged in appropriate agro-ecological areas." Myanmar is the third most vulnerable country to climate change impacts, according to the long-term climate risk Index (Eckstein et al. 2018, 9). Therefore, a focus on climate-resilient rice varieties is crucial. According to the region, the varieties need to be tolerant to salinization, water logging and floods (Nagothu 2014). There are many other constraints concerning rice production such as poor water management and high transport costs on poor roads (World Bank 2014, 22). The country struggles to produce good quality milled rice due to impure seeds, poor post-harvest practices and the mixing of different varieties and paddies. There are over 1'000 rice varieties cultivated in Myanmar, which can be divided into five groups. The new variety Pale Thwe needs more expensive and skilled labor to transplant rice (Shwebo et al. 2016, 71). This is confirmed by Boukhali and Guenat (2018, 11). According to Aung (2019, 32): "The interviewed households cultivated twenty six rice varieties in 2017 monsoon rice production season." According to Jungblut (2018, 41-42) the newly introduced variety S3 Sinthwelatt performed best in the two villages Boyargyi and Zokekali. Anyhow, according to Mr. Tun Zaw Htay (2018, cited in Jungblut 2018): "Some farmers have expressed that they are not entirely satisfied by the eating properties of S3 Sinthwelatt, which might be a constraint for adoption of this variety".

The Gulf of Mottama Project promotes new varieties, better use of fertilizer and training on cropping patterns. According to Boukhali and Guenat (2018, 26): "The CBA for paddy shows that the project support is relevant, and that farmers who adopt the improved practices have a clear advantage. But for the farmers, intensifying their paddy crop only makes sense where the agro-climatic conditions are bearable. And in many places, this is not the case." However, agriculture makes up only 40-50% of the farmers' income in the region (ibid.). According to Jungblut (2018, 42) farmers in the project area are interested to further collaborating with the project and to introduce new rice varieties.

2.2.2 Green gram production in Myanmar

Worldwide, pulses are produced on an area of 82.4 million ha (Khin New New Oo 2018, 1). Legumes are a major source of protein in Asia. They are valuable in many cropping systems due to their ability to fix nitrogen. According to Meelu and Morris (1988; cited in Swe Mon Aung 2018), incorporating green gram residues into the soil can increase rice yields equivalent to a nitrogen fertlizer input of 25 kg per ha. Myanmar is the leading producer of pulses among Association of South East Asian Nations (ASEAN) member countries. The production and export of black gram, green gram, pigeon pea, soy bean, butter bean, cow bean and kidney bean have increased during the last years. According to United States Department of Agriculture (Swe Mon Aung 2018) average yields reach between 404 and 536 kg per acre.

Green gram, also known as Mung bean, has been one of the major pulse crops of the Asian diet and the most cultivated pulse in Myanmar (Spielman and Pandya-Lorch 2010, 381-394; Khin New New Oo 2018, 1). Green gram is the seed of *Vigna radiata,* native to India, Bangladesh and Pakistan. The bean with husk appears green whereas without the husk, it shows a yellow color (MPBSA 2013). The bean is rich in protein, especially the consumption with cereal can increase the quality of protein in the meal (Spielman and Pandya-Lorch 2010, 381-394). Green gram beans are transformed into transparent noodles and vermicelli in Southeast Asia. Mung bean sprouts are a popular vegetable (Spielman and Pandya-Lorch 2010, 381-394). The Asian Vegetable Research and Development Centre (AVRDC) in Taiwan recognised the potential of these beans to increase farmer's income and diversify agroecosystems but also to supply protein to poor Asians. AVRDC launched a specific program to improve productivity and production. The introduction of improved varieties lead to an Asian-wide increase of production by 35 percent from 1985 until 2000 (Spielman and Pandya-Lorch 2010, 381-394). The actual annual growth rate in production was 23.5% between 1985 and 2000 in Myanmar. This is very high compared to the annual growth rate in production of 12% in overall Asia (Chadha 2010, 23). AVRDC was able to improve the bean through shortening the cultivation period, to gain uniform maturity, to incorporate resistance to a variety of pests and diseases, to reach less sensitivity to photoperiod and others.

Most of the green gram produced in Myanmar is exported to India, China, the European Union and Japan (Boukhali and Guenat 2018, 14-15). Many Myanmar farmers changed from pulses to other crops in 2017/2018 season due to Indian import restrictions (Swe Mon Aung 2018, no page). Some mungbeans are now exported to countries like Bangladesh, Pakistan, Sri Lanka and Nepal (Khin New New Oo 2018, 7). Because prices for pulses and beans had decreased, farmers had low incentives to use inputs for pulses and therefore yields were expected to decrease by 13% in 2017/2018. Myanmar's production of beans and pulses was expected to further decrease by 14% in the season 2018/2019 (Swe Mon Aung 2018, no page). The decrease in production is also caused by a lack of rainfall in some regions of Myanmar according to Theingi Myint (no date, 8).

Costs of production can be split into the following main categories; Human labor, bullock labor and machine labor, seeds, fertilizer, farm yard manure (FYM), plant protecting chemicals (PPC) and the interest on working capital (Angadi and Patil 2018, 1209). Green gram production shows good results in terms of profitability compared to other pulses like chickpeas or black gram (World Bank 2016, 65-66). Their net margin reaches 356'458 MMK per acre (880'807 MMK per ha) on average, whereas black gram and chickpeas reach 164'518 MMK, respectively 86'881MMK per acre (406'525 MMK, 214'682 MMK per ha).[2] Studies have further shown that profitability increases with farm size concerning all pulses. This is especially the case for green gram (World Bank 2016, 65-66).

In the GoM green gram is grown immediately after paddy as a winter crop. It can be used in order to prepare the soil for the next rice season. As it is an important product for sale, it contributes considerably to the farmers' income (Boukhali and Guenat 2018, 14-15). However, green gram can only be grown on land with a PH lower than 8,5. Saline conditions are not favourable either (Theingi Myint no date, 7).

2.2.3 Cost-Benefit Analyses (CBAs) on paddy and green gram

Cost-Benefit Analyses are useful to monitor and assess the outcomes and interventions of a project in a quantitative way. Therefore, such analyses should be carried out throughout the whole project cycle. Costs of an interventions as well as benefits need to be quantified in order to calculate a CBA. However, especially the latter can be challenging (SDC 2015, 1-5).

In the beginning of phase 2 of the GoMP in 2018, an ex-ante CBA has been calculated. This analysis is based on numerous assumptions. At the end of phase 2 (end of 2021), an ex-post analysis is planned. In the present research, the assumptions made in 2018, concerning monsoon paddy and green gram, were examined. This is an important contribution towards the ex-post analysis of 2021 (Boukhali and Guenat 2018, 6).

[2] Converted: https://exchangerate.guru/usd/mmk/1/

3 Materials and methods

The methods used in the present study include primary data collection. Such data was collected from farmers (in a farm household survey), key-informants (in specific interviews) and focus groups (in targeted discussions, FGDs). Table 1 shows the hypotheses formulated in chapter 1.2, and for each hypothesis, the selected data collection methods. These methods are then described in the following.

Table 1: Hypotheses and chosen methods

Hypothesis	Methods
1.1 Farmers are using different sources of information for different topics.	Farmer survey, key-informants
1.2 The Green Way app is potentially a major source of information for farmers in the GoMP.	Farmer survey, key-informants, literature review
2.1 Not all farmers fulfil the prerequisites for using the Green Way app.	Farmer survey, literature review (Thesis No No Aung), Key-informants project staff, FGDs
2.2 Most farmers do not use the farming record feature yet and they will need specific training before they can use it.	Farmer survey and FGDs
3.1 Without incentives farmers are not likely to share their economic information.	Farmer survey, literature review and FGDs
4.1 Some of the assumptions made during the CBA 2018 need revision.	Farmer survey, key-informants
4.2 Assuming that the farmers are willing to share their economic information, the quality of the collected data will determine whether this data can be used to update the CBA.	Farmer survey, key-informants

3.1 Literature review

Prior to fieldwork, literature review in the field of extension and farm economics as well as on mobile apps for agriculture and smartphone usage in Myanmar has been carried out. Therefore, Google scholar, Livivo, Ovid and Nebis as well as local platforms, namely the Myanmar Information Management Unit (Mimu; www.themimu.info) and the Land, Agribusiness and Forestry Forum Myanmar (MyLaff; www.mylaff.org) document repository, have been consulted. This literature has further been read in order to grasp rice and green gram production in Myanmar and in the target area.

Previous studies carried out in the scope of the GoMP including the Master's Thesis by No No Aung in 2019 and the Bachelor thesis by Benjamin Jungblut in 2018, as well as the CBA conducted in 2018 have been important sources of information for this paper. The assumptions made in the CBA of 2018 were examined in this paper in view of doing an ex-post cost benefit analysis, which will be carried out at the end of phase 2 of the project, end of 2021 (Boukhali and Guenat 2018, 6).

3.2 Data collection

3.2.1 Farmer survey

The survey has been carried out between June and July 2019. In total, 59 interviews with farmers have been conducted in eight villages in Bilin and Kyaikhto Townships, Mon State (cf. table 2 annex). The target villages (see figure 2 in introduction) have been chosen according to their accessibility during the rainy season through GoMP project staff.

In each village, trained farmers have been identified through the project. In addition, four non-trained farmers have been randomly selected. Trained farmers receive training through the GoMP on how to use the farming record feature on the Green Way app. All trained farmers (T) are also beneficiaries (B) of the GoMP, which have received support from the project in general. Non-trained farmers (NT) may be beneficiaries (B) or non-beneficiaries (NB) of GoMP (figure 6). There was no specific sampling according to gender. Men and women-led households have been included. The parts of the questionnaire on topics of highest interest, information sources and the Green Way app have been asked to male and female farmers of the same household if available (n=75).

Prior to the field visits, the questionnaire has been tested with two farmers in the GoMP sub-office in Kyaikhto.

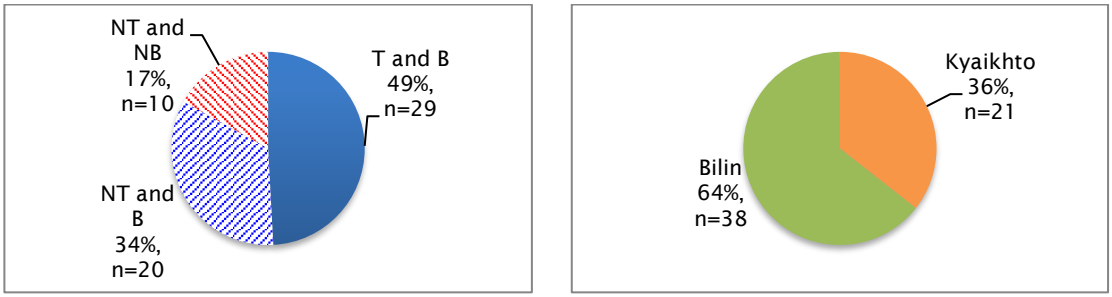

Figure 6: Sample characteristics according to level of support (left) and origin (right)

3.2.2 Key-informant interviews

For the formulation of the research questions and hypotheses, expert interviews and discussions have been carried out. During the preparation of the questionnaire and the discussion of preliminary results, project staff was asked for suggestions and opinions. A detailed list of the key-informants can be found in annex 3. Soe Khaing, master student at HAFL, was responsible for translation during the farmer survey. He assisted in analysing the collected data and helped organizing the logistics.

3.2.3 SWOT analyses and focus group discussions

In order to study the perception of different actors on the farming record feature, SWOT analyses have been conducted with the GoMP project staff, Greenovator and farmers that were most advanced in using the farming record. The agricultural officer from GoMP, Mr. Tun Zaw Htay, as well as the android and web developers from Greenovator Linn Wah Wah Zaw and Khin Sabai Thu gave their opinions during a meeting (cf. digital annex 7). These SWOT analyses have taken place in September 2019. On October 4th, two groups of farmers have been asked about the strengths and weaknesses and the current use of the farming record in the scope of two FGDs (cf. table 21, annex 2).

3.3 Data analysis

Quantitative and qualitative data was analysed after having used Excel for data entry. For qualitative data, clustering was chosen as main method of data analysis. Quantitative data was analysed statistically by using Excel and NCSS 9.0.19. In order to compare trained and non-trained farmers, Townships, way of cultivation and beneficiaries and non-beneficiaries of the GoMP, the data has been tested for normal distribution using NCSS program. These comparisons were two-sided. If the test of assumptions did not show a normal distribution, Wilcoxon signed rank-sum test has been chosen. If a normal distribution could not be rejected by all tests of assumptions according to NCSS, an equal-variance t-test, respectively an Aspin Welch unequal variance t-test according to the Modified-Levene Equal-Variance Test have been chosen. The significance level of 5% has been chosen for all statistical tests.

An analysis of variances (ANOVA) has been calculated for the comparison of the yields between the four types of farmers (normal, demonstrator, seed multiplier and seed producer).

4 Results and specific discussion

Chapter 4 is split into four main parts; The first one (chapter 4.1) covers agricultural interests of farmers and what kind of sources they use to access information, leading to answer RQ 1. For this part, female and male farmers of the same household have been asked. 75 individual farmers answered in total, 44% of them are women. Chapter 4.2 targets the recording of economic farming data through the Green Way app and allows to answer RQ 2 and RQ 3. A SWOT analysis shows main strengths and weaknesses of the farming record. The last two parts (chapter 4.3 and 4.4) cover economic data on rice and green gram production from a total of 59 households. This data can be used to verify the assumptions made during CBA 2018 and later to assess the quality of the data collected through the farming record, which leads to answer RQ 4.

Out of all surveyed households, 83% were members of the Coastal Farmer Development Association (CFDA) and therefore direct beneficiaries of the GoMP. Non-beneficiaries mentioned that they are not member of CFDA (and therefore not beneficiaries of GoMP) due to a lack of time (n=3) and the distance between their house and the village, where the GoMP support takes place (n=3).

Due to a delay of the farming record feature development, not all declared "trained farmers" have received a training on the farming record before the survey. However, it is important to assess if there are differences in interests and economic parameters between these two groups since it has to be assumed that the first economic data collected through the Green Way app is mainly derived from the group of the trained farmers.

4.1 Farmers' interests in agricultural information and sources

4.1.1 Results

In order to assess the potential of the Green Way app for information access, the following questions were analysed (see questionnaire in annexe 4): What are the farmer's topics of highest interest (a) and what are the information sources used to access these topics (b)? What are in general the information sources used (c) and how do farmers perceive the usefulness (d)? Answers to these questions are described in the following. Then, the use of smartphones and apps was assessed (e) while looking at possible gender gaps in these topics (f).

a) Agricultural and market information of highest interest

Seven topics were identified as topics of highest interest to farmers in the area. Farmers were asked "What agricultural information are you interested in?" The answeres include cropping techniques (50 responses=67%), weather information (26=35%) and market prices (24=32%; figure 7). Further, fertilizer and application techniques (18=24%), seed sources and prices (16=21%) as well as pests and diseases (9=12%) seem to be amongst topics of highest interest. 15% mention other interests such as application techniques concerning chemicals (5), financial assistance (3), land preparation techniques (2) and information about inputs in general (1).

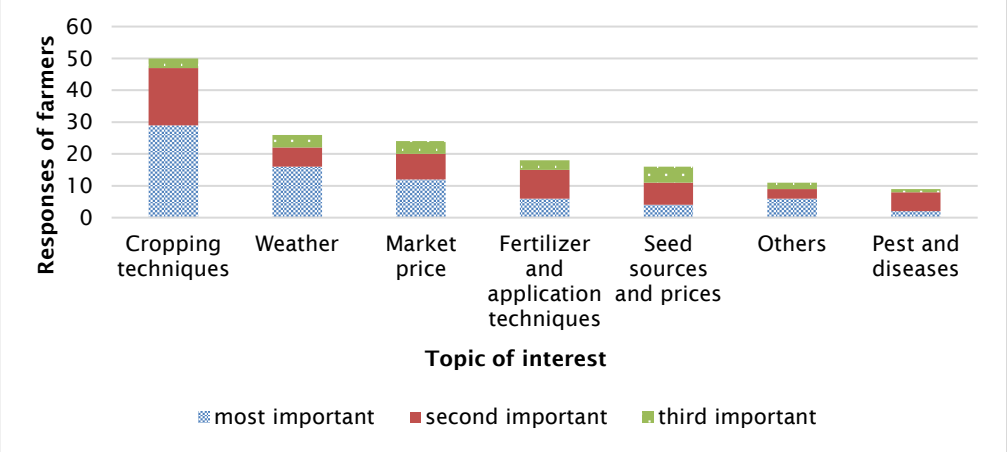

Figure 7: Topics of interest to farmers

There is a difference in terms of project beneficiaries and non-beneficiaries when it comes to the topics of highest interest. Project beneficiaries mentioned cropping techniques (71%) and market prices (36%) more often than non-beneficiaries (40% respectively 10%; figure 8). Pests and diseases are mentioned by 14% of the beneficiary farmers (n=9). Non-beneficiary farmers have not mentioned this topic as one of their highest interest. In contrast, non-beneficiary farmers show higher interests in weather conditions and other topics of highest interest. Other topics include chemical application, financial assistance and land preparation. Fertilizer and its application techniques as well as seed sources and prices seem to be of similar interest to the two groups.

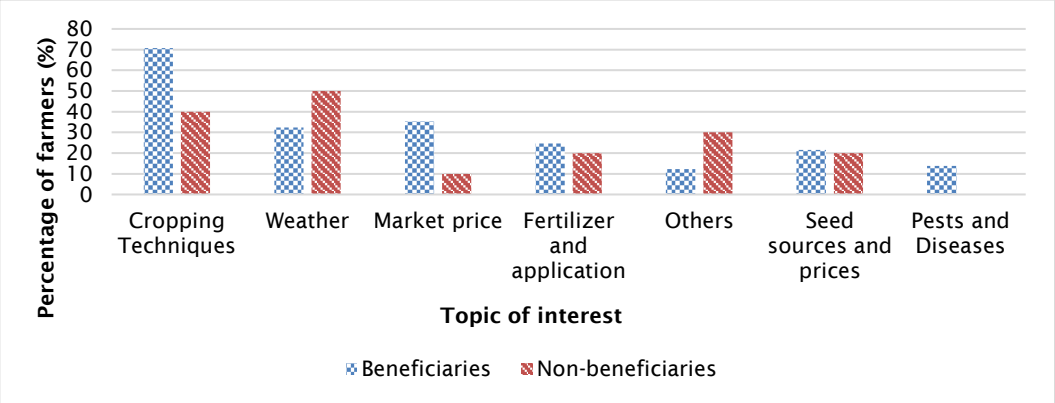

Figure 8: Topics of interest to project beneficiaries and non-beneficiaries

Trained farmers seem to have a slightly higher interest in seed sources and prices, fertilizer application as well as pests and diseases. Whereas non-trained farmers show higher interests in market prices, weather and cropping techniques than trained farmers, see digital annex 4.

b) Main sources of information to access topics of highest interest

Farmers need adequate sources in order to access their topics of highest interest. To access the topics of highest interest mentioned in part a, farmers spontaneously mention sources from three main categories; Personal communication, mass media and traditional extension services (table 2). Mass media is most often used by the interviewed farmers (96 responses) and includes the TV (40), radio (35), phone and other apps (12), Green Way app (6) and newspaper (3).

Table 2: Information sources mentioned to access topics of highest interest

Information sources	Responses*	Responses
Farmer-farmer, neighbor	37	
Merchant, middle-men	9	Personal communication: 46
Radio	35	
TV	40	
Newspaper	3	
Phone (internet, other apps)	12	
Green Way	6	Mass-Media: 96
Extension services	25	
GoMP	31	
DoA	24	Traditional extension services: 70
Other	9	

*Multiple responses possible

Further, traditional extension services are used to access the topics of highest interest (70). Latter is composed of DoA and GoMP providing trainings amongst others through Farmer Field Schools (FFS). In 2019, the DoA and GoMP staff worked together closely in all target villages (Tun Zaw Htay 2019,

personal communication). But in 2018 GoMP was the only extension service present in some villages, especially in Bilin Township (ibid.). In the scope of this research, GoMP and DoA is summarized as extension service since no other actors are present in the target villages (Tun Zaw Htay, 17.7.19). Personal communication seems to be less important than mass media and traditional extension services. However, other farmers and neighbors (37), merchants and middle-men (9) are mentioned as sources.

Trained farmers use traditional extension services more often than non-trained farmers (figure 9 ;difference: 39%). Trained farmers are further using the phone more often than farmers that are not receiving training on the farming record (difference: 9%). Anyhow, in total eight farmers mentioned the phone (internet and other apps) as source of information. Out of these eight farmers, six are trained farmers. The Green Way app is mentioned by a small number of four farmers, which is not sufficient to assess the differences between the two groups. In contrast, the radio is mentioned more often by non-trained farmers than trained (difference: 34%). It seems that farmers and neighbors play a bigger role for non-trained farmers than trained (difference: 33.9%). The differences are not big when it comes to the TV, merchants and middle-men (MM), other topics and the newspaper.

