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## **Master Thesis Report**

# **Determinants of decision-making process of using agricultural services: The case of in- or outsourcing agricultural machinery**

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## **Abstract**

The understanding of the decision-making process of farmers in choosing their mechanization strategy, i.e. in-or outsourcing of machinery services, until now was limited to financial consideration and it was not investigated whether also other determining factors were relevant for farmers causing a knowledge gap in this field of farm management. Therefore, the objective of this research is to create a deeper insight in the decision-making process of farm management by elaborating all determinants that influence the choice of mechanization strategy. In order to reach the objective, based on a literature review of mechanization alternatives and farmer's decision-making process, in total seven determinants of choosing a mechanization strategy have been derived, whose relevance in two regions of different countries have been analyzed through in-depth interviews with farmers as well as machinery service providers of those regions. This research thereby found that the decision of farmers in their choice of mechanization strategy besides the already known financial determinant, which is regarded as to limit the range of alternatives, additionally is influenced by five other non-financial determinants.

**Keywords:** mechanization strategy, agricultural machinery services, determinants of farmers' decision-making process

## **Management Summary**

The objective of this research is to create a deeper insight into the decision-making process of farm managements in the question of whether to in- or outsource agricultural machinery services by exploring and explaining the determinants that influence this choice for agricultural practice. In order to meet this objective, this research was divided into a literature study and a field research.

The literature study has identified different mechanization strategies for in-or outsourcing machinery services and highlighted their advantages and disadvantages. Based on this assessment, key aspects have been identified that differentiate the mechanization alternatives. Based on these key aspects and after reviewing the literature on farmer's decision-making process, this research then has derived seven theoretical determinants characterized with keywords that might influence farmer's decision-making process.

The subsequent field research then has by using in-depth interviews confronted the identified mechanization strategies as well as the theoretically derived determinants with the agricultural practice represented by eight farmers and three service providers that were located in two regions in Germany. Service providers were also interviewed in order to include an external view on the decision-making process of farmers.

Due to this confrontation, at first it could be concluded that most agricultural services were in-sourced by farmers due to the therewith gained flexibility. Furthermore, most of the identified mechanization strategies including their advantages and disadvantages were known and also pursued amongst the identified farmers.

Concerning the decision-making process on mechanization strategies farmers confirmed that their decisions are not purely based on financial considerations. Accordingly, based on the confrontation of theoretical determinants, it further can be concluded that farmers' decision-making is influenced by the following six determinants: Financial determinant, Quality requirements, Flexibility, Social Influences as well as Time and Labour availability.

According to these findings and by considering the limitations of this research, the following recommendations to managers of agricultural businesses, in particular farm managers, are given. First of all, managers should take into account the different mechanization strategies of in-or outsourcing and in particular should acknowledge their consequences of pursuing. Furthermore, when making the decision, the identified influencing determinants should be evaluated with respect to the conditions on farm as thereby the adequate mechanization strategy of executing machinery services can be found easier.

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## **1. Introduction**

The structure of agriculture in Europe has been changed significantly over the last decades. Under the influence of the Common Agricultural Policy of the European Union launched in 1962, the progressive agriculture has suppressed the times of food shortage and developed itself towards a modern industry producing more food than is needed in Europe (EUROPEAN COMMISSION, p.7, 2012) and even capable of extending its production in non-food sectors. This trend is, besides other factors, facilitated by the modernisation of the technology and practices used in agriculture. Besides the application of fertilizers, plant protection products or breeding techniques as some examples, this production increase was enabled by the innovative, steadily improving agricultural machinery which results in higher performances, better working quality (EUROPEAN COMMISSION a, p. 10, 2012) and less needed labour forces. However, the flip side of this productivity increase is that more pressure on agricultural commodity markets is created as price volatilities increased during the time (OECD, p. 7, 2011). Especially low but also volatile prices cause risks and uncertainty as well as business problems for the farmers (OECD, p. 13, 2011). Additionally, increasing operating costs of farming, e.g. costs for land use, administration or machinery (EUROPEAN COMMISSION, p.2, 2011a) are diminishing margins. These volatile prices and higher costs are two important aspects for the structural change of agriculture in Europe which is recognized in decreasing amounts of farmers and increasing sizes of the remaining farms (EUROPEAN COMMISSION, p. 2ff, 2011b).