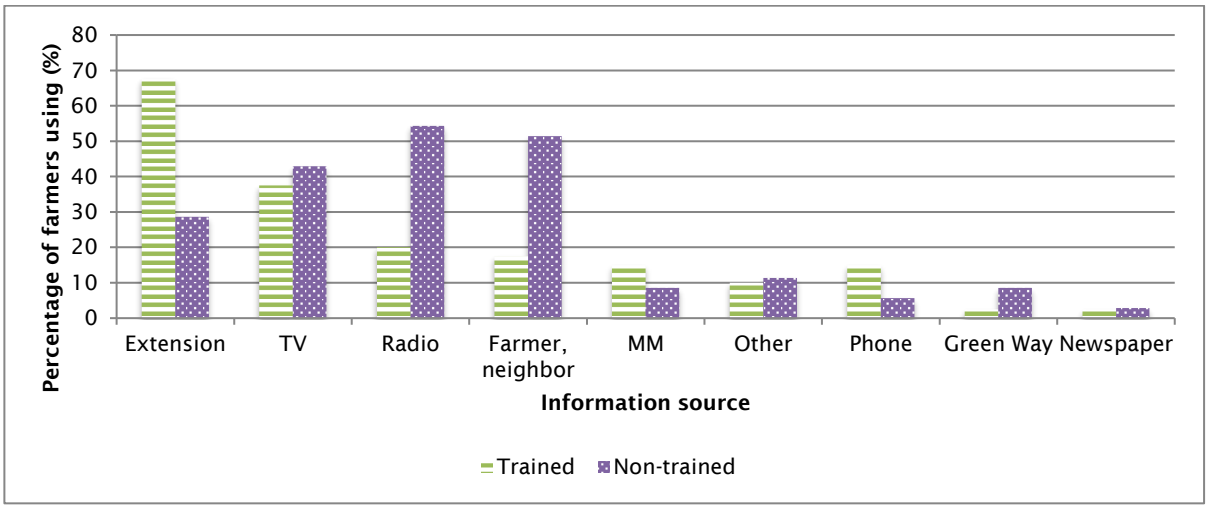

Figure 9: Information sources used by trained and non-trained farmers to access topics of interest

Beneficiaries and non-beneficiaries do not access the same sources of information as illustrated in figure 10. Non-beneficiaries do not have access to GoMP and DoA providing extension services, hereas beneficiaries mention this source by 38%. Non-beneficiaries have not mentioned merchants or middle-men (MM) as a source while 14% of the beneficiaries mention this. 70% of all non-beneficiaries mention other farmers and neighbors as important sources whereas only 46% of the beneficiaries mention this source. The newspaper, radio and phone are more often mentioned by non-beneficiaries than beneficiaries.

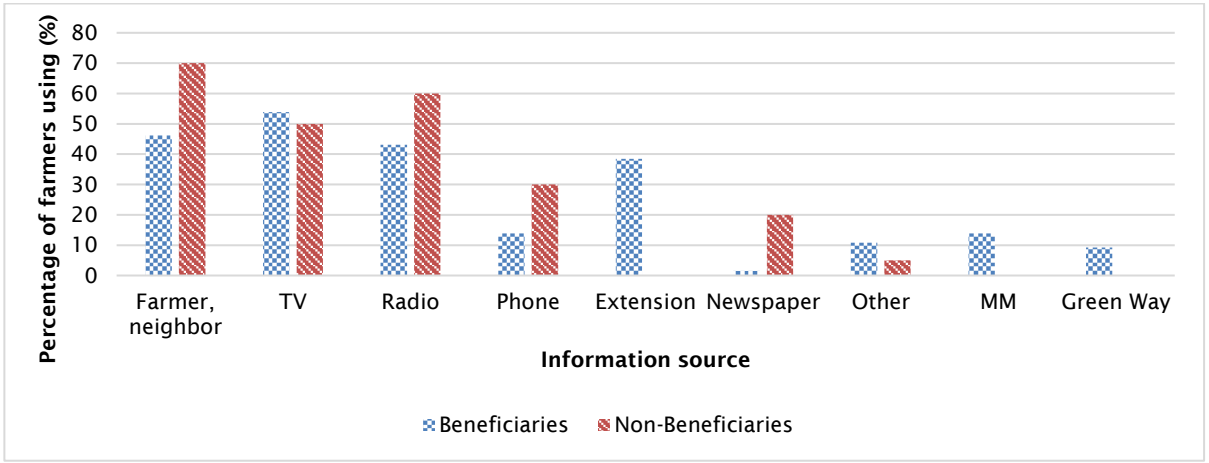

Figure 10: Information sources used by beneficiaries and non-beneficiaries to access topics of interest

These sources of information are used to access different topics of highest interest. Therefore, a closer look will be taken on the main sources of information used according to the type of information of highest interest (table 3). Extension services are mostly used to access information on cropping techniques (39 responses), fertilizer and its application (13), seed sources and prices (12) and pests and diseases (9). While the GoMP is mainly used to access information on cropping techniques (15) and information on fertilizer application techniques (10). In order to access weather information, mass media such as the TV, radio or the phone is used. Farmers get information on market prices through discussion with other farmers or neighbors and merchants.

Table 3: Information sources used for different topics

Topics	Main sources of information used by farmers (responses)*
Weather	TV (18), radio (15), phone (4)
Market price	Farmer/neighbors (9), merchant/middle-man (9), TV (5)
Pests and diseases	Extension services (9)
Cropping techniques	Extension services (39), TV (11)
Seed sources and prices	Extension services (12), farmer/neighbors (5)
Fertilizer and application	Extension services (13), farmer/neighbors (10), radio (4)
Others	Extension services (10), farmer/neighbors (9), radio (4)

*multiple responses possible per farmer

c) General use of different sources of information

In addition to the question on the information sources used to access the topics of highest interest, farmers were asked whether they use certain information sources or not.

As shown in figure 11, information sources that are used the most are: Farmers or neighbors (97%), mass media (83%), brokers or middle-men (83%), DoA (80%), farmer group CFDA (79%) and trainings of GoMP (73%). This is followdd by processors (56%) and input suppliers (53%). Smartphones and apps are used by a minority of the farmers. 23% of the farmers use apps on their smartphones. There is a distinction between Green Way app, used by 13% and the total of other apps used by 19% of the farmers.

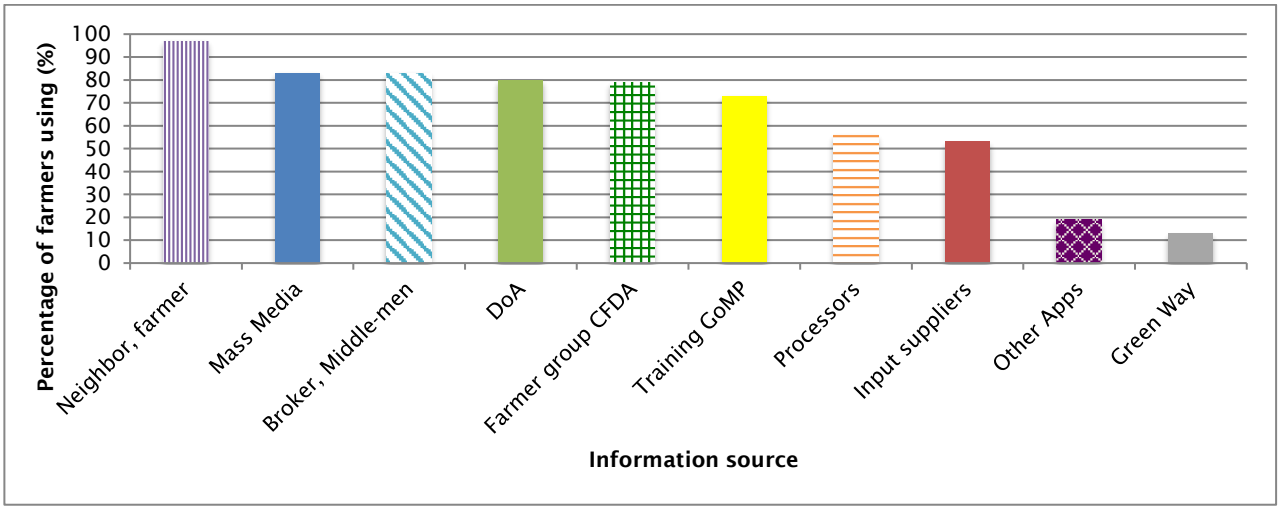

Figure 11: Frequency of use of different sources of information

d) Usefulness of information sources

If the information source (mentioned in part c) was used by the farmers, an additional question on the usefulness of these information sources has been asked. The farmers have rated the sources in four categories from not useful to very useful (figure 12).

Three information sources; The farmer group (CFDA), DoA and trainings of the GoMP, are generally useful to very useful to the interviewed farmers. Concerning all other sources, more than 10% of the farmers rate the source as little to not useful. Neighbors and other farmers are highly appreciated as information source. However, 15% of the farmers (n=11) think that other farmers and neighbors are

little or not useful as information source. 73% (n=8) rated the Green Way app as useful or very useful, despite 27% (n=3) of the farmers rate the Green Way app as little to not useful. The usefulness of other apps is rated the same as Green Way.

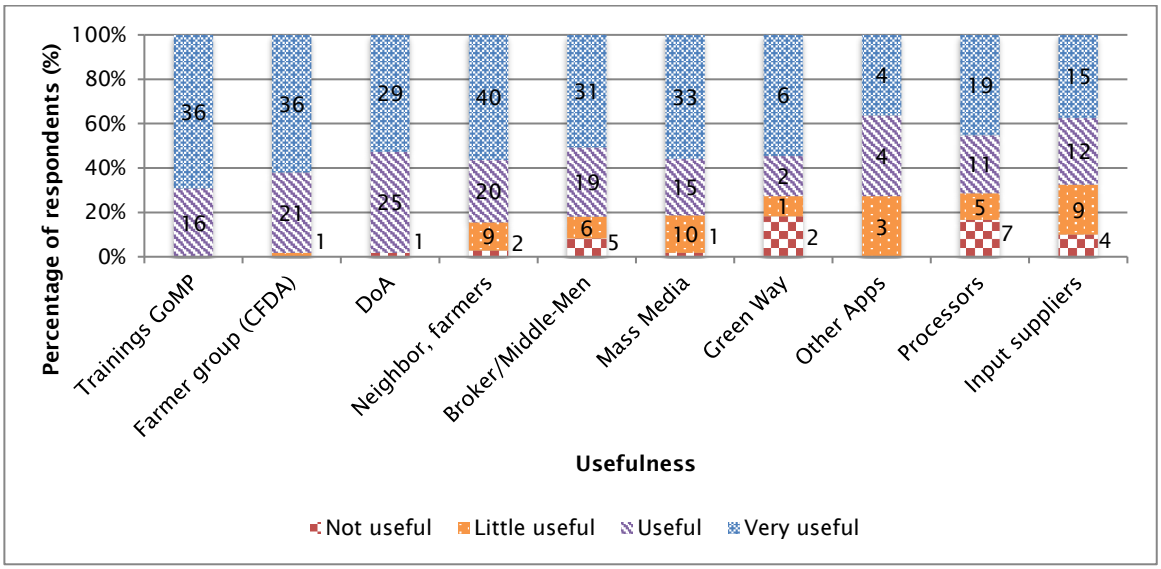

Figure 12: Usefulness of information sources ranked according to usefulness (very useful combined with useful)

e) Role of the smartphone and Green Way app

While most farmers have access to a smartphone, the rates of using phones and apps for agricultural information are still low. 88% of all interviewed farmers have access to at least one smartphone in their household. 39% of the farmers know apps that provide information for agriculture. Mostly Green Way and Facebook but also apps called Plant Protection and Htew Toe are known apps (table 4; cf. chapter 2.1.3). 23% of all farmers use apps that provide information for agriculture. 65% of these farmers are trained farmers. Tools on Facebook[3] and Green Way are used the most (table 4).

Table 4: Number of farmers knowing and using different apps

App	Respondents that know	Respondents that use
Green Way	25 (33%)	10 (13%)
Facebook tools	12 (16%)	11 (15%)
Plant Protection	5 (7%)	2 (3%)
Htew Toe	2 (3%)	2 (3%)

While looking at the question of the topics of highest interest, only eight farmers mentioned the phone as information source to access their topics of highest interest. Among these farmers, the phone is used for a range of different topics except for seed sources and prices. The Green Way app is used for accessing information on cropping techniques (3), market prices (1), pests and diseases (1) and land preparation techniques (1).

f) Access to information and gender aspects

As shown in figure 13, female farmers are more interested in market prices as well as seed sources and prices than men. Whereas male farmers show a higher interest in weather conditions, pests and diseases, fertilizer usage and cropping techniques. Concerning cropping techniques, seed sources and seed prices as well as other topics, the differences between the two groups are not big.

[3] For example: GoMP Facebook page, Farmer groups on FB

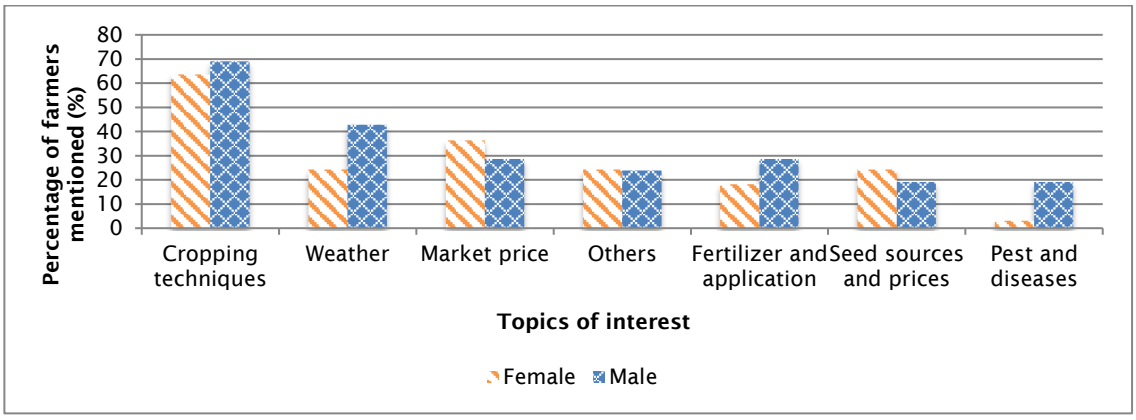

Figure 13: Topics of highest interest to male and female farmers

Concerning the use of different information sources in general, most sources show slightly higher rates of usage for male farmers compared to female farmers (figure 14). This is especially the case for extension services. The difference is highest for the GoMP, followed by DoA, input suppliers, mass media and the farmer group CFDA is also used by a higher percentage of male farmers than female farmers.

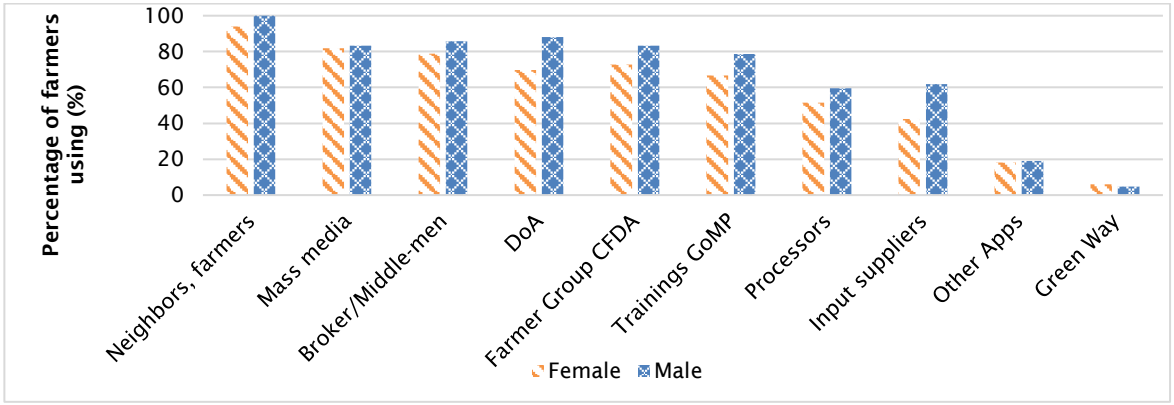

Figure 14: Use of information sources by female and male farmers

As shown in figure 15, there are only minimal differences between the two groups concerning access to smartphone and the knowledge and use of apps. There is no difference between female and male farmers when it comes to access to smartphones in households. 91% of all male farmers know the Green Way app, whereas 83% of the female respondents know it (difference 11%). 17% of the interviewed male farmers use the Green Way app for accessing information on agriculture. However, 9% of the female farmers use it.

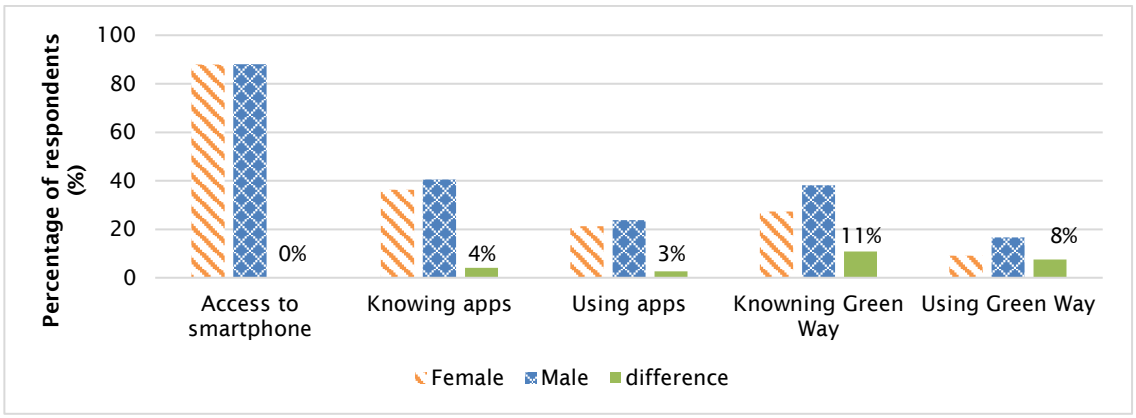

Figure 15: Use of apps by female and male farmers

4.1.2 Discussion

a) Topics of highest interest and sources of information

According to Aker (2011, 633): "Farmers have different types of information needs during each stage of the process, ranging from weather forecasts, pest attacks, inputs, cultivation practices, pest and disease management, and prices." The topics of highest interest depend on the time of the year and the current cultivation steps. These questions should be repeated during different seasons of the year in order to have a complete overview of the topics.

Direct beneficiaries of the GoMP are more interested in cropping techniques and prices than non-beneficiaries. This higher interest could be explained through the discussion of these topics during FFS and other trainings conducted by GoMP and DoA. Weather information is of greater interest to non-beneficiaries. A possible reason could be that non-beneficiaries do not get in touch with other topics like cropping techniques (through FFS) and are therefore less likely to mention them. Beneficiary farmers might be living closer to markets since farmers mention the location of the farm as reason why they are not beneficiaries of GoMP, (cf. chapter 4, p. 16). Beneficiaries could have more choice when it comes to market prices, which could be another reason for the higher interest.

Trained and non-trained farmers do not seem to have the same topics of highest interest. Trained farmers are for example more interested in seed sources and prices. This might be a reason why they also use other sources of information than non-trained farmers. Trained farmers show a higher rate of using extension services (see figure 9) which provide information on seeds and prices (table 3). The higher use of extension services can be explained through the close collaboration of beneficiaries, mostly trained farmers, with extension services. Withal, farmers should not depend on extension services provided through the GoMP only. These farmers have to switch to other information sources when the project ends at the end of 2021, which might have far-reaching consequences for the individual households.

The GoMP seems to provide important extension services which are used and appreciated by the farmers in the area (see figure 10). Since DoA and GoMP collaborate closely, they cannot be assessed separately. Beneficiaries have access to the GoMP trainings whereas non-beneficiaries have not (figure 9). Therefore, trained farmers, which are exclusively beneficiaries of the GoMP, show higher rates of the extension services than non-trained farmers, which are beneficiaries or non-beneficiaries of the project (see figure 8). Extension services are accessed in order to learn about a broad range of different topics including pests and diseases, cropping techniques, seed sources and prices, fertilizer and its application and others (table 3). Farmers rate the trainings of GoMP, DoA and the farmer groups (CFDA), which is organized by GoMP, as very useful to useful (figure 11).

Farmers and neighbors seem to be very important information sources for farmers (see figure 10). In general, there are high rates of usage amongst beneficiaries and non-beneficiaries as well as trained and non-trained farmers (see figures 8 and 9). This is a potential for spreading information from GoMP. Furthermore, farmers who attend trainings are likely to speak with other farmers and neighbors about the topics learnt through extension services.

When it comes to the usefulness of the information sources, one can assume that farmers tend to use sources that are useful to them. Farmers mostly mentioned that the sources they use are useful to very useful. They might have said that a source they do not use is not useful. However, the question on the usefulness was only asked if the farmers were using the sources. The Green Way app is amongst the sources that more than 20% of the farmers rate little to not useful. Since the app is innovative and complex to use, farmers might struggle to use it correctly and they therefore think that it is not useful. Further, Green Way is a newly introduced app and not yet known. It is therefore difficult to assess its' usefulness.

Hypothesis 1.1: *"Farmers in the GoM are using different sources of information for different topics"* can be confimed through the knowledge gained in this chapter. Withal, there is a difference between the two groups of direct beneficiaries and non-beneficiaries as well as trained and non-trained farmers, mentioned in the discussion above. As shown in table 3, extension services are used to access five topics of highest interest, mass media is used to access five and personal communication to access four topics. However, the survey was targeting the individual interests of farmers which can of course vary from person to person. Further, the understanding of the different topics might vary in addition.

Farmers often mention more than one source for each topic. It seems to be important to have several information sources and compare the information given.

b) Use of smartphones and apps in Myanmar

There is a potential to increase internet penetration since Myanmar has reached a penetration rate of 26% in January 2017, which is low compared to the Southeast-Asian average of 53% (Kanale 2017). This rate is likely to have risen by the year of 2019. According to Konijnendijk and Roest (2018): "The country's smartphone penetration has rocketed to a whopping 80%, and data use is on par with what we see in developed European countries".

The survey data has shown that 88% of all interviewed farmers have access to at least one smartphone in their household (cf. figure 15). According to observations and CGAP (2018), most phones in Myanmar are smartphones. Nonetheless, having access to a smartphone does not mean that farmers use it. Farmers in Kyaikhto estimate that 40% of all farmers actually use the smartphone (FGD 2 2019). Further, some farmers might use their smartphone for calls only, so phone apps are not necessarily used. In contrast, one main reason for having a phone is direct access to information, mentioned by 90% of the people (Thwa Tar Min, Fife, Bohlin 2014, cited in Kraas et al. 2014, 96). However, the use of smartphones needs to be learnt. The observations made during the survey show that the main respondents often do not have a phone but their sons and daughters do. So, almost all households have smartphones but according to Kraas et al. (2017, 96) the main user group of phones are young and educated people aged between 18 and 34 years. Many users share their phones with family members and friends (ibid.). During the survey of this paper it has been observed that younger people are more likely to use smartphones than older farmers. This shows that the training should include the young generation of a household. After all, the young generation might not be interested in agriculture, following the trend in rural Myanmar. Many young adults go to neigboring Thailand in order to find better paid jobs, which leads to a small percentage of young adults in the project villages.

Almost 40% of the interviewed farmers know about phone apps for agricultural information and 23% of the farmers in the area use them. It has been observed that most mobile phones are smartphones, so most farmers should be able to access apps. The interviewed farmers mentioned mostly Green Way as app that they know and use. However, since there has been a training on the Green Way recently, farmers might be more likely to remember Green Way app compared to other apps they have heard about longer time ago. FB and Htew Toe are mentioned as well. Golden Paddy and other apps available in Myanmar app described in chapter 3.1.3 have not been mentioned by the interviewed farmers. 13% use the Green Way app in order to access information. This percentage is likely to grow in the future due to an increased internet penetration, increased use of smartphones and trainings on the Green Way app.

The following two examples show the advantages of mobile phones over other mass media tools. First, the information provided through radios is limited to one-way communication and to certain topics. Second, newspapers are usually more common in urban areas and do therefore not always reach the rural poor (Aker 2011, 636). According to GSMA and asia (2015, 3) farmers in Myanmar join mobile phone internet services because they want to meet basic communication needs. However, as soon as they were connected they used it for business, social status and entertainment. Hence, farmers would probably use the smartphone for their farming activities in a second step after the basic communication needs have been satisfied.

*Therefore the Green Way app is surely a potential source of information for farmers. It is unclear whether it will become a major source (**Hypothesis 1.2**).* Due to the wide range of information provided through the app (see chapter 2.1.1), farmers could access a broad range of topics through one source. The three topics of highest interest (cropping techniques, weather and market prices) can all be found on the Green Way app. The app could simplify the search for information, since a lot of different sources of information are used to access information on agricultural topics (cf. table 3). According to Aker (2011, 632): "Mobile phones significantly reduce communication and information costs for the rural poor. This not only provides new opportunities for rural farmers to obtain access to information on agricultural technologies, but also to use ICTs in agricultural extension services." The Green Way app might be integrated into extension services provided through the GoMP and DoA.

Mass media is used by 80% of the interviewed farmers, figure 11. Farmers might change from mass media like the TV and radio to apps like Green Way in order to access information. Withal, the

information provided on the app could help the farmers to get a broader choice on information. More opportunities will increase the farmers' possibilities and therefore the chance to increase their incomes.

c) Smartphone in agriculture and gender

It is important to know about the differences in gender when it comes to using smartphones and apps. According to GSMA and LIRNasia (2015, 2): "Women in Myanmar are 29% less likely to own a mobile phone than men". This gap is especially high amongst lower income households. However, the study states further that many women have access to phones belonging to the household (ibid.). So they might not own it but can still use it to access agricultural information. Concerning the decision to purchase phones, it is usually the family senior, male or female, who decides on behalf of the household (ibid., 3). Some women were not interested in agriculture at the time of the survey, which might be a reason why they did not want to participate in the survey.

The percentage of female farmers (9%) using Green Way as information source is not significantly smaller than the one for male farmers (17%). Male farmers use apps more often as information source (cf. figure 14). Female farmers mention the GoMP (26%) and DoA (18%) more often when it comes to the use of different sources to access agricultural information (cf. figure 14). As the differences concerning other information sources are relatively small, the GoMP needs to be aware of this when conducting training on the app but also on agricultural practices in general.

4.2 Green Way as tool to collect economic data

On the one hand, Green Way app provides information. On the other hand, economic data on crop production can be collected through a farming record tool. This data could be used by farmers to get an overview of expenses and income and by the GoMP in order to assess farmers' economic performances in the project area (income, production costs, etc.) and to perform economic calculations, including updating CBA calculations (cf. chapter 2.1.2). With the information gained through this data, the project aims at improving farmers' lives and incomes (Tun Zaw Htay 2019, personal communication).

This farming record feature has been released in June 2019 during the conduction of the survey. A selected number of farmers (see chapter 2.1.2) got training on how to use the farming record between Mid-June and Mid-August (Tun Zaw Htay 2019, personal communication). It has to be considered that the survey has taken place in a very early stage during the introduction of the farming record.

4.2.1 Results

a) Main strengths and weaknesses of the farming record

SWOT analyses have been carried out in order to understand the perception of different stakeholders on the farming record feature. Table 5 (cf. table annex 7) shows strengths, weaknesses, opportunities and threats of the feature according to these stakeholders (amended by the author, marked with * in table 5).

The GoMP aims at collecting economic data through the app in order to save time and resources (Tun Zaw Htay 2019). Therefore, the project works together with Greenovator which developed this feature with the aim to help farmers recording their data (Linn Wah Wah Zaw and Khin Sabai Thu 2019, personal communication). One of the main strengths of the feature is that expenses and income can be recorded easily (ibid.). As a consequence, a seasonal and yearly comparison of costs and benefits is shown on the app. Farmers mention that they are therefore able to plan their farm activities better. Furthermore, the data recorded can be used to plan activites like fertilizer application in advance, according to the data from previous years (FGD 1 2019). Linn Wah and Khin Sabai Thu (2019) mention that the agricultural inputs used can be recorded on the farming record, which helps farmers to remember the exact amounts used. In addition, the GoMP can track the use of inputs of project beneficiaries. Family labor can be recorded on the feature which is important since family labor hours are generally not recorded and therefore not known (ibid.).

Table 5: Summarized SWOT analyses on the farming record, based on interviews with Greenovator, GoMP, farmers and own reflections

Strengths	**Weaknesses**
• Collects data in an easy and cheap way • Compares costs and benefits • Plans and reviews farm activities • Checks input use • Records family labor • Is supported by GoMP • Gives an opportunity to contact experts	• Needs precise information from farmers • Has limited supporting resources of GoMP • Lacks professional support in areas outside of GoMP • Requires understanding of calculations and economics • Is difficult to find on Green Way app • Does not prevent mistakes in data entry • Provides limited possibilities to delete data
Opportunities	**Threats**
• Connects producers and consumers *Faces…* • increasing access to smartphone and network connection • Motivated farmers in GoMP • new generation and their skills • increased access to certification standards *Could contribute to…* • collection of data and advice through extension services	*Faces…* • low internet connection in some villages • low rate of smartphone use • old smart phone versions and play store availability • difficulty of recording and typing data (Unicode) • issues concerning data privacy • Data may not be representative of the population depending on who uses the tool. • Challenge of data collection from farmers not using the app

There are issued related to operations of the app as well as principles of data collection and data handling. One big weakness of the feature is that good quality data can only be guaranteed through training of the app users. Farmers outside of the GoMP area do not receive support on how to fill in the questions (Linn Wah and Khin Sabai Thu 2019). According to Tun Zaw Htay (2019, personal communication), another important weakness is that the monitoring of data entry through GoMP is too limited in resources to make the data from the farming record usable.

Another important issue concerns user friendliness. Farmers mention that it is not easy to find the farming record tool on the Green Way app (FGD 1 2019). In addition, mistakes in data entry happen easily and there are limited possibilities to delete single data lines. Until now, only whole sheets but not single lines of data can be deleted by the farmers. If farmers want to delete single lines, Greenovator or GoMP needs to be contacted (ibid.). For the project's purpose of data collection, farmers need to fill in the information precisely, so the collected data can be used for economic calculations.

b) Main opportunities and threats of the farming record

Tun Zaw Htay (2019, personal communication), who is responsible for the training on the farming record, mentions several opportunities. The farmers in the project villages have good access to smartphones and good internet connection through four different mobile phone carriers. In a lot of farmer households, sons and daughters use the smartphone. This young generation is well educated and is therefore able to read and write on the app. In addition, the participation of the farmers in the project is good, which will help to spread the use of the farming record (Tun Zaw Htay 2019, personal communication). According to Linn Wah Wah Zaw and Khin Sabai Thu (2019, personal communication), the feature provides a tool to track costs and benefits and can help farmers to produce according to standards in a following step. Since the farmers have practice on how to record their data, they are prepared to fill in the governmental agricultural forms as well. Further, the feature could be used to connect farmers and consumers. A barcode on an agricultural product could provide consumers with information on how and where the product was produced (ibid.).

On the other hand, there are threats to this tool. Tun Zaw Htay (2019, personal communication) mentions that the internet connection might not be sufficient in rural areas. Farmers do not always have smartphones or find it difficult to use. The version of the smartphone can make the use of the app impossible since Green Way runs on newer smartphone versions only. According to Linn Wah Wah Zaw and Khin Sabai Thu (2019, personal communication), farmers might not have the playstore app to download Green Way app. So farmers need to find another way for downloading (ibid.). Farmers mention that they have difficulties to use the farming record, especially when it comes to typing economic data. Due to the change of the Unicode system concerning Myanmar language letters, the app is not readable on old smartphone versions. Data privacy is a potential threat to the feature (Tun Zaw Htay 2019, personal communication), more on this can be found part d of chapter 4.2.2.

c) Current use of the farming record

Figure 16 shows the usage rates of smartphones, apps and Green Way based on the survey and FGDs conducted in the scope of this research. As mentioned in chapter 4.1.1 part e, 88% of the respondents have access to a smartphone in their households, but only about 40% are estimated to use it. 33% of the interviewed farmers know the Green Way app and 13% use it. So if only 40% use smartphones, the percentage of 13% using the Green Way app shows that around 25% of the farmers that use smartphones use the Green Way app as well. However, these figures are based on the sample of this research and may not be representative of the farmers' population in the GoMP area. According to Tun Zaw Htay (2019, personal communication), 20% of the farmers that use the Green Way app will use the farming record in the future. When asking the farmers directly if they will use the farming record in the future, 25% said that they will use it. However, as this question was asked after having explained the farming record, it is not likely that farmers were able to honestly estimate if they are going to use it or not. According to Linn Wah Wah Zaw and Khin Sabai (2019, personal communication), 260 farmers in the area of the GoMP have registered on the farming record feature since the end of June until September 18th 2019.

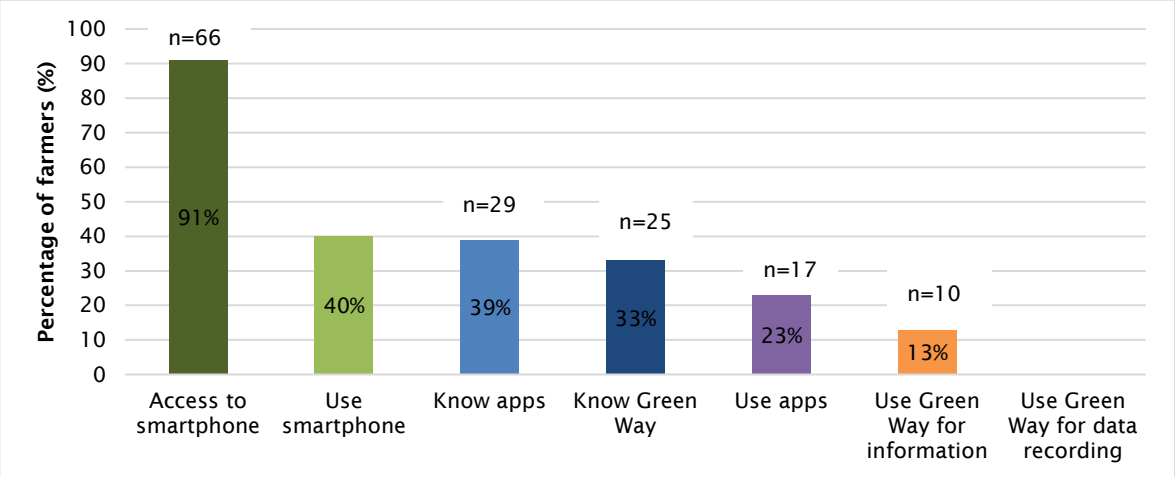

Figure 16: Use and access of smartphones, Green Way and other apps for agriculture

d) Incentives

Farmers who showed interest in the Green Way app and the farming record (n=23) were asked about the incentives they would need in order to use the farming record and share their data. 57% of these farmers answered that they need technical knowledge on farming. Training was mentioned second by 30% of these farmers (figure 17). Two out of 23 respondents mentioned that the costs for using the app should be covered and one farmer expects presents in order to use the feature.

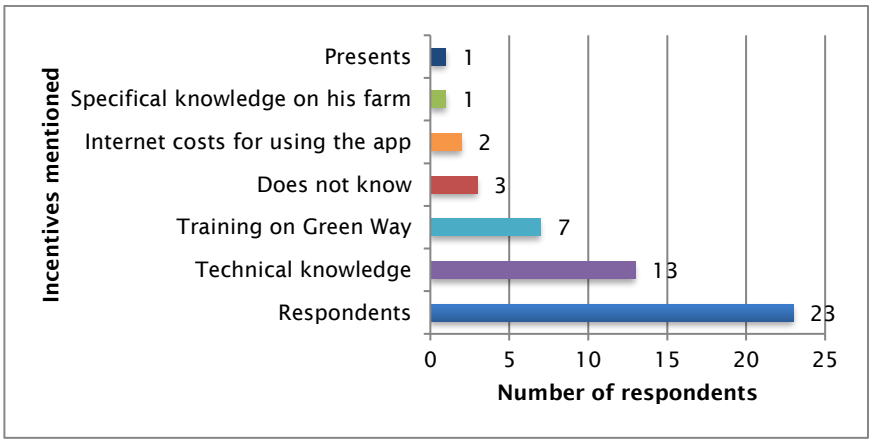

Figure 17: Incentives mentioned during the survey

During the FGD 2 (2019), farmers made clear that they expect to get technical information and advice on agricultural practices in exchange of sharing their data through the app. Some farmers wish for specific advice according to the data they filled into the farming record. Further, farmers have the wish to compare their own performance indicators with others. These indicators should be based on the

method of cultivation. For example, farmers should see the key indicators for direct seeding and transplanting paddy separately (FGD 1 2019). Training on the farming record is crucial for understanding the purpose of the feature and handling data recording (FGD 1 and 2 2019).

4.2.2 Discussion

a) SWOT analyses

The author of this thesis has added all observations made during the trainings and visits to the farmers to complete the picture of the SWOT with an outsider perspective (table 5 and annex 7).

The GoMP is encouraging farmers to record their data because of various opportunities it can bring to increase incomes. Farmers who produce according to GAP or organic standards are likely to earn more than their colleagues. Recording is important if farmers choose to produce according to standards of GAP or SRP. This is also why the project puts emphasis on the farming record (Tun Zaw Htay 2019, ToT). According to the Sustainable Rice Platform (2019, 3): "The SRP performance indicators for Sustainable Rice Cultivation allow for quantitative measurement and assessment of the sustainability impacts of adoption of recommended practices at farm level." Such performance indicators include profitability, labor productivity, water use efficiency, productivity and others (ibid.). The farming record of Green Way could be a useful tool to record such farm data and could therefore lower the gap for farmers who are used to record performance indicators, to cultivate according to standards like SRP. Exports are also a growing opportunity. If farmers want to export or certify their produce, they need to provide evidence of their production standards. The farming record enhances traceability and can be used to record such data (Greenovator 2019, personal communication). According to Linn Wah and Khin Sabai Thu (2019), farmers who record get practice on recording and they therefore face less troubles when filling in the papers from the government. Mobile phones can be used to collect data and "….therefore improve the accountability of extension services" (Dillon 2011, cited in Aker 2011, 638). GoMP and DoA acting as extension services in the area could later collect the data from the app in order to target their advice in a more specific way. This is also mentioned as an incentive for farmers to use the farming record (cf. part d, chapter 4.2.1). Through the recording of farm data farmers could be able to prove the ownership or cultivation of land to the government or third parties. This is especially important since there are gaps in the current legal framework like a lack of customary land use rights (FAO and MRLG 2019, 3).

b) Willingness of farmers to use the farming record

At the time of the survey, only one farmer was using the farming record, which confirms the first part of ***Hypothesis 2.2****: "Most farmers do not use the farming record feature yet…"* . The farming record was released at the end of June 2019 (with delay from original release date), while the survey was conducted. Therefore hypothesis 2.2 needs to be reviewed at the end of 2020 when the paddy is harvested and the first data of the farming record is available. By then, it will also become clear which and how many farmers used the tool in 2019.

According to Tun Zaw Htay (2019, personal communication), 20% of the farmers using Green Way today will use the farming record in the future. As shown in figure 16 (chapter 4.2.1 part c), 10 farmers use the Green Way today, which would mean that only two farmers will use the farming record in the future. According to Linn Wah Wah Zaw and Khin Sabai (2019, personal communication), 260 farmers in the area of the GoMP have registered on the farming record (cf. part c chapter 4.2.1). However, this is just a registration and does not mean that the farming record is used and the data is useful for analyses.

Even if farmers are willing to use the farming record, they first need to find the farming record feature on the Green Way app, which is a challenge according to farmers participating in FGD 1 (2019). And even more important, most farmers do not know about the Green Way app, so there is a need for some kind of promotion. This has been done through GoMP trainings on the Green Way app until now.

Since most farmers are not using apps, it has to be assumed that the handling of such apps can be challenging. Also, farmers need to understand the advantages of the farming record in order to provide data. During the FGDs farmers clearly mentioned that training is crucial. Volunteers of the GoMP help them to record data on the app and on paper. Only, one out of 17 farmers at the FGD 2 (2019) was able

to record his data without a tutor. Therefore, the second part of ***hypothesis 2.2****: "…and they will need specific training before they can use it."* can be confirmed.

c) Prerequisites in order to use the app

Not all farmers have access to a smartphone in their household (see chapter 4.1.1 part e). But like mentioned in chapter 4.2 c) most households possess at least one smartphone. It is important to consider that most respondents did not use the phone themselves, but their children did.

In general, farmers in the project area are able to read (Tun Zaw Htay, personal communication 2019). Another prerequisite for the farming record tool is to be able to write. According to No No Aung (2019, 29), who interviewed farmers in Kyaikhto, Bilin and Thaton Townships, 12% of the beneficiary households and 32% of the non-beneficiary households are illiterate. These farmers are not able to use the farming record themselves. However, household members could assist them in order to be able to fill in their data. According to Willmott-Harrop (2017), voice calls and messages instead of written information could be used to provide information for illiterate farmers. The potential of voice messages for answering the farming record would need to be assessed.