In order to meet these challenges, it has become increasingly important for the farm management to improve their efficiency. Therefore, farms specialized into certain production fields, such as dairy or arable farming, as by production increases the costs per unit can be lowered. Once in that field, farms continuously optimize their operational business. One important input factor thereby is the use of agricultural machinery, as according to LIPS and BUROSE (p.40, 2012) about 20 to 30% of farm's total costs are caused by machinery use. For the farm management there are different alternatives to either in-or outsource agricultural machinery services: They can either invest into own machinery or they can outsource necessary work processes to e.g. contractors (IGATA et al. p. 30, n.k.). Another option is the rental of machinery which can be designed in different ways. However, the choice between these alternatives is crucial for the farm management as they may affect farm business differently.



This managerial decision is already highlighted several times across the literature in different ways (e.g. WANDER and ZELLER, n.k.; BEATON et al., 2005). However, the existing scientific knowledge about farmers choosing their mechanization strategy is limited to financial consideration although research in the field of farmer's decision-making process has verified that decisions are not only based on cost minimization (EDWARDS-JONES, p. 784. 2012). Other non-financial aspects, such as quality assessment of agricultural machinery services, personal attitudes or the impact of technologies might be, are either not taken into account or only mentioned on a theoretical base. The problem thereby is that at the moment an illustration of all impacting determinants in the choice of how to execute machinery services is missing since it is little known in scientific literature about how the agricultural practice is making their decision in this question. An overview of these determinants however could deliver crucial knowledge for different people, for example actual deciding farmers who therewith get a better theoretical fundament, the agricultural engineering industry getting a better insight in farmer's decision behaviour or maybe even entrepreneurs looking for offering system solutions to practical agriculture.

This research wants to close this knowledge gap by better understanding farmer's decision-making process in choosing agricultural machinery services as it is an important operational field of agriculture with a high potential to save costs but simultaneously the requirement to deliver qualitative and efficient work.

### **1.1 Research Objective**

Therefore, the objective of this research is to create a deeper insight into the decision-making process of farm managements in the question of whether to in- or outsource agricultural machinery services by exploring and explaining the determinants that influence this choice for agricultural practice. The question that is central in this research hence formulates as follows: What are the determinants of farm management when deciding how to execute agricultural machinery services?

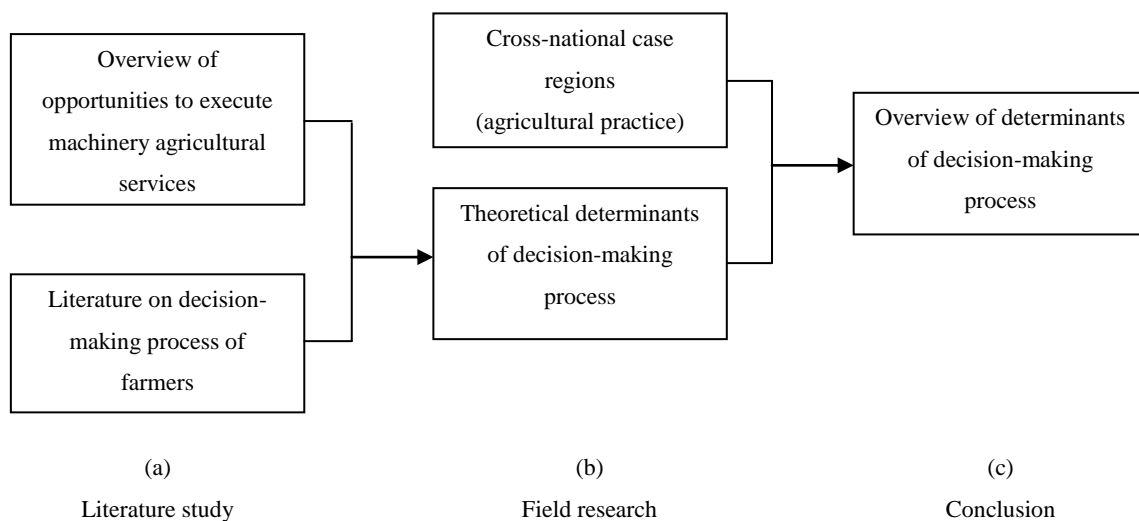
For this, the existing knowledge on mechanization strategies as well as the way of farms handling this decision will be investigated in order to elaborate an overview of the choice influencing determinants to create a better understanding of and insight in this decision-making process.