Therefore, ***Hypothesis 2.1****: Not all farmers fulfil the prerequisites for using the Green Way app,* can clearly be confirmed. However, it depends if we look at the Green Way app as information source; there farmers need to be able to read and use the phone only. If we look at the recording tool, farmers need to be able to write economic data and understand some basic economics in order to be able to fill in the form correctly.

d) Data privacy

When the farming record tool was released, a question was missing, and this was: "Do you want to share your data?" (Van der Zanden 2019, personal communication). If farmers want to use the farming record tool, they need to share their phone number, location, farm size and information on the ownership of the land (Linn Wah Wah Zaw and Khin Sabai Thu 2019, personal communication). According to Tun Zaw Htay (17.7.2019) the collected data from the farming record will be shared with GoMP and Greenovator only. The GoMP should explain the farmers about their data privacy on the one hand. On the other hand, Greenovator has a tool against any claim if such a question is included in the feature.

According to Myanmar Centre for Responsible Business (MCRB), Institute for Human Rights and Business (IHRB) and the Danish Institute for Human Rights (DIHR) (2015, 153): "Legislation that regulates data privacy typically details a consent mechanism to inform and request permission from users, provides a legal permission of what constitutes personal data, mandates an allowable timeframe for the use of any data after consent is given, and includes regulatory mechanisms for pursuing grievances about the use of data." National data protection laws are implemented in many countries around the world in order to hinder unauthorized third parties to access private information. Such a data privacy law is not in place and does therefore not hinder companies and governments in Myanmar to share personal data. Users should be asked for permission if data is collected, stored or shared. Therefore, ASEAN has started to create frameworks for protection of data privacy (ibid., 153-155). As Myanmar is member of ASEAN, such a law should be implemented in the coming years. Until then, there is no official law on data privacy; companies and government departments need to care for the protection of their own and the data of their customers. Especially companies working in the ICT need clear policies about the way of data collection, storage and sharing. A company's "privacy-policy" should also stipulate under what circumstances governments are allowed to have access to the company's data. These "privacy-policies" need to be available to the public so users can be aware on what data is collected and shared (ibid., 163-164).

According to the same sources "Public's awareness of the needs to protect personal data is quite low." However, the awareness on private data protection amongst companies based in Myanmar has risen (ibid., 156). In Myanmar, people live closely with extended family members. Therefore, the understanding of a private space is not the same as in Western cultures. Myanmar is not familiar with the concept of data privacy and do not see its importance (ibid., 162). Farmers in the GoM are willing to share all their data, also when it comes to very personal data such as phone numbers or locations of the farm. Farmers have the hope that they will get more specific advice on farming practices due to the shared data (FGDs 2019). According to Linn Wah Wah Zaw and Khin Sabai Thu (2019, personal communication), Greenovator is working on a privacy-policy.

e) Incentives needed

In order to use the farming record and share economic data, one would assume that farmers need incentives to be willing to fill in their data and share it with Greenovator, as described in ***Hypothesis 3.1****: Without incentives farmers are not likely to share their economic information.* At this early stage of the implementation of the farming record, firstly, most farmers did not know what the farming record was about. They could therefore not value what incentives they would need. Secondly, farmers were not able to chose whether they want to share their data or not (see part d). So if they use the farming record, the data is shared automatically. However, out of the farmers that were able to answer, 57% wanted technical knowledge as incentives. Nevertheless, this technical knowledge is already accessible for all farmers through the Green Way app as described in chapter 3.1.1. The training on the tool is mentioned by 30% of the farmers, although the training is something they get in advance and not in exchange of their economic data.

During the FGDs, farmers mentioned that the company should give specific advice on the farm situation according to the data shared through the farming record (FGD 1 2019). However, as this is based on a small sample of farmers that know Green Way and the farming record, more research is needed in order to answer **hypothesis 3.1.** According to Linn Wah Wah Zaw (2019), there is a pilot project in Rakhine State on giving advice about farming practices according to data from farmers. Farmers fill in their information on production and the app will give them advice on how much and which inputs they should use. A similar service could be provided through the farming record feature (ibid.). If farmers get more specific advice, they might have a better chance to increase their incomes, which is the main goal of GoMP. On the other hand, this advice could be a potential incentive for farmers to use the farming record. However, the app should not be connected to input companies who would place their products and sell as much as possible. 9% of the farmers that were interested in using the farming record mentioned that the costs for using the app should be covered. Farmers do not have to pay for the app but the downloading process requires internet connection. Therefore, the cost of the data needs to be paid by the farmer. Once the app is downloaded, data is only required when new information is loaded.

f) Observations on the use and training

The farmers are generally very motivated to learn about Green Way and the farming record. This chapter provides some critical observations from the author.

The versions of the farming record have changed after the release of the feature. Changes should be limited as much as possible, since farmers might be confused about the different appearance of the app. Farmers could lose motivation to use the app which could lead to a loss of the number of farmers that provide economic data for GoMP.

Some farmers have attended trainings on the Green Way app, but did not know what the app was about when the author asked them some days after the training. This shows that there is a lack of interest or understanding amongst some farmers that attend the training. One reason for this might be that some households send the older generation to attend trainings on the Green Way app because younger members of the households are needed in the fields. This should be avoided by the project since older farmers often do not know how to use the phone and are therefore less likely to use the app afterwards. If the elder generation gets training on the app, the trainings should start with basic knowledge transfer on the use of smartphones and apps in general before introducing specific apps and tools like the farming record.

The selection of the trained farmers was based on the interest of the farmers in the app. This means that trained farmers need to convince their non-trained peers first, before they can explain the feature to them. There is a risk that only farmers who work closely together with the GoMP will use the farming record because they get training first and have access to smartphones. Furthermore, since some trained farmers have no smartphones, GoMP trains them on recording their data on logbooks and a volunteer will put the data in the app later. These farmers will not be able to explain the farming record tool to other farmers in the village.

4.3 Monsoon paddy production in the GoM

Farmer households (n=59) were asked about economic performance indicators of paddy and green gram production. This chapter will describe the situation for paddy concerning production area (a), way of production (b), yield (c), prices for paddy (d), production costs (e) and income (f) during monsoon season 2018. The change in income from paddy between 2015 and 2018 (g) is described in the following chapter.

Burmese units are still widely used in rural Myanmar. Therefore, local baskets were converted into kg. The conversion rate for paddy and green gram from World Bank (2016, 97) was taken as basis after having discussed the rates with Mr. Tun Zaw Htay (2019, personal communication). In Myanmar acres instead of hectares are used as units of surface. Therefore, land areas are expressed in acres in this paper.

4.3.1 Results

a) Farm size and area of paddy production

The total average farm size of all interviewed farmers in Bilin and Kyaikhto Townships was 14.4 acres. Monsoon paddy is produced on 14.1 acres on average, which means that in most cases, all or almost the whole farm area is used for paddy production during rainy season.

49% of the interviewed farmers got a training on how to use the farming record feature or were expecting to attend a training in the weeks after the survey had taken place. The training was conducted by volunteers of the GoMP with four to five farmers per village in a total of 45 villages (Tun Zaw Htay 2019, personal communication). There was no significant difference between the trained (n=29) and non-trained (n=30) farmers on the total farm area (p=0.81; table 6). Further, there is no significant difference concerning the area of monsoon paddy production between farmers in Bilin and Kyaikhto Townships (p=0.06).

b) Way of production

There are two main ways of sowing rain fed wetland rice. Most farmers in the area transplant their paddy (n=24; figure 18) or perform direct seeding through broadcasting (n=22). One farmer in Kyaikhto used a seeder in order to broadcast seeds (figure 19). All other farmers that practiced broadcasting did it by hand. Most farmers chose the method of transplanting or direct seeding but 13 households chose combined methods.

Figure 18: Women transplanting paddy in Bilin Township (Source: Braun)

Figure 19: Direct seeder for paddy in Boyargyi, Kyaikhto Township (Source: Braun)

GoMP beneficiaries are more likely to choose one method of cultivation (84%), whereas 50% of the non-beneficiaries use a combination of the ways to produce paddy. Therefore, beneficiaries of the GoMP are more likely to choose transplanting and direct seeding as their method of cultivation (figure 20). However, there is no big difference between beneficiaries and non-beneficiaries when it comes to transplanting or direct seeding. Farmers in Bilin Township are more likely to choose the method of transplanting than farmers in Kyaikhto Township.

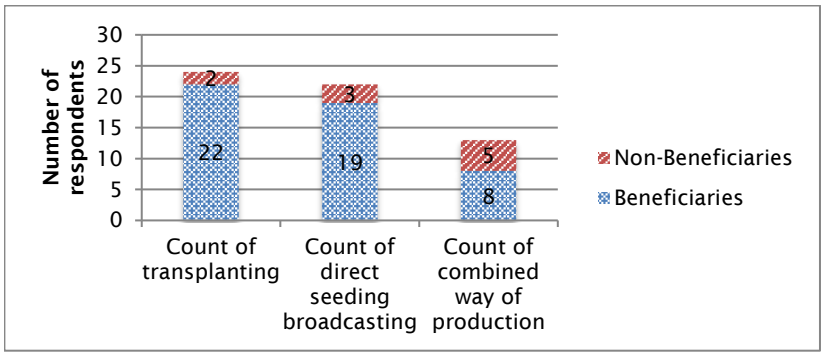

Figure 20: Way of cultivation of beneficiaries and non-beneficiaries

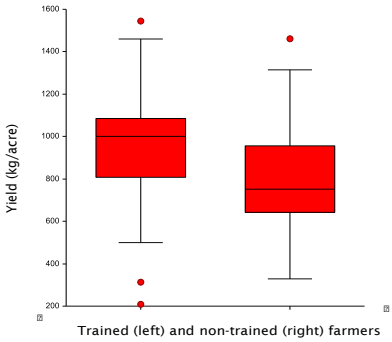

Figure 21: Yield (kg/acre) of trained (left) and non-trained farmers (right); *converted from local units

c) Yield

Farmers in the area produce on average 871 kg of monsoon paddy per acre. It has to be considered that there is a big range between the farmer with the lowest productivity of 0 kg and the highest productivity of 1'544 kg per acre. Many farmers experienced floods in 2018 and therefore lost a significant share of their production. One farmer even lost his yield completely due to flooding.

Table 6: Area of production and yield of trained and non-trained farmers

Item	**Trained** (n=29)	**Non-trained** (n=30)	**t-test results (p-value)**
Farm area (acres)	14.3	14.6	0.81
Area of monsoon paddy production (acres)	13.6	14.6	0.75
Yield (kg/acre)*	948.6	793.5	0.02

There is no significant (p=0.67) difference in yield between farmers living in Bilin Township (883.4 kg/acre on average, n=38) and Kyaikhto Township (847.7 kg/acre on average, n=20). Trained farmers reach a significantly higher mean yield of 948.6 kg per acre, whereas non-trained farmers reach 793.5 kg (p=0.02) on average (figure 21). This difference between trained and non-trained farmers is bigger in Kyaikhto than in Bilin Township.

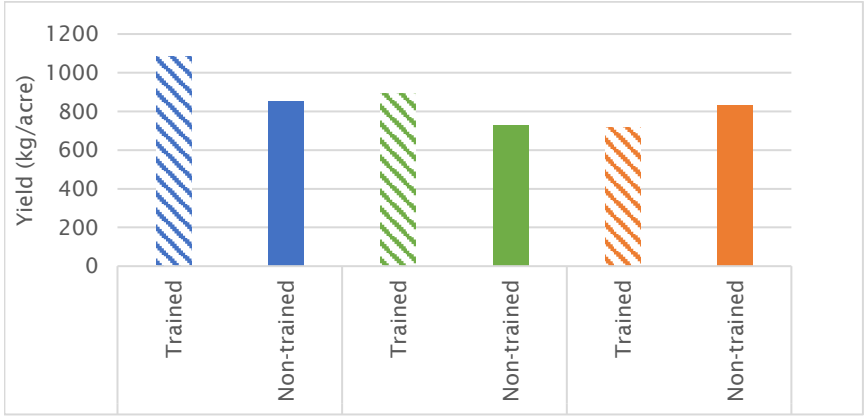

Figure 22: Yield of trained and non-trained farmers according to the way of cultivation

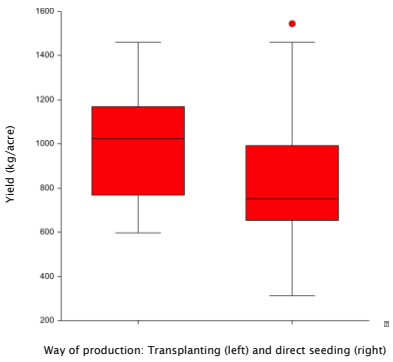

Figure 23: Yield of farmers transplanting (left) and direct seeding (right)

Farmers who choose the method of direct seeding, through broadcasting or using a seeder, achieve a significantly lower yield of 796 kg per acre, whereas farmers who transplant their paddy reach 989 kg per acre (p=0.03), figure 23. Farmers who use combined methods reach on average less yield than farmers who choose one way of cultivation (figure 22). This is significantly lower compared to the transplanting farmers (p=0.04) but not significantly lower compared to the farmers that choose combined methods of cultivation (p=0.84). Non-trained farmers perform better when choosing combined methods of cultivation compared to direct seeding (figure 22).

According to Tun Zaw Htay (2019, personal communication), farmers producing paddy can be assigned to four types: Normal (n=23), Demonstrator (n=17), seed multiplier (n=5) and seed producer (n=2; figure 24). 29% of the respondents are demonstrator farmers, 9% seed multipliers and 3% seed producers of the GoMP. 5% are multiple farmer types. Demonstrator farmers work closely together with the GoMP. Some FFS and trainings of the GoMP are organized on these farms. Seed producer cultivate the first filiale (F1) generation of paddy whereas seed multipliers "multiply" the F2 generation (Tun Zaw Htay, personal communication 2019). There is a significant difference (p=0.03) in productivity between normal and demonstrator farmers (table 7).

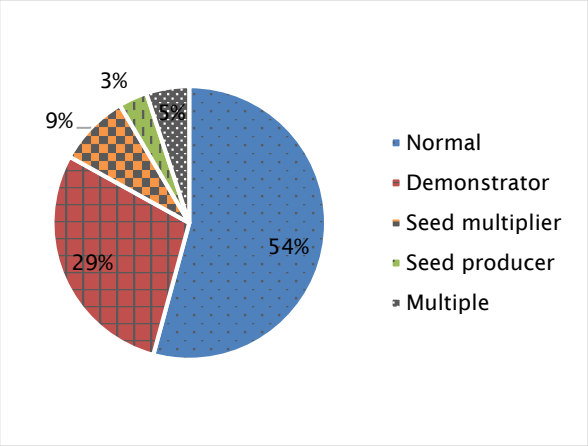

Figure 24: Types of farmers

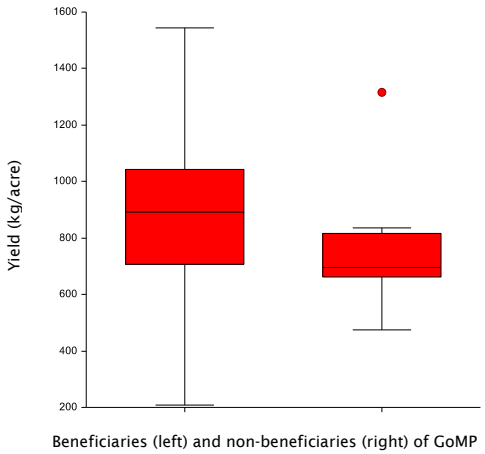

Figure 25: Yield of beneficiaries (left) and non-beneficiaries (right)

Table 7: Yield of different types of farmers (*significantly different from other group); *converted from local units

Type of farmer	Average of total production (kg/acre)*
Normal (n=32)	752.0*
Demonstrator (n=17)	1'003.5*
Seed multiplier (n=5)	861.0
Seed producer (n=2)	1'252.2
Multiple types (n=3)	1'113.1
Mean	**857.8**

There is no significant (p=0.22) difference in yield between beneficiaries of the GoMP (mean: 892 kg per acre; n=49), and non-beneficiaries (mean: 758 kg/acre; n=10). The variances of the beneficiaries is more significant compared to the one of non-beneficiaries (figure 25)

d) Prices for paddy

Farmer households sell 75% of their paddy production and keep the rest for self-consumption and use it as seeds for the next cultivation period (Tun Zaw Htay 2019, personal communication). Farmers in Bilin Township sell on average 77% of their total paddy production, whereas farmers in Kyaikhto sell 70%. Trained farmers sell a higher percentage of their total production than non-trained farmers (80%, respectively 70%). Beneficiaries sell 78% of their total production, whereas non-beneficiaries sell 62%.

Farmers in the area receive on average 430 MMK per kg of paddy produced. There is a price range between 239 MMK and 671 MMK per kg of sold paddy. However, the prices depend on the place of selling. Paddy farmers sell their production on the farm or they bring it to the miller. 71% of the interviewed farmers sold their paddy at farm gate, where farmers receive a significantly higher price (on average 115 MMK/kg) than farmers who go to the miller and sell their paddy (figure 26; p=0.00). The farmers who go to the miller have to pay transportation costs additionally, so they try to avoid going to the miller to sell their paddy (Tun Zaw Htay 2019, personal communication). 10% of the interviewed farmers had not sold the paddy at the time of the visit. They have stored their bags of paddy in their house and were waiting for higher prices.

Farmers living in Bilin Township get significantly (p=0.05) higher prices (14.6%) than farmers living in Kyaikhto Township (figure 27). Farmers living in Theinchaung tend to receive the highest price of 503 MMK per kg of paddy, whereas farmers from Kha Ywel receive the lowest price of 289 MMK per kg on average, digital annex 2.

Trained farmers get on average 7% higher prices for paddy than non-trained farmers. However, this difference is not significant (p=0.49).

The analysis of variances for the different types of farmers (normal, demonstrator, seed multiplier and producers) has not shown any significant difference between the four types of farmers (p=0.33).

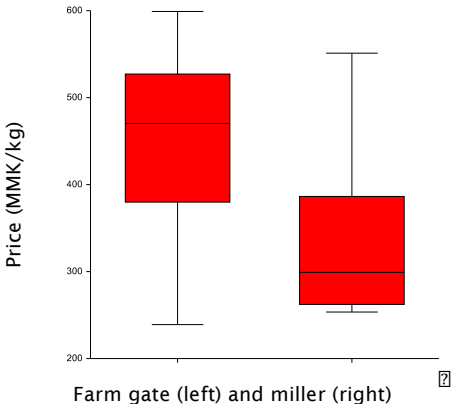

Figure 26: Average price per kg of paddy produced according to the place of selling

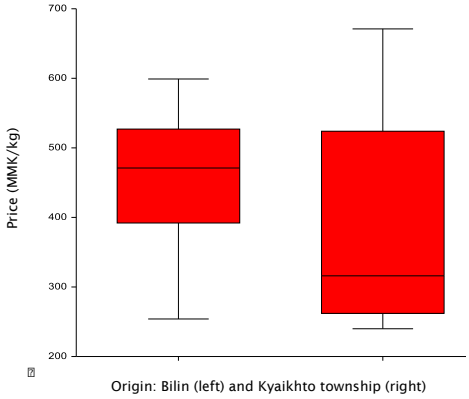

Figure 27: Average price for paddy in Bilin (left) and Kyaikhto (right) Townships

e) Production costs

Paddy production costs can be split into the following seven categories: Labour costs, machinery costs (power tiller for land preparation, figure 29), costs for animal power, costs for fertilizer and its application, costs for chemicals and their application, costs for seeds and costs for credits (figure 28).

Farmers in the area have total production costs of 192'281 MMK per acre on average. The production costs are not significantly different in Kyaikhto and Bilin Township (p=0.60). As shown in figure 28, Shan Chaung has the lowest production costs per acre out of the eight villages, whereas Theinchaung reaches the highest amount.

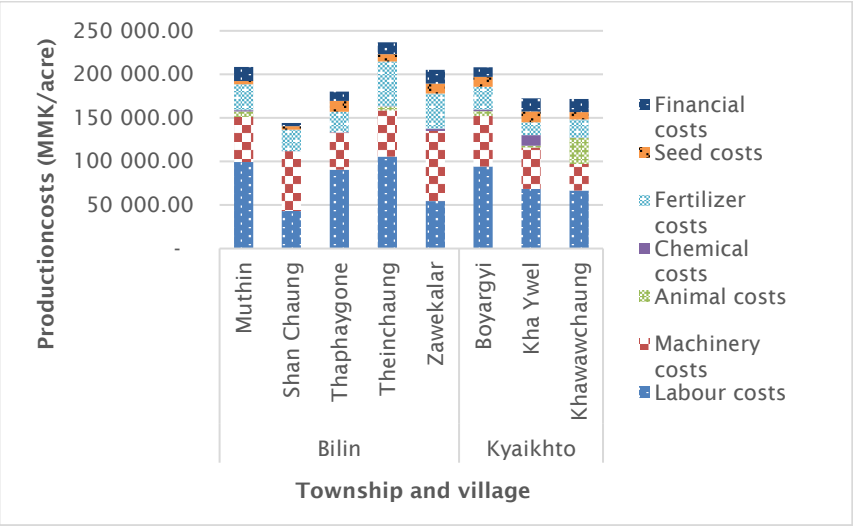

Figure 28: Average production costs according to the village

Figure 29: Land preparation in Bilin Township (Source: Braun 2019)

In most villages, labour costs (including own labour) make up the biggest part of total costs (41%), followed by costs for machinery (28%) and fertilizer costs (16%). However, this is not the case in Shan Chaung and Zawekalar, where machinery costs make up bigger parts than labour costs. 19% of all interviewed farmers use animals as draft power. Animal costs are most important in Khawarchaung where they make up 17% of total production costs. No draft animals are used in Shan Chaung, Tha Pay Kone and Zawekalar. Costs for fertilizer are highest in Theinchaung with an average amount of 51'387 MMK spent per acre. In this case, fertilizer makes up 25% of the total production costs. Chemicals are used by 31% of the interviewed farmers and there is a wide range of the costs spent for chemicals. Kha Ywel has highest costs for chemicals with an average of 11'824 MMK per acre, whereas farmers in Shan Chaung spend 191 MMK per acre on average. 5% of the total production costs are spent for buying seeds. 39% of the interviewed farmers used seeds from the previous year and did therefore not buy any additional seeds.

Farmers in the area use six different sources for seasonal credits; The revolving fund of the GoMP, Myanmar Agricultural Development Bank (MADB), Vision Fund Myanmar, a Chinese agency, cooperative agencies and private credits (table 8). 95% of all interviewed farmers receive a credit from the MADB under the Government of Myanmar. The time of reimbursement might vary between the different sources and within the cooperative agencies. However in the scope of this paper, 8 months have been assumed for all credits with no exact figures available (table 8). Farmers spent on average 135'498 MMK on credits, which corresponds to 12'590 per acre. All interviewed farmers were credit receivers, except for two farmers in Shan Chaung.

Table 8: Sources of credits for paddy production (Tun Zaw Htay and Zaw Win Latt, 2019 personal communication)

Source of credit	Credit amount (MMK)	Interest rate per month	Interest rate per year	Duration (months)	Number of households benefitting (n, % of interviewed HH)
MADB	150'000 /acre		8%	11	56 (95%)
Revolving fund GoMP	150'000-500'000	2%		8	28 (47%)
Cooperative agencies (several sources)	100'000-600'000	1.5-2.5%		8 (estimation)	8 (14%)
Chinese agency	500'000	2%		8 (estimation)	2 (3%)
Private Credit	300'000 + 900'000	5%		8 (estimation)	2 (3%)
Vision Fund Myanmar	400'000	2.5%		8 (estimation)	1 (2%)

Trained farmers (n=29) have significantly higher costs for seeds (p=0.004, difference 52%) and credits (p=0.05; difference 27%) compared to non-trained farmers (n=30; figure 30). In contrast, non-trained have slightly, but not significantly higher costs for animals (67%, p=0.27), chemicals (43%, p=0.75) and fertilizer (3%, p=0.93). However, the total production costs are not significantly different between trained and non-trained farmer (p=0.38).

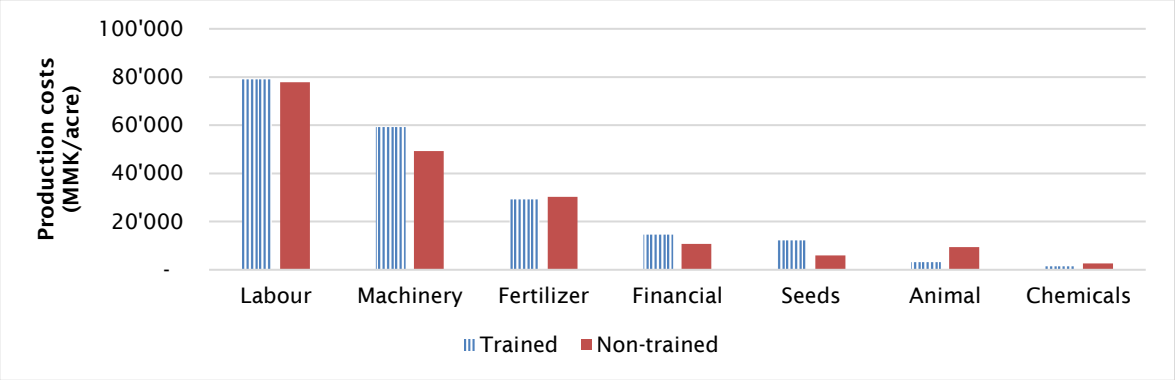

Figure 30: Production costs of trained and non-trained farmers

Farmers that transplant their paddy (n=24) have on average total production costs of 241'398 MMK per acre, compared to significantly lower costs of 146'165 MMK per acre for farmers who perform direct seeding (n=22, p=0.00). Farmers who chose combined methods of cultivation reach on average 179'648 MMK per acre, which is significantly different from farmers that practice transplanting (p=0.00) and direct seeding (p=0.02). The biggest difference in costs between farmers who transplant and farmers who broadcast is found in labour costs. Farmers that transplant have on average 70% higher labour costs than their colleagues who perform direct seeding (p=0.00; figure 31). In contrast, farmers who practice direct seeding spend more of their money for machinery than for labour. Farmers who perform direct seeding, have higher costs for animals (60%), however this difference has not shown any significance (p=0.34). The amounts of machinery costs are similar for all ways of production. Costs for fertilizers are 35% higher for farmers that choose the method of transplanting than for farmers who perform direct seeding (p=0.01), or chose a combined method of cultivation (p=0.02).

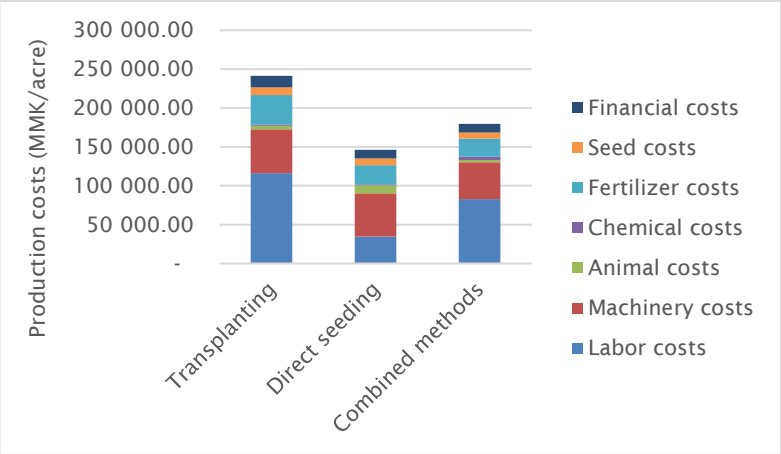

Figure 31: Production costs according to the way of production

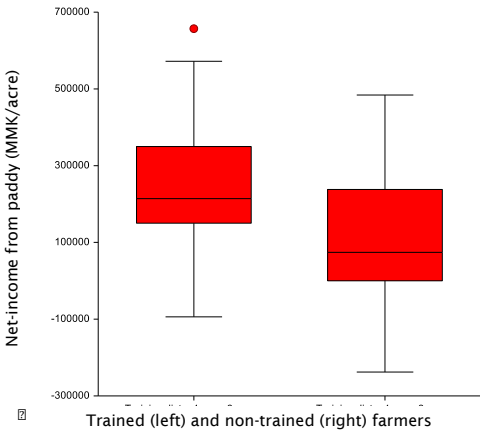

Figure 32: Net-income of monsoon paddy production of trained (left) and non-trained farmers (right)

f) Income from paddy production

The income is an economic indicator that is important to farmers and was therefore calculated based on the economic data from the survey. Farmers in the area reach net-incomes between -239'000 and 657'000 MMK per acre (mean: 162'780 MMK/acre). The net-income per acre is significantly higher for trained farmers (mean: 225'808 MMK/acre) than for non-trained farmers (mean: 101'854 MMK/acre; p=0.008; figure 32).

Farmers who choose transplanting (n=24) as way of cultivation reach net-incomes of 212'747 MMK per acre on average, which is not significantly (p=0.224) higher than the average net-income of farmers seeding directly (n=22; 143'599 MMK/acre).

Trained farmers who transplant their paddy (n=14) do not reach a significantly higher net-income than trained farmers who perform direct seeding (n=9; p=0.079). Trained farmers who choose combined ways of production (n=6) have significantly (p=0.015) lower net-incomes than trained farmers who transplant their paddy (figure 33). However, producing with combined methods is not significantly less productive than seeding directly (p=0.12). Non-trained farmers who perform direct seeding (n=13) do not reach significantly higher net-incomes than non-trained farmers who transplant (n=10) their paddy (p=0.67). There is also no significant difference between farmers who choose single or combined ways (n=7) of cultivation (p=0.69 and p=0.99).

Production costs reach on average 50% of the amount of the gross-income of paddy production per acre. Trained farmers spend generally less than 50% of the amount of the gross-income for production costs, whereas non-trained farmers spend most of their gross-income as production costs. It has to be considered that some farmers had production costs but no income due to floods in 2018.

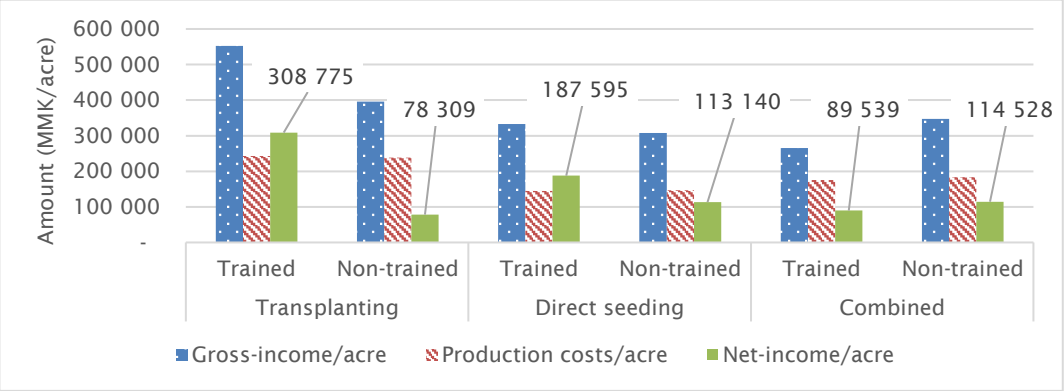

Figure 33: Income and total production costs of trained and non-trained farmers

There is no significant difference between the net-incomes of GoMP beneficiaries and non-beneficiaries (p=0.18; figure 34). However, there is a high standard deviation of the beneficiaries (SE=188'849 MMK) and a small sample of non-beneficiaries (n=10), which has to be considered.

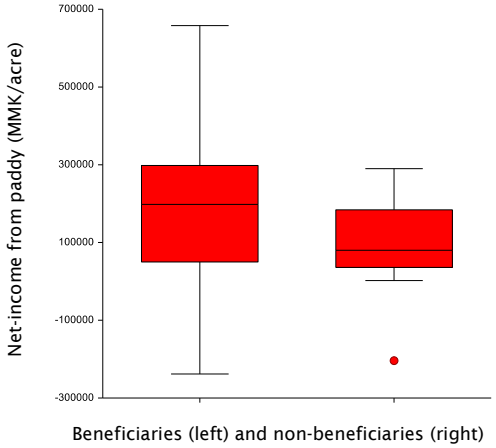

Figure 34: Net-income of direct beneficiaries and non-beneficiaries

g) Situation 2015 compared to 2018

5% of the interviewed farmers did not observe any change in income from paddy production comparing 2015 and 2018. 44% of the farmers observed a decrease in income during this period. In contrast 51% had an increased income from 2015 until 2018. The latter changed by 24% on average. The farmers who stated a higher income in 2015, had on average 27% higher incomes in 2015 compared to 2018. Therefore, a general trend cannot be observed. However, farmers with an improved income in 2018 mention technical changes (n=14), amongst others through the farmer group (CFDA), as reasons. Weather condition, mainly salt water intrusion and floods, are mentioned as additional reason (n=8). Three farmers state that a change in variety had positive effects on their income. Soil fertility and the

use of fertilizer are mentioned by three beneficiaries. A change in varieties as well as changes in fertilizer usage may be an effect of the GoMP.

Incomes decreased between 2015 and 2018 due to weather conditions in combination with an increase of pest and diseases (n=19, 76% of farmers with higher incomes in 2015). Four farmers mentioned a change of cultivation technique and three farmers think that a change in their cultivated varieties is the reason for a decrease in income between 2015 and 2018.

Table 9: Incomes of paddy production in 2015 compared to 2018

Reasons for higher income in 2015 (n=24/59)	**Reasons for lower income in 2015 (n=27/59)**
Weather conditions (floods, salt water intrusion) and pests and diseases (19)	Technical improvements, amongst others due to farmer group CFDA (14)
Change in cultivation techniques (4)	Weather conditions (floods, salt water intrusion) (8)
Change in varieties and seeds used (3)	Change in varieties and seeds used (3)
	Improved use of fertilizer (3)

Beneficiaries of the GoMP are more likely to have a lower (n=23) than a higher income (n=19) in 2015 compared to 2018. Concerning non-beneficiaries, five farmers had higher incomes and four farmers generated lower incomes than in 2018 (figure 35).

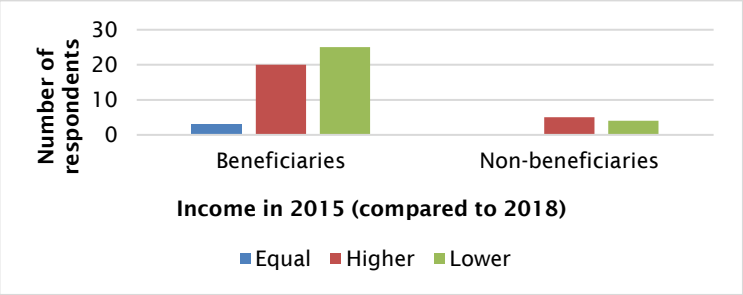

Figure 35: Beneficiaries and non-beneficiaries comparing incomes of 2015 with 2018

There is a difference between farmers from Bilin and Kyaikhto Township concerning the change of income from paddy production. On the one hand, 23 farmers in Bilin Township mentioned that they had lower income in 2015 compared to 2018. In contrast, 12 farmers had higher incomes in 2015 (figure 36). On the other hand, 13 farmers from Kyaikhto Township mention that they had higher incomes in 2015, compared to six farmers that had lower incomes in 2015.

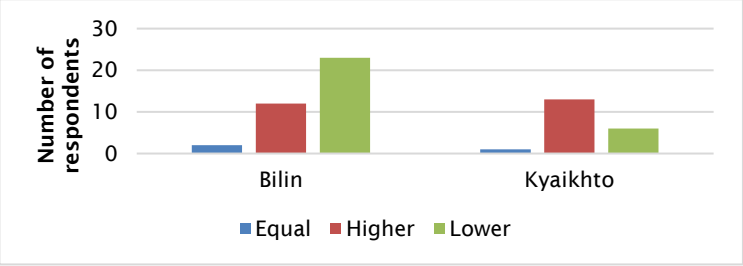

Figure 36: Farmers from Bilin and Kyaikhto comparing incomes of 2015 with 2018

4.3.2 Discussion

a) Economics of paddy production

The average yield of the interviewed farmers is 871 kg per acre and is close to 814 kg[4] per acre in 2017 stated by No No Aung (2019, 37). According to Jungblut (2018, 33-34), farmers reached between 261 and 1'636 kg[5] per acre depending on the rice varieties used. The average yield stated in this thesis are low compared to the countries' average of 1'643 kg per acre (DAP 2012, cited in Aung 2019, 18). World Bank (2014, 17) reports an average yield of 1'274 kg per acre for monsoon paddy. However, the productivity in coastal areas might be lower than in other more fertile areas of the country, amongst others due to flooding, salt water intrusion and others.

As described in chapter 4.3.1, the way of cultivation has an important influence on yield and production costs in paddy cultivation. Farmers who perform direct seeding have lower production costs than farmers who transplant their paddy, as described in part e of chapter 4.3.1. Withal, farmers that transplant get significantly more yield than farmers who perform direct seeding, see part c. According to Mr. Tun Zaw Htay (17.7.19), there is an important difference for some cultivation steps between the two main ways of cultivation. Farmers who transplant paddy, do not generally practice weeding. Further, direct seeding comes along with a higher amount of fertilizer used and there is an important difference in land preparation; The land is ploughed and harrowed once for direct seeding. In contrast, the land is once ploughed and in addition harrowed one to two times if transplanting (ibid.). This is an important reason why the production costs of farmers practicing direct seeding are much lower than they are for farmers that transplant their paddy.

Trained farmers are mostly demonstrators, seed multipliers and seed producers, which has to be considered since there are significant differences in average yields when it comes to the types of farmers (cf. table 7). However, this is also due to their different aims of production.

One interviewed farmer lost his yield due to flooding. This was included in the calculations since flooding happens almost every year due to heavy rainfall during monsoon season. According to observations of the author, flooding is a fear of many farmers when they plant monsoon paddy. As described in chapter 4.3.1 part g, weather is the most important factor for a lower yield in 2018 compared to 2015. However, most farmers mentioned that their income from paddy has increased due to mainly technical improvements but also weather conditions and other changes at farm level.

Table 10: Place of selling of monsoon paddy

Village	Miller (n)	Farm gate (n)
Bilin	**2**	**34**
Muthin	1	6
Shan Chaung		6
Thaphaygone		8
Theinchaung		7
Zawekalar	1	7
Kyaikhto	**8**	**8**
Boyargyi	1	5
Kha Ywel	3	1
Khawawchaung	4	2
Grand Total	**10**	**42**

There seems to be a big interest of the collectors and millers to buy the harvested paddy at farm gate. According to Theingi Myint (no date, 11): "These local collectors or brokers travel even to remote and difficult to access areas to collect harvests from farm gates, collection points and small rural markets until they accumulate a sufficient quantity." Some farmers have to sell their paddy immediately because they need working capital for the cultivation of a second crop. This is unfavourable concerning prices, since they are generally low around harvest time. Therefore, some farmers store paddy in order to benefit from higher prices later in the year (Theingi Myint no date, 12). This has been done by 10% of the interviewed farmers.

In most cases millers and brokers buy the paddy at farm gate (Tun Zaw Htay 2019, personal communication). Anyhow, some farmers need to go to the miller, pay transportation costs additionally and sell their paddy for a lower price at the miller (ibid.). There are three reasons why prices are higher at farm gate. First, millers are interested in wet paddy with a moisture content of at least 15% because they can dry it systematically. This moisture content is usually best right after harvesting, when the paddy is sold at farm gate, and decreases later on. Second, if the moisture content is high (usually if sold at farm gate), the basket of paddy is heavier. Due to the higher weight, higher prices may be payed also due to a lack of weighing systems and control at the farm. Third, some farmers don't need to sell

[4, 5] Converted: World Bank (2016, 97)

the paddy immediately because they are not in an urgent need of money. The quality of the paddy may decrease until they sell it at the miller, which has a negative effect on the price (Tun Zaw Htay 2019, personal communication).

Another reason for lower prices may be due to the accessibility of some farms. Farmers in Kyaikhto Township are more likely to sell directly to the miller (table 10) and they therefore receive on average lower prices than farmers in Bilin (cf. chapter 4.3.1 part d). The majority of farmers from Kha Ywel and Khawarchaung sell to the miller. This could be explained with the low accessibility of the villages, see map on figure 2. These two villages are far away from the Township capital, whereas Boyargyi is very close to the Township of Kyaikhto.

Farmers in the area achieve a mean income of 162'780 MMK per acre from monsoon paddy production. The average income is slightly higher than the figure of 143'000 MMK cited by No No Aung (2019, 37-38). Also the average selling price of 430 MMK per kg is higher than the 331 MMK per kg[6] cited by No No Aung (2019, 37-38). Possible reasons might be price fluctuations from year to year but also the different villages visited within the scope of the two research papers.

According to Theingyi Myint (no date, 3), farmers apply for additional credits, since the credit from MADB is often not sufficient to cover production costs. Therefore, farmers hold credits from different lenders. Because of this, they are more likely to get indebted, which is a big issue of paddy farmers in the region according to Zaw Win Latt (2019, personal communication). The farmers taking out loans from the MADB with an interest rate of 8% per year have to repay the credits after 11 months (Zaw Win Latt 2019, personal communication). The revolving fund of the GoMP calculates credit costs according to the sector and the financial possibilities of the farmers to pay back the loan. According to the revolving fund team in the GoMP, some farmers repay credits at the end of the 8th month, whereas others pay back every month depending on the farmers' cash situation. Due to the different terms and conditions of the lenders, interest rates, without amortisation have been used for calculation. The interest rates and the period of the credits from the MADB and the revolving fund of the GoMP as given by the farmers, have been crosschecked with the help of Zaw Win Latt and other staff of the GoMP (2019, personal communication).

Table 12 summarizes the average performance indicators of trained and non-trained farmers. Trained farmers reached significantly higher net-income than non-trained farmers. This higher net-income is on the one hand due to the higher prices trained farmers reach on average, amongst others because trained farmers are more likely to sell at farm gate. On the other hand, trained farmers reach a higher productivity per acre. Trained farmers have higher seed and machinery costs which could be explained through the use of improved varieties and machines. Further, trained farmers have less fertilizer and chemical costs, which also contributes to a higher income per acre. This comparison shows that some parameters are significantly different between the two groups. If the trained farmers use the farming record, while the non-trained farmers do not use it, the data collected through the app will only represent the average trained farmer. The performance of non-trained would not be included in CBA calculations based on the app data.

Table 11: Comparison of main performance indicators of trained and non-trained farmers (cf. description of these groups in chapter 3.2.1) for paddy

Item	Average trained	Average non-trained	Significance
Area of cultivation in total (acres)	14.3	14.6	No (p=0.814)
Area of paddy production (acres)	13.6	14.6	No (p=0.649)
Yield (kg/acre)	949	794	Yes (p=0.047)
% of sold paddy	80%	70%	
Production costs (MMK/acre)	198'850	185'931	No (p=0.375)
Seed costs (MMK/acre)	12'170	5'898	Yes (p=0.004)
Financial costs (MMK/acre)	14'567	10'678	Yes (p=0.045)
Net-Income (MMK/acre)	225'808	101'854	Yes (p=0.008)

[6] Converted: World Bank (2016, 97)

b) Verification of assumptions made in CBA 2018

As stated in chapter 2.2.3, a CBA has been conducted in 2018. The assumptions made, have been updated with data collected through the survey. A table with all assumptions and updated figures can be found in annex 6.

The mean cultivated area per farmer is much bigger (19.5 aces for non-beneficiaries, respectively 13 acres for beneficiaries) than the 4.5 acres, assumed during CBA 2018.

In general, the additional production costs with the project have been assumed to be higher than the survey data has shown. For the method of direct seeding, project beneficiaries spend 6'000 MMK per acre more than non-beneficiaries, compared to the assumed additional production costs of 80'000 MMK. For the method of transplanting, the difference is smaller. Withal, the average additional costs of 80'000 MMK assumed during CBA 2018 would need to be lowered to around 39'000 MMK according to the survey data.

Paddy prices are influenced by the place of selling. Farmers might sell at farm gate for 420 MMK per kg without and 460 MMK per kg with project or they go to the miller and sell for a lower price as shown in table 12 (cf. part d of chapter 4.3.1). Overall, the assumed farm gate price of 250 MMK is too low. A price increase though the project is only achieved when selling at farm gate. Concerning prices at the miller, farmers that are beneficiaries of the GoMP (n=12) receive on average 18% less for their paddy than farmers who are non-beneficiaries (n=5). However, the sample is small (five non-beneficiaries at miller and five non-beneficiaries at farm gate).

Table 12: Verification of assumptions CBA 2018 for price of paddy

Price of paddy	**Unit**	**CBA 2018**		**Survey**	
		Without project	With project	Without project	With project
Farm gate price for paddy	MMK/kg	250	250	421	456
Price increase for better quality	%				8
Price for paddy at the mill	MMK/kg			403	341
Price increase for better quality	%				-18

According to the assumptions made during the CBA 2018, an additional yield of 575 kg per acres is achieved through the project (table 13). This figure is high, since farmers achieve 871 kg per acres on average. Around 200 kg per acres would be an accurate figure according to the data from the survey. Farmers transplanting paddy have on average a higher yield than farmers who practice direct seeding. This has been confirmed by the figures from the survey of this paper, see figure 23 in chapter 4.3.1.

Table 13: Verification of assumptions CBA 2018 on paddy for additional yield through project

Additional yield with project (kg/acre)	**CBA 2018**	**Survey**
Direct seeding	500	128
Transplanting	650	284
Average yield increase	**575**	**206**

Concerning the average additional incomes, the assumptions from CBA 2018 are not very different from the survey figures. However, the assumption of approximately 64'000 MMK might be lifted to 85'000 MMK per acre, which is amongst others due to higher prices that farmers receive for their paddy. The comparison of income in 2015 compared to 2018 has shown that beneficiaries of the GoMP are more likely to have equal or lower income from paddy in 2015 than non-beneficiaries (cf. chapter 4.3.1, f). Therefore, beneficiaries are more likely to have increased their income in this period than non-

beneficiaries. However, when looking at the difference between farmers living in Bilin and Kyaikhto Townships for this comparison of income in 2015 and 2018, the differences between the two years are higher. This means that the project has an influence but other factors like the region and the year can have superior influence.

Further, the inflation rate has an effect on household economics. According to the International Monetary Fund (IMF) 2019, the inflation rate in Myanmar was 7.3% in 2015 and 5.9% in 2018. Therefore, the individual housholds had a decreased purchasing power per unit of money between 2015 and 2018. So, if farmers say their income from a specific crop was higher in 2015, this statement could be due to the higher purchasing power compared to 2018.

Hypothesis 4.1 elaborated in the beginning of the research: *"Some of the assumptions made during the CBA 2018 need revision"* can be confirmed as some assumptions do not correspond to the data collected through the survey. This is especially the case for yield and prices of selling concerning paddy production. The CBA of green gram will be shown in part b of chapter 4.4.2. However, it has to be considered that the CBA was applied for the entire project area, whereas this research targets two townships.

4.4 Green gram production in the GoM

Green gram is produced by 36% (n=21) of all interviewed farmers with an average area of production of 8.1 acres. 33% of the interviewed farmers in Kyaikhto and 37% of the interviewed farmers in Bilin Township cultivated green gram in addition to monsoon paddy.

This chapter describes the situation for green gram concerning production area (a), yield (b), prices (c), production costs (d) and income (e). The change in income from green gram between 2015 and 2018 (f) is described in the following paragraphs. As mentioned in chapter 4.3, local Myanmar units (baskets) were converted into international measurements (kg). One basket equals 32.66 kg (World Bank 2016, 97).

4.4.1 Results

a) Area of production

The average area of production is significantly higher in Bilin (10.2 acres) than in Kyaikhto Township (3.9 acres; p=0.01). In Shan Chaung and Boyargyi farmers produce rice only, whereas in Muthin six out of seven interviewed farmers produce both rice and green gram (table 14).

Trained farmers cultivate green gram on an average of 11 acres, whereas non-trained farmers use less land (6 acres) for the cultivation of green gram, which is not significantly different (p=0.08).

Table 14: Green gram production according to village and Township ; *converted from local units

	Number of farmers producing green gram	Average of production area (acres)	Average yield (kg/acre)*
Bilin Township	**14**	**10.2**	**227.9**
Muthin	6	8.3	190.1
Thaphaygone	3	16.8	231.9
Theinchaung	2	6.0	226.3
Zawekalar	3	10.0	300.7
Kyaikhto Township	**7**	**3.9**	**217.7**
Kha Ywel	4	5.5	290.3
Khawawchaung	3	1.8	145.2
Average	**21**	**8.1**	**224.8**

b) Yield

On average farmers produce 225 kg of green gram per acre. Non-trained farmers reach 244 kg whereas trained farmers achieve 202 kg, which is not significantly different (p=0.4). As shown in table 14, farmers living in Bilin Township do not have significantly higher yields than farmers from Kyaikhto Township (p=0.85). However, there are some differences between the villages. Yields in Zawekalar are on average two times higher than in Khawarchaung.

There is neither a significant difference between beneficiaries (n=16) and non-beneficiaries (n=4; p=0.12) of the GoMP nor between trained and non-trained farmers in terms of yield (p=0.12; p=0.4).

c) Prices for green gram

Farmers sell 91% of their green gram. However, trained farmers sell 87%, whereas non-trained farmers sell 95% of their production. On average farmers receive 1'227 MMK per kg of green gram. Trained farmers do not get a significantly higher price (+25 MMK/kg) than non-trained farmers (p=1).

81% of the farmers go to the miller and sell their paddy, whereas the rest sells at farm gate. Farmers who sell at farm gate receive 66 MMK per kg more than farmers who go to the miller and sell, which is not significantly different (p=0.11).

d) Production costs

The average total production costs reach 153'844 MMK per acre. Total production costs can be split into seven categories, as illustrated in table 15. The biggest part of the production costs is spent for labour (48%). Costs for machinery (18%), seeds (12%) and chemicals (10%) make up important parts of production costs as well. There is neither a significant difference in total production costs between the two Townships (p=0.35) nor between beneficiaries and non-beneficiaries of the GoMP (p=0.62). Trained farmers reach total production costs of 166'811 MMK, whereas non-trained farmers reach 142'056 MMK per acre. This is not significantly different (p=0.36).

Table 15: Amount of different categories of Green gram production costs

Type of production costs	**Production costs (MMK/acre)**	**Percentage of total production**
Labour	73'268	48%
Machinery	28'087	18%
Seeds	15'893	12%
Chemicals	17'938	10%
Fertilizer	10'354	7%
Animals	5'905	4%
Financial	2'380	1.5%
Total production costs	153'844	

Concerning labour costs, farmers pay wages of 4'000 MMK to 10'000 MMK per hour for labour. In total, trained and non-trained farmers pay similar amounts per acre. Draught animals are used by four farmers for the cultivation of green gram. The biggest and significant difference in production costs between trained and non-trained farmers is found in seed costs, as shown in figure 37. Trained farmers spend on average 22'719 MMK per acre for seeds, whereas non-trained farmers spend 9'688 MMK (p=0.06).

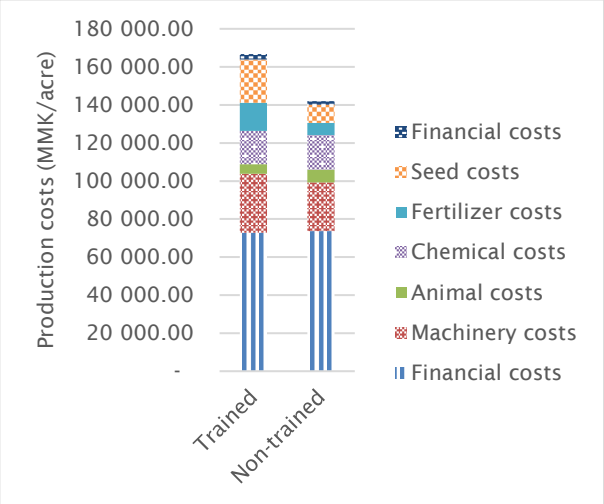

Figure 37: Average production costs of green gram of trained and non-trained farmers

Farmers in the study area obtain seasonal credits for green gram production from two different sources; The MADB and the Revolving Fund of the GoMP (table 16). The duration of these seasonal credits is four months. The financial credits are calculated according to the description in part e of chapter 4.3.1. The average household has credit costs of 9'212 MMK, which corresponds to 2'380 MMK per acre. Nonetheless, there are differences between the villages. Farmers in Khawarchaung did not take any loans for green gram production.

Table 16: Sources of credits for green gram production

Source of credit	Amount of credit (MMK)	Interest rate	Duration (months)	Number of farmers profiting (%)
MADB	100'000 /acre	8% per year	4	16 (76%)
Revolving fund GoMP	200'000 and 500'000	2% per month	4	2 (10%)

d) Income from green gram production

Farmers reach a gross-income of 271'998 MMK per acre on average. Since production costs make up 58% of this gross-income, a net-income of 105'201 MMK per acre is reached on average. This figure includes farmers that lost a part of or the total yield due to flooding, salt water intrusion and others. The average net-income for farmers with a "normal" yield is 143'053 MMK per acre (table 17).

Table 17: Net-income of all farmers (left) and farmers with « normal » yield (right)

Unit	Net-income of all farmers (n=21)	Net-income of farmers with "normal" yield (n=18)
MMK/acre	105'201	143'053

The gross-income per acre is significantly higher in Bilin (271'148 MMK/acre) than in Kyaikhto (196'881 MMK/acre) but there is no significance shown in the net-income of the two groups (p=0.175). Trained farmers reach a net-income of 56'815 MMK per acre (respectively 110'983 MMK per acre if looking at the positive net-incomes only) on average, whereas non-trained farmers reach 149'189 MMK (respectively 168'708 MMK/acre) . However, this difference is not significant (p=0.085, respectively 0,138). A significant difference between beneficiaries and non-beneficiaries of the GoMP has not been found (p=0.15).

e) Situation in 2015 compared to 2018

For most farmers the income was lower in 2015 compared to 2018. From all interviewed farmers, two mentioned that they did not observe any change in their income by comparing the income in 2015 with 2018. Six farmers said that their income from green gram was higher in 2015 than in 2018, whereas

nine farmers said that the income was lower in 2015. The average change was 37% for a lower income in 2015, respectively 44% for higher income in 2015. Reasons for a lower income in 2015 were: Weather conditions, mainly salt water intrusion or pest and diseases (n=6), technical knowledge including soil preparation and way of production (n=3) and a change in the varieties used (n=1). The main reason why farmers had a higher income in 2015 compared to 2018 are weather conditions, mainly floods and salt water intrusion in 2018. One farmer mentioned that his soil fertility was lower in 2018.

Eight beneficiaries mention that their income from green gram was lower in 2015 compared to 2018, while four farmers mention the opposite (figure 38). There are only four non-beneficiary farmers planting green gram. Therefore, no statement on this group can be made.

Figure 38: Comparing incomes from green gram 2015-2018

4.4.2 Discussion

a) Economics of green gram production

The interviewed farmers produce 225 kg of green gram per acre on average. Boukhali and Guenat (2018, 15), estimated an yield of 450 kg per acre, respectively 600 kg for beneficiaries of the project. This figure needed to be revised (cf. part b of this chapter).

The average yield of 225 MMK/acre is slightly lower than the figure of 229 kg per acres stated by Theingi Myint (no date, 31)[7] who studied farmers' incomes derived from the production of pulses in Mon State. Since there is only little literature on green gram production, the figures of this paper have been compared to indicators of pulses production in general. The average price farmers get for their green gram is 1'227 MMK per kg of green gram. This is slightly higher than the figure of 1'089 MMK per kg[8], cited by Theingi Myint (no date, 31). Studies have further shown that profitability increases with farm size concerning all pulses. This is especially the case for green gram production (World Bank 2016, 65-66). The production costs of green gram are 153'844 MMK per acre on average. This figure can be compared to the costs of pulses of 124'333 MMK per acre stated in Theingi Myint (no date, 30). However, the latter is based on a larger area in Mon State. According to Theingi Myint (no date, 30) farmers in Mon state earned about 247'030 MMK per acre through pulses production. The figure obtained in the scope of this research reaches 271'998 MMK per acre, which is slightly higher.

As mentioned in chapter 3.2.2, green gram can only be grown on land with a pH lower than 8,5. Saline conditions are not favourable either (Theingi Myint no date, 7). Therefore, green gram can be very profitable on land with good conditions, whereas it is not productive on unfavourable land.

The comparison of economic parameters of trained and non-trained farmers is summarized in table 18. Between the main performance indicators of the two groups, no significant differences have been found. However, there are differences between the two groups which have to be considered, especially since it is not clear what kind of farmers will use the farming record first.

[7, 8] Conversion: World Bank (2016, 97)

Table 18: Comparison main performance indicators of trained and non-trained farmers (cf. description of these groups in chapter 3.2.1) for green gram

Item	Average trained	Average non-trained	Significance
Area of production (acres)	7.6	3.9	No (p=0.066)
Yield (kg/acre)	202	244	No (p=0.391)
% of sold green gram	87%	95%	
Production costs (MMK/acre)	166'811.2	142'056.4	No (p=0.364)
Income of all farmers (MMK/acre; n=21)	56'815.0	149'188.9	No (p=0.085)
Income of farmers with "normal" yield (MMK/acre; n=18)	110'983.3	168'707.8	No (p=0.138)

b) Verification of assumptions made in CBA 2018

The CBA 2018 has come up with assumptions based on a small number of interviews conducted in 2018 (Guenat 2019, personal communication). Therefore economic data collected through the survey were used to update the assumptions made. A table with all figures can be found in annex 6.

According to the assumptions made during CBA 2018, farmers cultivate green gram on 4.5 acres on average. The corresponding figure from this paper is 7.5 acres for farmers that do not directly benefit from the GoMP, respectively 8.25 acres for direct beneficiaries of the GoMP. However, the area of production depends on the region. There is a difference between Bilin and Kyaikhto Township (cf. part a in chapter 4.4.1). The area which was supported by the project (for example through seeds) was not looked at in the scope of this paper and can therefore not be compared to the 0.5, respectively 1.5 acres stated in CBA 2018.

The additional production costs with the project were estimated to be 40'000 MMK in CBA 2018. According to the data from this paper, the production costs are by 21'285 MMK lower with the project. However, the difference between direct beneficiaries and non-beneficiaries of the GoMP are not significant (p=0.54) for the data from the survey. A plausible explanation for this could be that farmers buy less chemicals and fertilizer since the project promotes sustainable ways of production like composting.

Concerning yield, the CBA 2018 has shown an additional yield of 150 kg per acre, whereas the data from the survey shows a loss of yield of -93 kg with the project (table 19).

Table 19: Verification of assumptions CBA 2018 on green gram for additional yield with project

Yield (kg/acre)	CBA 2018	Survey
Without project	450	299 (n=4)
With project	600	206 (n=7)
Additional yield with project	**150**	**-93**

The net-income increases by 212'000 MMK with the project according to the CBA 2018 (table 20). However, such an increase cannot be confirmed by the data from the survey 2019. On average farmers with the project earn 97'144 MMK per acre less than farmers who are non-beneficiaries of the GoMP. It has to be considered that only four farmers that do not benefit directly from GoMP, cultivated green gram. This shows that the data of the non-beneficiaries is based on a small sample. Further, the difference between direct beneficiaries and non-beneficiaries has not shown any significance for all parameters studied. There are farmers that have low yields due to floods and salt water intrusion, while being direct beneficiaries of the project. This lowers the average as well, as illustrated in table 20 where the average of farmers with "normal" yield is shown.

As stated in part e of chapter 4.4.1, most beneficiary farmers mention that they had lower incomes in 2015 compared to 2018. Three out of eight beneficiaries, who had lower incomes, mention that weather conditions and salt water intrusion are the reasons for the lower income. For the remaining five farmers the project support could have influenced the increase in income. This again is based on a very small sample of farmers.

Table 20: Verification of assumptions CBA 2018 of income from green gram

Net-income (MMK/acre)	CBA 2018	Survey all farmers	Survey farmers with "normal" yield
Without project	460'000	183'842	183'842
With project	672'000	86'698	131'398
Additional net-income with project	**212'000**	**-97'144**	**-52'444**

The project supports farmers on a maximum of 5 acres of their total farm area. So if the focus is on a small area, the yield might be high on this small area but not on the total area of green gram production. In the scope of this research the total area of production was included.

There is less support from the project side concerning green gram than paddy, there are no FFS on green gram and the support consists of trainings and presentations, no practice. Therefore, the impact of the project is expected to be smaller.

The assumptions made during CBA 2018 were based on interviews conducted in villages of Mu Thin, Bilin Township and Kha Wa Chaung, Kyaikhto Township in Mon State and some villages in Bago region. Most villages visited during the survey in 2019, have not been included during the visits in the scope of the CBA 2018. The data from this study does not include indicators from farmers living in Bago region, which is important since green gram is more relevant for the income of farmers in Bago region than in Mon State (Tun Zaw Htay 2019, personal communication). Further, it has to be considered that the data is collected in Bilin and Kyaikhto Township and does not necessarily correspond to all Townships in the project area.

The sampling was based on training on the farming record and not on the benefit through the GoMP. A sampling on latter would have lead to more representative data for the update of the CBA. However, this would have not been optimal for other research questions in the case of this paper. Further analyses with bigger sample sizes are crucial in order to update the figures.

The GoMP supports farmers through new techniques and the introduction of new varieties. Further, the farmers are supported to increase the quality of their green gram through improved management (Boukhali and Guenat 2018, 15). According to the sensitivity analysis during CBA 2018, yield is the most sensitive factor of green gram. Therefore, the focus of the GoMP should be to increase yields. However, the importance of green gram for soil fertility should not be underestimated (ibid., 26-27). According to Meelu and Morris (1988; cited in Swe Mon Aung 2018) incorporating green gram residues into the soil can increase rice yields equivalent to a nitrogen fertilizer input of 25 kg per ha.

Hypothesis 4.1 *elaborated in the beginning of the research: "Some of the assumptions made during the CBA 2018 need revision"* can be confirmed as most assumptions do not correspond to the data collected by the survey. This is especially the case for yield and income concerning green gram. Since the survey was conducted with a limited number of green gram producers, it is crucial to do further analyses with a bigger sample of farmers.

5 Overall Discussion

In order to assess the potential of the farming record feature for economic data collection, many different subjects have been studied in the scope of this Bachelor Thesis. The following chapter aims at connecting and discussing them and pointing out limitations of the research.

5.1 Potential of the farming record

The topics of highest interest mentioned by the farmers (cf. chapter 4.1.1) could potentially be accessed through the Green Way app. This app was used by 13% of the interviewed farmers for accessing information (cf. chapter 4.2.1). However, farmers use a variety of sources according to their topics of highest interest. Therefore, farmers would most likely access the app for some information and access other kind of information through other sources.

Farmers and neighbours seem to be very important information sources for farmers. This is important for spreading information on the farming record. Trained farmers are likely to speak with other, also non-trained, farmers and educate them on how to use the farming record. This is crucial for the spreading of the farming record and the collection of economic data.

This paper did not look at the quality of the information provided through Green Way, which is crucial if farmers should use the information from the app in a long term. Future research on the latter and adaptations of relevant contents on the app is especially important, since farmers that are using the Green Way app for information are aware of the app and know how to use it. If they hear from the farming record feature, they have fewer barriers in order to record their data on the app. At the time of the survey, most farmers did not know and use Green Way even if this app has been introduced by GoMP and Greenovator in an earlier stage. Reasons are amongst others a lack of smartphone use and knowledge on apps for agriculture in general. If farmers know how to use smartphones, they are more likely to use apps like Green Way as well.

We should not underestimate that 10 years ago, most people in Myanmar did not have access to the internet nor were able to afford it (Einzenberger 2016, 302). Nowadays, internet access has improved (Tun Zaw Htay, 2019). But, some farmers might not have internet connection in their rural homes, which is limiting the possibilities to use apps. Since the younger generation is growing up with smartphones, it is likely that the rate of smartphone and app usage will increase in a short period of time. This is a huge opportunity for apps like Green Way. However, this younger generation is often not interested in agriculture, amongst others due to the hard work and low incomes (Khine Zin Yu Aung 2019), and therefore use their smartphones for other purposes. According to a study conducted by Hamblin et al. (2017, 23), there will be a "quite dramatic ageing of the type 3 farming household population with the proportion aged over 60 years increasing from 23.6% in 2014 to over 40% in 2034 (….)". These figures are not favourable for the use of apps amongst farmers in Myanmar.

Literature review has shown that there is a gender gap in accessing agricultural information in Myanmar (GSMA and LIRNasia 2015, 2). In the scope of this paper, a small sample of farmers was studied. However, male farmers show higher user rates over a big range of different information sources (cf. figure 17 in chapter 4.1.1). Further, male farmers seem to be slightly more familiar with the Green Way app and they also use it more often than female farmers. If male farmers are more likely to use the Green Way app, it is also more likely that they will use the farming record in the future.

All these examples have shown that there are many barriers for farmers in order to be able to use the farming record. The GoMP should be aware of these barriers and help lowering them.

A strategy of GoMP on how to generate relevant data through the app is needed. Training on the use of smartphones in general could lower farmers' barriers to use apps and therefore the farming record. When the farmers have finished filling in their data on the farming record, they will see an overview of their costs and benefits for specific crops (cf. chapter 4.2.1). It is important to assess the perceptions of farmers on this information. Further, the handling and processing of farmers with this information should be studied. This table might be an incentive for farmers to share their economic data. But this can only be looked at when farmers have seen and studied the tables. Further, it would be crucial to know if farmers that are using the farming record over a long period of time have a better overview of their costs and benefits and improved farming management, which could then lead to higher yields and increased incomes. According to Tun Zaw Htay (2019, personal communication), increased incomes are the overall objective of the agricultural work of GoMP.

Farmers mention several incentives in order to be willing to use the farming record and share data. Some farmers mention the wish for specific advice according to their economic data shared through the Green Way app. This would require that extension services look at this data and try to use it for their work. This seems to require a lot of effort but could help farmers more effectively. According to Aldosari and Baing (2013, 619): "Yet, the information and Communication Technology (ICT) can be combined with the other extension methods for making extension more effective."

When filling in the economic data on the app, farmers cannot choose to keep their data private or share it with Greenovator. This does not seem to be a problem for farmers in the area as they are willing to share their data mainly because of the hope they have to receive specific advice on their farming practices according to the data shared. Withal, farmers should be aware of what happens with their data and they should be able to choose whether they want to share their data or not. Awareness training would be important also in terms of other apps and digitalisation in Myanmar in general.

The training on the farming record is focussing on farmers that are working closely together with the GoMP. These farmers are motivated to work with the feature and they have been introduced to the logbooks on paper where they could record their economic indicators as well. Knowledge on basic economics is crucial in order to understand the purpose of the farming record. However, it is not likely that farmers, who are not working as closely with the project, show similar reactions to the farming record. Further, their economic indicators might be significantly different, as shown in chapter 4.3 when comparing economic paddy production parameters of beneficiaries and non-beneficiaries as well as trained and non-trained farmers. The trained farmers should have been selected in a random way by the project for a correct experimental design.

In practice it is difficult to collect economic data since not all farmers know operating figures corresponding to the survey questions. A lot of figures had to be calculated during the survey according to the data given by the farmers. For example, some farmers did not know the amount of hours they transplanted paddy, but they did know the amount of seedlings they planted. Hence, farmers might not be able to respond directly to certain questions on the farming record, which leads to the collection of incorrect data. On the other hand, data collection through smartphones can be more accurate since the farmer himself enters the data in real time (Daum et al. 2018, 144).

According to survey data, farmers sell 91% of their produced green gram, which is a higher percentage than for paddy production (75%). This is confirmed by Theingi Myint (no date, 8): "Rice is mainly grown for food security while pulses are main income crop for farmers." Beneficiaries mention market prices more often than non-beneficiaries (cf. chapter 4.1); this could be explained through the higher selling rate of paddy (cf. chapter 4.3.1 part d). Concerning incomes from crop production, monsoon paddy (mean: 162'780 MMK/acre) shows higher net-incomes on average than green gram production (mean: 105'201 MMK/acre). This could be explained through the very low productivity of green gram and stands in contrast to Theingi Myint (no date, 31) stating that pulses lead to higher profit for farmers than paddy However, high standard deviations have to be considered in the survey data. The data from green gram includes farmers that have lost part or all yield due to flooding and other reasons. According to Tun Zaw Htay (2019), green gram is not the main source of income in Mon State like in other States and Regions in Myanmar.

According to Van der Zanden (2019, personal communication) GoMP has to prove that 3'000 farmers have increased their income by at least 15% until the end of project phase 2 (end of 2021), which is an important indicator of output 1.1 of the project logframe (Helvetas et al. 2018, annex 2, p. 3). This could be verified through 750 farmers using the farming record and providing useful economic data (ibid.). However, the GoMP needs to make sure to use a representative sample of data for future CBA calculations. So, if the economic data from the app is not representative for all farmers, the project cannot rely on it only, but needs to find other ways for data collection. Another way of data collection could be done through surveys or with the help of the logbooks distributed to farmers in the GoMP. According to No No Aung (2019, personal communication) the quality of the logbooks on paper was not sufficient for data analysis in 2018. Only 22% of the farmers had logbooks at the time of No No's visits to the villages (ibid.). There is also the risk that logbooks are only used by the same farmers that use the mobile farming record already. Economic data from farmers that are illiterate or not recording data are not considered. In this case survey might be the better choice.

Hypothesis 4.2: *"Assuming that the farmers are willing to share their economic information, the quality of the collected data will allow the CBA update"* can therefore not be confirmed. Comparing the first data collected through the farming record with survey data is crucial for studying the quality of the data collected through the farming record. If the data from the farming record differs largely from survey data, it means that farmers do not fill in the data correctly. The farming record would need to be cross-checked and adapted in order to make the data collection user friendly. It could also mean that there is only a certain group of farmers that use the app. If the trained farmers are going to give training to untrained farmers, the user group of the farming record might grow. As it is not clear whether all trained farmers will use the farming record and all non-trained won't use it, more research on first, identifying and second, comparing economic parameters of users and non-users is needed. However, there are more reasons for a lack of data quality. It has to be considered that family labour is not included in the calculations of total production costs and of profit on the mobile farming record, while it has been included in the calculations on the survey data. This needs to be discussed and unified.

Stakeholders need to collaborate to ensure good data quality for future CBA calculations. Farmers need to be willing to learn how to record data. Greenovator needs to make sure that farmers understand the

questions on the app and update the feature accordingly. GoMP needs to monitor the collection of data by the farmers closely. The potential of the farming record can then be unlocked.

5.2 Limitations of this research

A limit of this research is related to languages. The author was dependent on a translator from Myanmar language to English. Sometimes, a second translator had to translate local languages and dialects to Myanmar. Therefore, survey questions were broken down to easy terms in order to avoid misunderstandings. Further, most agricultural apps mentioned in this paper are only accessible in Myanmar language, which made it impossible for the author to study the apps in detail.

During the survey volunteer students of the GoMP accompanied the author and Soe Khaing, Master student at HAFL. This was essential for orientation and some translation of local accents mentioned above. However, the volunteers already knew these farmers. Some farmers might have been influenced by the presence of the volunteers when it came to the questions on the use and usefulness of the GoMP as information source.

The GoMP area includes 60 villages in eight Townships (Helvetas et al. 2018, 20-22). This research is limited to eight of these villages, located in two Townships. Farmers from other villages might use different information sources and might have different opinions on the farming record than the interviewed farmers. Farmers had to remember economic data from 2018, which might have led to some deviation from the actual costs or incomes.

Most interviewed farmers were men. When asking if their wife had time to answer some questions some male farmers refused before asking their wives. Sometimes women in the interviewed households did not want to answer because they had no or little interest in agriculture. Out of the women participating in the survey, some might have been influenced by the presence of their husbands.

This research was conducted at a very early stage of the introduction of the farming record. Therefore, most farmers were not acquainted with Green Way at the time of the survey. It was therefore not possible to sample according to farmers using and not using the farming record, which should be done in future research. The situation of smartphones and apps can change rapidly. This research provides a snapshot of the situation.

6 Conclusions

To conclude, the four main research questions formulated at the beginning of this research paper will be answered. Therefore, this chapter is structured according to these research questions.

RQ 1: What information on rice and green gram production and value chains are of highest interest to farmers in the GoM and what are the main sources of information that they use?

Farmers are mainly interested in cropping techniques, weather conditions, market prices, fertilizer and its application, seeds and its prices as well as pests and diseases. There are differences in the topics of highest interest between direct beneficiaries and non-beneficiaries of GoMP, as well as trained and non-trained farmers. Fore example, 36% of all beneficiaries are interested in market prices; the rate for non-beneficiaries is 10%.

The main sources used to access this information are other farmers and neighbours, the TV and the radio. Mass media seems to be the most important kind of source. Nevertheless, the choice of information source depends on the interest of the farmers. For accessing cropping techniques, extension services are used, while farmers that are interested in weather conditions access the radio and the TV.

RQ 2: What are the prerequisites, potentials and challenges of the Green Way app for economic data collection in terms of data quality?

Most farmers fulfill the prerequisite of having access to a smartphone, but they mostly do not use the device. The Green Way app was used by 13% of the farmers for information purposes at the time of the survey in July 2019. One farmer was using the app for data recording. In September 2019, 260 farmers had registered on the farming record feature but the quality of the data needs to be studied in future research. Another prerequisite is that farmers need to be able to read and understand the questions on

the farming record and type correct economic data. Most farmers are able to read the information provided through the app but they struggle when it comes to typing in their data. This has several reasons from not being able to write to a lack of practice with typing on the keyboard.

One major potential is that the farming record could simplify the collection of economic data by the GoMP. Another important potential is that farmers will get practice on how to record, which will help them to better manage their farming activities and might be of major importance for future certification of their farms.

However, there are many challenges to the recording; the training on the app is crucial for sufficient data quality. In addition, the users of the app need to be identified. Their economic performance needs to be compared to the performance of non-users. If the non-users perform significantly different than the users, like shown for trained and non-trained farmers, other ways of data collection need to be found in addition to the farming record on the app. Other challenges like the low knowledge and use of smartphones, especially amongst the older generation, or the issue of data privacy need to be monitored closely by the project.

Recommendations and future research concerning RQ 2:

- Implementation of trainings on how to use smartphones in general.
- Carry on with close support on the recording of farmers to ensure that farmers understand the purpose of recording and the advantages of the app.
- Monitoring the dissemination of the app and the use of the farming record in the villages
- Improve the app and its user friendliness to avoid errors in data recording,

***RQ 3:* Are farmers willing to share their economic data via the Green Way application and what incentives are needed to enhance their willingness to share?**

It has to be considered that this research has taken place during an early stage of the implementation of the farming record feature. This had a limiting influence on the information farmers could provide on the willingness to share data, as well as the incentives needed.

Until now, farmers cannot decide whether they want to share their data on the app or not. If they fill in the farming record, the data goes directly to Greenovator. Such a question on data sharing is needed according to the GoMP and recommended for issues of data privacy.

Farmers in the area seem generally willing to share their data, also when it comes to personal data like phone numbers and locations. They have the hope to get specific advice due to the data they provide. Withal, the awareness on issues of data privacy seems to be low amongst farmers, which should be addressed in future trainings and discussions within the GoMP.

The main incentives are training on how to use the farming record and specific technical advice according to the data shared through the app. Financial compensation of internet data use does not seem to be of great importance to farmers. However, more research on the incentives is important during a later stage of the implementation when more farmers will know the farming record and are therefore able to give their opinion on incentives.

Recommendations and future research RQ 3:

- Develop clear terms and conditions on data privacy of the Green Way app together with Greenovator. Integrate a box in the app where farmers can chose to share the data or not.
- Incorporate awareness training on data privacy in extension services provided through GoMP
- Future research on the incentives to share economic data is needed at a later stage of the implementation.

RQ 4: a) How realistic are the assumptions made for the CBA of the rice and green gram production and value chains in 2018?

The assumptions made during CBA 2018 are based on a few interviews. To provide a larger database, the figures were updated with data from the survey in the scope of this thesis. Concerning paddy production, some assumptions concerning production costs and net-incomes seem to be realistic. The

additional net-income with the project is slightly higher than expected. However, the assumptions on yield levels are too high, while the assumptions on paddy prices are too low.

Concerning green gram, the yield levels are also lower than expected during CBA 2018, which has an important effect on the additional net-income of green gram production. The latter shows a negative figure, which means that non-beneficiaries earn more than beneficiaries according to the data of this study. In general the assumptions made for green gram need to be revised because they are not realistic when compared to the survey data of this paper. The study area and sample size is crucial and should be considered in future research.

Recommendations and future research RQ 4a:

- The assumptions made during CBA 2018 for green gram need to be revised. A larger sample is important. The value added through the project cannot only rely on a comparison with the baseline, but a comparison between adopters and non-adopters (trained/non-trained) for the same year is needed (with-without comparison).
- In future comparisons, the sample should target the same area. The focus on crops like green gram is different in Mon State and Bag Region.

b) Can the CBA update at the end of GoMP phase two rely on the data collected through the Green Way app?

The implementation of the farming record is at a very early stage to answer this research question. But according to the comparison of economic performance indicators made between trained and non-trained farmers, the CBA update cannot only rely on the data from trained farmers only, but needs to include economic indicators from farmers that do not use the app. Such data can be collected through surveys or the existing logbooks on paper. More research on the method of data collection is needed, especially since farmers who do not use the farming record might not use the logbooks as well.

There is also a need for further research on the economic parameters of farmers using the farming record and farmers that do not use it. This comparison could be done at the end of 2020 when farmers have had time to get used to the farming record. Mr. Soe Khaing, Master Student at HAFL, could look into this topic in the scope of his Master Thesis.

Recommendations and future research concerning RQ 4b:

- Identify users and non-users of the farming record at the end of 2020.
- Find appropriate ways for data collection of the non-users if the main economic parameters of the two groups are significantly different.
- Look at the economic information filled into the logbooks and find out whether this data has gained in quality compared to the stage when No No Aung collected the books. This is an important indicator for the quality of the training and support of GoMP.

There is a big potential of apps like Green Way for information sharing in agriculture. Yet, the research on the potential of economic data collection is at a very early stage. There are many open questions when it comes to data quality, security and use, while many more fields of ITC and agriculture wait to be discovered. Especially Myanmar, which has gone through a rapid change in digitalisation, could benefit from these changes and provide more specific extension services to rural farmers.

More research on the potential of the Green way app to collect economic data could contribute to the achievement of output 1.1 of the GoMP, "to improve and/or diversify fisheries and on-farm livelihoods through skills and market system development". This could then contribute to the SDC's Agriculture and Food Security overall goal aiming at: "*Smallholder farmers, including women and men of all ethnicities, have increased food security, access to livelihood assets, productivity and income".*

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Annex

1. Mandate for Bachelor Thesis
2. Interviewed farmers and participants of FGDs
3. List of Key-informants
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2. Paddy analyses
3. Green gram analyses
4. Analysis o topics of highest interests, information sources and Green Way
5. Analysis of use of information sources
6. Statistical analyses on crop production
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7. Notes Meetings and SWOT analysis with different stakeholders

1. Mandate for Bachelor Thesis

Bern University of Applied Sciences
School of Agricultural, Forest and Food
Sciences HAFL

Mandate for Bachelor Thesis of Anna Braun, 2019

Working title **Potential of the Green Way application to collect economic data on rice and green gram production in the Gulf of Mottama, Myanmar** (temporary)

Background

The Gulf of Mottama (GoM) is located in southern, coastal Myanmar. It is the biggest intertidal mudflat in Southeast Asia, covering an area of 42'500 ha (Jungblut 2017, 9; RSIS 2017). This mudflat builds an important ecosystem for rare wildlife and is a source of livelihoods for about 1'500'000 people living in the coastal areas of the gulf (Embassy of Switzerland 2018, 1). Important ecosystem services provided by the GoM are: Food for humans, pollution control and detoxification, tourism, biodiversity and nutrient cycling (RISI 2017, 4).
The Gulf of Mottama Project (GoMP) contributes to the overall goal of the Swiss Agency for Development and Cooperation (SDC) in agriculture and food security, which reads as follows: "*Smallholder farmers, including women and men of all ethnicities, have increased food security, access to livelihood assets, productivity and income".* The implementing agencies Helvetas Swiss Intercooperation (HIS), Networks Activity Group (NAG) and the International Union for Conservation of Nature (IUCN) cooperate from 2015 until 2021, in order to achieve their development goal: "The unique biodiversity of the GoM is conserved and sustainably developed in order to benefit human communities that depend on it" (Embassy of Switzerland 2018, 2).
A Gulf of Mottama Coastal Natural Resource Plan (CNRMP) has been elaborated during phase one from September 2015 until April 2018 (Helvetas Myanmar 2018, 4-7). The entire coast of Kyaikto township and most of Bilin township in Mon state has been acknowledged as a Ramsar site in order to protect the ecosystem. In the current second Phase of the project the specific **project objective** is: "The implementation of the GoM Coastal Resources Management Plan is supported and results in improved livelihood security for vulnerable women and men in targeted coastal areas of the GoM." The **three Outcomes** of the Project are:

- **Outcome 1:** Livelihoods are secured and diversified to build communities' resilience**.**
- **Outcome 2:** Coastal Natural Resource use is sustainable and well-managed, and biodiversity is conserved.
- **Outcome 3:** Coastal Natural Resources Governance is coordinated and effective, and awareness on the GoM values is raised.

Most people living in the gulf depend on agricultural production, especially on rice production during wet season, lasting from April to November (Jungblut 2017, 9). Rice is the most important agricultural crop in Myanmar, grown on half of the arable land (IRRI 2013, x).
In Myanmar a mobile application called Green Way has been developed by Greenovator, an agricultural technology and service social enterprise based in Yangon. This application, which aims at supporting farming activities, is also called the digital linkage between farmers and technicians across the country. The GoMP has been working with Greenovator since November 2018. Their goal is that 5'000 GoMP members register on the mobile platform. The partnership is aiming at providing mobile farm income record books to the farmers (Yin Yin Phyu 2019). This farming record feature should allow Greenovator and the GoMP to collect economic data on crop production, mainly rice and green gram.

Objective

The objective of this thesis is to assess the potential of Green Way to collect economic data on rice and green gram production.

Justification

This thesis will look at the two functions of the Green Way; On one hand the application provides information to the farmers and on the other hand it collects information from the farmers. It is important to know what kind of farmers access information through the application. The willingness of farmers to share their economic data through the farming record feature of the mobile application will be assessed. The need and potentials for incentives will be discussed in order to enhance the willingness of farmers to share economic data. Further, the quality of the data obtained through the application needs to be verified.
Economic data on rice and green gram production will be collected through surveys. This data will provide information to measure the farmers' performance with these crops, and it can be used to verify assumptions made during the ex-ante CBA calculated in 2018. This verification of assumptions is also an important step towards the ex-post analysis which will be carried out at the end of phase 2 (end of 2021) (Boukhali and Guenat 2018, 6).
This thesis will contribute to outcome 1 of the GoMP by providing further knowledge on the

potential of Green Way to provide information and to collect economic data from the farmers. Outcome 1 of the GoMP is split into the three following outputs:

- **Output 1.1:** Improve and/or diversify fisheries and on-farm livelihoods through skills and market system development.
- **Output 1.2:** Develop off-farm options through skills and market system development.
- **Output 1.3:** Support communities for disaster risk management, planning and adaptation.

Output 1.1 is where this Thesis with the main objective contributes to. In the scope of output 1.1, activity 1.1.2 "Facilitate applied agricultural research, assess and test value chain opportunities in fisheries and farming, livelihoods" is implemented, which is where this BSc-Thesis is imbedded in. This FA will focus further on activity 1.1.3 "Disseminate and promote implementation of successful approaches" through the Green Way application.

Assignments

Expected results of this Bachelor Thesis are the following:

1. The Greenway application and the farming record feature is understood by the student. In order to achieve this, the following tasks have been carried out:
   1.1 Familiarize myself with app
   1.2 Discuss with Greenovator
   1.3 Assist Training of Trainers (ToT) for App with selected farmers on how to use the app.
2. Farmers' topics of highest interest and their information sources, the potential and quality of data collection through the Green Way application and the willingness of farmers to share economic data is studied through the following tasks:
   2.1 Develop Questionnaire and logistic plan
   2.2 Carry out key-informant interviews with project staff
   2.3 Test farmer questionnaire
   2.4 Carry out interviews
   2.5 Conduct statistical analysis of the data
   2.6 Conduct qualitative analysis of the data
   2.7 Compare data from surveys with first results of farming record
   2.8 Conduct FGD if necessary
   2.9 Analyze data from FGD
3. A draft version of the Bachelor Thesis is written, the assumptions made during the CBA 2018 are verified and all results are presented in a debriefing for the GoM project staff and at HAFL. Following tasks are needed in order to achieve this:
   3.1 Develop research questions and hypotheses
   3.2 Write Bachelor Thesis
   3.3 Verify the assumptions made during CBA 2018
   3.4 Carry out a debriefing at GoMP office (Mawlamyine) and Helvetas headquarter office (Yangon)
   3.5 Present findings at HAFL

Resources

1. Literature provided through Nebis, Ovid, Google Scholar and the local platforms Mylaff and MIMU.
2. Key-informants from the project: Jos van der Zanden (Chief technical advisor), Than Htike (Project manager), Tun Zaw Htay (Agricultural officer). If possible, other companies that provide mobile phone applications for agriculture in Myanmar and people from the Department of Agriculture (DoA) will be interviewed.
3. Farmers in Bilin and Kyaikhto townships will provide information on their cultivated monsoon rice and green gram. Information on topics of highest interests, sources of information and the farming record feature of the Green Way application are collected.

Supervision: Dominique Guenat

Assessment: Evaluation form HAFL

Submission: 04 December 2019

Postponing of the date of submission is only possible in exceptional cases. In this case, the request needs to be submitted to the direction of the HAFL two weeks before the original date, endorsed by the responsible professor. Papers that are submitted after the valid deadline receive the mark F.

Date: 16.6.2019

The following regulations need to be observed:

- Richtlinien für Semesterarbeiten, Bachelor-Thesis und Minorarbeit
- Bewertungsraster mit den Bewertungskriterien
- Anleitung zum Abfassen von selbständigen studentischen Arbeiten
- Studien- und Prüfungsreglement
- HAFL-Richtlinien betreffend Plagiaten

2. Interviewed farmers

Table 21: Survey households

Kyaikhto:	Trained housekols	Non-trained households
Kha Wa Chaung (16)	4	4
Kha Ywea (18)	1	4
Bo Yar Gyi (19)	4	4
Bilin:		
Shan Chaung (24)	3	4
Thein Chaung (25)	4	4
Tha Pyay Kone (26)	5	3
Z (27)	5	3
Mu Thin (28)	3	4
Total :	**29**	**30**

Table 22: Participants of the two FGDs

FGDs	Men	Women
FGD 2: Kyaikhto		
Kha Wa Chaung (16)	2	
Kha Ywea (18)	1	1
Bo Yar Gyi (19)	5	
FGD 1: Bilin		
Shan Chaung (24)		1
Thein Chaung (25)	2	
Tha Pyay Kone (26)		1
Zoke Ka Li (27)	2	
Mu Thin (28)	1	1

3. List of Key-informants

Name/organization	Place	Date	Subjects
Buerli Markus, SDC	Yangon	26.4.2019	SDC in Myanmar Discussion BT
Scandola Francesco, Impactterra	Yangon	25.4.2019	Discussion Application Green Way and Golden Paddy
Yin Yin Phyu, Greenovator	Yangon	25.4.2019 20.5.2019	Discussion about Greenway application and my research
Zaw Win Latt, GoMP	Mawlamyine	21.5.2019 22.8.2019	Discussion on sources of information and topic of highest interest to farmers Credits of farmers
Tun Zaw Htay, GoMP	Kyaikhto	23.5.2019 19.7-20.10.2019	Discussion Questionnaire Discussion results from surveys
Than Htike Aung, GoMP	Mawlamyine	28.5.2019	Discussion Questionnaire
Jos van der Zanden, GoMP	Mawlamyine	21.5-4.6.2019	Discussion Questionnaire
Dominique Guenat, HAFL	Zollikofen, Mawlamyine (E-mail)	August-September	Discussion assumption CBA 2018
U Paw San, GoMP	Mawlmayine	16.9.2019	Discussion on different agricultural apps in Myanmar
Linn Wah Wah Zaw and Khin Sabai Thu, Greenovator	Mawlamyine, Yangon (skype)	18.9.2019	SWOT analysis and discussion on data privacy

4. Blank Survey questionnaire

Farmer Questionnaire (1st part)

Township:		Village Tract:		Village:		HH ID:	
Name of main respondent:			Sex:	( ) f ( ) m	Date:		

Introduction

Hello, I am a student from Switzerland. I am studying agriculture and currently I am working in the GoMP. I am doing research on rice and green gram production and the use of the Green Way mobile application in this area.
I would like to ask you a few questions about your crop production first. Then we continue with questions concerning sources of agricultural information and the Green Way application. Thank you for sharing your information.
Before we start, I would like to ask you whether you have access to a smartphone in your household? If no: Ask all questions until 2nd part information sources.

General information

Trained farmer:	( ) yes ( ) no	Type of farmer:	( ) Normal ( ) Demonstrator	( ) Seed multiplier ( ) Seed producer
Farmer group member:	( ) yes ( ) no	Reasons:		

Crop production in 2018

Total area of production: acres	Area of monsoon rice production: acres	Area of green gram production: acres
Total monsoon rice production: baskets/kg	Monsoon rice sales: baskets/kg	Lowest price per basket: MMK Highest price per basket: MMK

Situation before project (2015)

What was the income from Rice in 2015 compared to 2018? (in %)	( ) equal ( ) higher ( ) lower ….. %
What are reasons for that?	
What was the income from Green Gram in 2015 compared to 2018? (in %)	( ) equal ( ) higher ( ) lower …..%
What are reasons for that?	

Monsoon Rice production 2018

Way of production:
( ) Direct seeding by using seeder ( ) Direct seeding by broadcasting ( ) Transplanting[1]

Production costs of monsoon rice 2018 (for area mentioned)		Family labor (days):	Hired labor costs (MMK):	Machinery costs (fuel, rents) (MMK):	Costs for animal power (MMK):
Land preparation					
Direct seeding	[1]**Seedbed preparation**				
	[1]**Taking out plants from seedbed** (includes transportation)				
	[1]**Transplanting**				
Fertilizer application					
Chemical application					
Weeding					
Roguing (seed-multipliers and producers only)					
Harvesting					
Threshing and cleaning					
Storage					
Where do you sell your rice?		( ) collector at farm gate	( ) farmers go to miller and sell		
Transport costs					

Costs for chemicals (Pesticides, Insecticides etc.): MMK	Costs for chemical and natural fertilizer: MMK	Costs for seeds: MMK
Financial costs (credits, loans): MMK	Other costs: MMK	

Farmer Questionnaire (1st part)

If Green Gram is cultivated: Production 2018

Total Green gram production: baskets/kg	Green gram sales: baskets/kg		Highest price per basket: MMK Lowest price per basket: MMK	
Production costs of Green Gram 2018	Family labor (hours):	Hired labor costs (MMK):	Machinery costs (fuel, rents) (MMK):	Costs for animal power (MMK):
Land preparation				
Seed sowing and covering plots				
Fertilizer application				
Chemical application				
Weeding				
Harvesting				
Threshing and cleaning				
Storage				
Where do you sell your green gram?		( ) collector at farm gate	( ) farmers go to miller and sell	
Transport				

Costs for chemicals (Pesticides, Insecticides etc.): MMK	Fertilizer costs: MMK	Costs for seeds: MMK
Financial costs (credits, loans): MMK	Other costs: MMK	

Farmer Questionnaire (2nd part)

Men in household

What agricultural information are you interested in (1=highest interest)?

Type of information (max 3)		**Main sources to access this information**
	Weather	
	Market prices	
	Pest and diseases	
	Cropping techniques	
	Livestock	
	Seed sources and prices	
	Other:	

Are these sources of information available and useful?

Sources	Available?	How useful is it for your farm? (1=not useful, 2= little useful, 3=useful, 4=very useful)
Mass media (TV, radio..)	( )	
Green Way App	( )	
Other mobile apps	( )	
Neighbors, farmers	( )	
DoA	( )	
Input suppliers	( )	
Brokers/middle-men	( )	
Processors (millers)	( )	
Trainings GomP	( )	
Farmer group CFDA	( )	

Do you know mobile phone applications that provide information for agriculture?
( ) Yes ( ) No
If yes, which ones?

Do you use any mobile phone application?
( ) Yes ( ) No
If yes, what are the ones you use often?

Do you know the Green Way application?
( ) Yes ( ) No
-If no: Explain the information sharing and data collection part of the App.

What for do you use the Green Way application?
( ) Information ( ) Farming record

Will you use the Farming record in the future?
( ) Yes ( ) No

Give reasons why you will / will not use it as farming record?

What incentives would you need in order to share economic data on the Greenway application?

What would you do if you would not find the fertilizer you bought in the list (Printed form in Myanmar)?

What do you think about this table (Separate sheet in Myanmar)?

Step of cultivation	**Total costs**
Field preparation	
Seedbed preparation	
Harvest…	

Cost and benefit analysis: What do you think about this table (Separate sheet in Myanmar)?

Paw San

Costs	Benefits

Shwe Bo

Costs	Benefits

Farmer Questionnaire (2nd part)

Women in household

What agricultural information are you interested in (1=highest interest)?

	Type of information (max 3)	**Main sources to access this information**
	Weather	
	Market prices	
	Pest and diseases	
	Cropping techniques	
	Livestock	
	Seed sources and prices	
	Other:	

Are these sources of information available and useful?

Sources	Available?	How useful is it for your farm? (1=not useful, 2= little useful, 3=useful, 4=very useful)
Mass media (TV, radio..)	( )	
Green Way App	( )	
Other mobile apps	( )	
Neighbors, farmers	( )	
DoA	( )	
Input suppliers	( )	
Brokers/middle-men	( )	
Processors (millers)	( )	
Trainings GomP	( )	
Farmer group CFDA	( )	

Do you know mobile phone applications that provide information for agriculture?
( ) Yes ( ) No
If yes, which ones?

Do you use any mobile phone application?
( ) Yes ( ) No
If yes, what are the ones you use often?

Do you know the Green Way application?
( ) Yes ( ) No
-If no: Explain the information sharing and data collection part of the App.

What for do you use / what for would you use the Green Way application?
( ) Information ( ) Farming record

Will you use the Farming record in the future?
( ) Yes ( ) No

Farmer Questionnaire (2nd part)

Give reasons why you will / will not use it as farming record?

What incentives would you need in order to share economic data on the Greenway application?

What would you do if you would not find the fertilizer you bought in the list (Screenshot on separate sheet)?

What do you think about this table (Separate sheet in Myanmar)?

Step of cultivation	**Total costs**
Field preparation	
Seedbed preparation	
Harvest…	

Cost and benefit analysis: What do you think about this table (Separate sheet in Myanmar)?

Paw San

Costs	Benefits

Shwe Bo

Costs	Benefits

5. Notes Focus Group Discussions

Focus group discussion 1 with farmers from Bilin township on 4.10.2019

Presentation round:

Farmers do not fill in the record themselves but with the help of the volunteers. Some only put the data on paper and not into the app.

Village	Male	Female
Shan Chaung		1
Zawakalar	2	
Thapaygone		1
Theinchaung	2	
Muthin	1	1

Strengths	Weaknesses
Easy to see Costs and Benefits	Cannot use the phone and therefore does not see the Costs and Benefits
Recording of farm activities in an easy way	Myanmar letters have changed to Unicode system, which makes typing difficult.
From the Greenway many information which are valuable to plan farming activities	Mistakes in data entry happen easily
Farming record could be used to compare the performance to other farmers	When phone brakes, tool cannot be used
Question and Answer section of the Greenway is very useful	She does not know her profit and expenses. Therefore, the farming record cannot be filled in.
To know performance indicators like yield/acre	Android system is hard to use
Timing of fertilizer application can be recorded and accessed afterwards	No internet access in some areas of the villages
(Green Way: Information on pests and diseases and how to fight them are very important)	The farming record is hard to find on the Green Way app.

Prerequisites:

- Good Internet access
- Old phones cannot read the Unicode letters on the App
- Knowledge on phone usage is needed
- Training on how to use the phone + big wish for training on how to use the smartphone
- Some farmers have difficulties to see, they enter incorrect data.

Incentives

- Training mentioned above
- Personal logbook on the Green Way app: Farmers could note their activities and review it when needed (some phones do not have a note function)

Data privacy

Reactions: The data is not secret, so we don't have any problem to share our data.

The information is good for the company and our phone number is useful to contact us and give us advice.

When showing them the question which would be incorporated into the app, they said that the answer would be a yes.

Incentives

Until now they do not get anything for filling in the farming record. But they wish to get specific advice according to the data they filled into the farming record. Especially, advice on land and soil preparation is important.

Observations during training to other farmers in the village

They have difficulties to adapt new technologies and systems in general.

Focus group discussion 23 with farmers from Kyaikhto township on 4.10.2019

Presentation round:

Farmers can only put their data with the help of the volunteers. Sometimes they record only on paper together.

1 farmer says that he can use it himself.

Village	Male	Female
Kha Ywel	1	1
Boyargyi	5	
Khawarchaung	2	

Strengths and Weaknesses

Strengths	**Weaknesses**
Good tool to know expenditures in detail	Difficulty to use phones and apps
Green Way is good for agricultural news	No change of the data entered possible
To see profit and loss/ costs and benefits of the whole farm	It takes a lot of time to get used to the application
	App does not work on old versions of phones
	If the phone gets lost, everything is lost (therefore logbook on paper is better)
	No skills in using the phone

Do you prefer Logbooks or apps?

For younger farmers app, for older farmers logbook

But the Green Way is very good for accessing information.

How many farmers use the phone? 40% approx.

Prerequisites:

For the farmers reading is not the problem but typing is. And if they type wrong data they cannot change the data easily (only the whole sheet can be deleted but not single fields)

However, some farmers do not use updated versions of the app, so they cannot even delete sheets yet.

How important is training? Very important also because farmers use the phone. The more farmers use the phone, the easier it gets to enter data.

Some farmers think that the phones skills are not a big problem because their children can help. Most farmers in the GoMP know how to use logbooks, so the recording itself should not be a problem.

Incentives:

Suggestions and advice. Compare the data to others and get advice on the performance of the own farm. They want to know the average performance indicators of the area so they can compare themselves to others. This would help them to make better decisions. The expenses should be based on the way of production because then they can see wether it is worth it changing their way of cultivation or not.

Data privacy

They want to show others how they do, so no problem. *Government could see the performance of their farm and this data could be used to negotiate on a better price!*

They would answer yes to the question if they want to share their data.

No additional incentive needed.

Training:

The farmers showed other people in their village how the farming record looks like. And explained benefits. However, farmers do not know how to type on the phone. Training is needed concerning this.

Sharing through zapya is very easy for the information part.

Update of assumptions CBA for paddy		CBA 2018			Surveys		
	unit	without project	with project	additional costs with project	without project	with project	additional costs with project
Paddy production costs							
Direct seeding	MMK/acre	70.000	150.000	80.000	140.372	146.777	6.405
Transplanting	MMK/acre	120.000	200.000	80.000	206.385	245.069	38.684
Additional costs on average	MMK/acre			**80.000**			**22.545**
Area per farmer	ac	4,5	1,5		19,5	13,0	
Interest rate on credit	%	12	12		8	8	
Working capital	MMK	100.000	200.000				
Yield of paddy				additional yield with project			additional yield with project
Direct seeding	kg/acre	700	1.200	500	685	814	128
Transplanting	kg/acre	1.150	1.800	650	728	1.012	284
Average yield increase	kg/acre			**575**		284	**206**
Price of paddy							
Farm gate price for paddy	MMK/kg	250	250		421	456	
Price increase for better quality	%					8	
Price for paddy at the mill	MMK/kg				403	341	
Price increase for better quality	%					-18	
Net-income of paddy				additional income with project			additional income with project
Direct seeding	MMK/acre	105.000	150.000	45.000	81.432	224.197	142.765
Transplanting	MMK/acre	167.500	250.000	82.500	121.092	147.455	26.363
Average increase in income	MMK/acre			**63.750**			**84.564**

Update of assumptions CBA for green gram		CBA 2018			Surveys		
	unit	without project	with project	additional costs with project	without project	with project	additional costs with project
Green gram production costs							
Direct seeding	MMK/acre	80'000	120'000	40'000	171'075	149'790	-21'285
Labour	MMK/acre	60'000	100'000	40'000	91'907	68'905	-23'002
Area per farmer	ac	4.5	3.5		7.50	8.25	
Interest rate on credit	%	2	2		8	8	
Working capital	MMK	100'000	200'000	100'000			
Yield of green gram				additional yield with project			additional yield with project
Direct seeding	kg/acre	450	600	150	299	206	-93
Price of green gram							
Farm gate price for green gram	MMK/kg	1'200	1'320	120	1'194	1'280	86
Price increase for better quality	%		10			7	
Price for paddy at the mill	MMK/kg				no data	1'220	
				additional income with project			additional income with project
Net-income of green gram	MMK/acre	460'000	672'000	212'000	183'842	86'698	-97'144

7. Summary of SWOT analyses

SWOT Summary all Stakeholders

Strenghts	Weaknesses
• Easy (Linn Wah and Khin Sabai Thu) and cheap (me) way to collect and study (Tun Zaw Htay) economic data (farmers). • Costs and Benefits can be easily compared between seasons and years (Linn Wah and Khin Sabai Thu, farmers) • Valuable information for planning farm activities (farmers) • GoMP can observe what inputs the project members are using (Linn Wah and Khin Sabai Thu) • Family labour can be recorded and analysed (Linn Wah and Khin Sabai Thu) • GoMP can easily support farmers since many farmers in the area are known by project staff (Tun Zaw Htay) • Experts from Greenovator can be contacted directly if needed (me)	• Precise information from farmers is needed in order to be able to collect correct data (Linn Wah and Khin Sabai Thu) • Lack of professional support in areas outside of the GoMP (Linn Wah and Khin Sabai Thu) • Project staff is not able to support the farmers enough (Tun Zaw Htay) • In order to understand the purpose of the feature, a general understanding of economics and mathematics is needed (me) • It can be hard to find the feature on the app (farmers, me) • Mistakes in data entry happen easily (farmers) • Limited possibilities to delete data (farmers)
Opportunities	**Threats**
• A good phone network connection through four SIM cards (me, Tun Zaw Htay) • Almost every HH has a smartphone (me and Tun Zaw Htay) • The farmers seem to be highly motivated to work with the project (Tun Zaw Htay and me) • Most farmers have educated children who can read and write (Tun Zaw Htay). This new generation is skilled in using the phone (me). • Certification standards request precise recording. Farmers who know how to record are more likely to get certification (Linn Wah and Khin Sabai Thu). • Farmers can easily see and compare costs and benefits (Linn Wah and Khin Sabai Thu) • The practise on recording allows farmers to be more efficient with government related paperwork (Linn). • Extension services could use the collected data in order to provide farmers specific technical knowledge on their farm situation (me) • The feature could connect consumer and farmers through barcodes. Consumers get to know details on how the product was produced (Linn Wah and Khin Sabai Thu)	• Play store App might not be available, so farmers need to find other ways to download the app (Linn Wah and Khin Sabai Thu) • Data privacy: Data holders can use data from farmers for other business (Tun Zaw Htay) and third parties could access the data (me) • Low internet connection in some villages (Tun Zaw Htay, farmers). • Some of the farmers have no smart phone or are not able to use it (Tun Zaw Htay). • The app needs relatively new smart phone versions, some farmers lack this (Tun Zaw Htay, farmers). • Farmers in the GoMP area are not used to record regularly (Tun Zaw Htay, farmers). • Lack of understanding of farmers concerning the questions and therefore collection of incorrect data (me) • Farmers might not see the benefits of putting their data into the system (me) • The collected data does not correspond to the actual data since not all farmers record their data (me). • Illiteracy amongst older generation of farmers (me) and lack of education in general (Tun Zaw Htay). • Myanmar letters have changed to Unicode system, which makes typing difficult (farmers).