## 2. Methodology

Based on the perception that little is known about the farmers' decision-making process in choosing an agricultural mechanization strategy, this study is designed as a theory building qualitative research which is recommended for an in-depth investigation of complex phenomena (VERSCHUREN and DOOREWAARD, p.22, 2010) such as the choice of mechanization strategy. More specifically, the following research framework as illustrated in Figure 1 is applied in order to achieve deeper insights of the farm's managerial decision between in- or outsourcing agricultural machinery services.

A literature study (a) delivers on the one hand, after placing the mechanization decision within the levels of farm's strategies, an overview of the advantages and disadvantages of the existing opportunities for agriculture to decide on how to execute machinery services, i.e. different ways of in- or outsourcing, and thereby depicts why such mechanization strategies differ among each other. On the other hand, the literature study reviews the scientific findings of farmers' decision-making process. The combination of both delivers theoretical derived determinants of the decision-making process of agricultural services.

The subsequent Field research (b) then confronts those theoretical determinants with the factors that are of importance for the agricultural practitioners in the decision of how to execute machinery farm operations by looking into two different regions of farming located in Germany and the Netherlands. This confrontation of the theoretical and practical view results in an overview of determinants (c) that are proved to be relevant in choosing between in- or outsourcing of agricultural machinery services.



**Figure 1: Research Framework**  
(Source: own design)

In order to achieve the research objective, this research hence follows according to VERSCHUREN and DOOREWAARD (2010) two succeeding research strategies, namely a desk research and a case study research. The following sub-chapters describe the intention and approach of these strategies within this research in further detail. A definition of the concepts that are often used in this research can be found in Appendix A.

## **2.1 Literature Study**

The first part of this research is a desk research in which the current literature is investigated to support a better understanding of the farm management's decision process in relation to the use of agricultural machinery services. The literature study is mainly conducted by using search engines like Google Scholar and the online libraries of the Wageningen University and University of Bonn. Additionally, specific knowledge of professional agricultural journals is included to create better understanding of the research context, in particular when it comes to the characterization of the different mechanization strategies.

Before approaching the farm management's mechanization decision, it is important to understand in which strategic farm context this question becomes relevant. Therefore, Chapter 3 describes the strategic composition of farms in relation to the general known strategic levels of companies and places the decision of how to execute agricultural machinery services accordingly. Relevant literature in this context is found by search terms like "farm's strategic composition" or "farmer's strategy".

As the exploration of determinants that affect the decision of choosing machinery services is the aim of this study, the next step is to depict the characteristics of all different mechanization strategies farmers can follow in order to understand the differentiation between executing machinery services. Hence, Chapter 4 starts with explaining the literarily known agricultural mechanization alternatives and continues with compiling their benefits and disadvantages. Thereby key aspects become evident in which the alternatives differentiate themselves. They are highlighted in the end of Chapter 4 and are further concerned in the next chapter. The literary background is found by search terms that focus on mechanization strategies, like "farm mechanization", "owning or hiring" or "agricultural service provider". Relevant information is also found in professional journals highlighting different mechanization alternatives.

As the farmer's decision into a certain mechanization strategy is a basic principle of this research, Chapter 5 starts with reviewing the scientific findings of the farmer's decision-making process found by search terms like "farmer's decision-making", "farmer's strategic choice" or "modelling farmers' decision-making". The review shows that the traditional view

of farmers to be motivated by profit maximization has changed towards a broader view on farmers' decision behaviour. Studying the literature on farmer's decision-making process of using agricultural services furthermore showed as stated in the introduction that there was no scientific approach to characterize determinants that affect the choice into agricultural machinery services. Since such determinants however are expected to add value, the approach of this research is to combine the differentiation characteristics of mechanization strategies which are introduced as key aspects and elaborated in Chapter 4 with the nowadays understanding of farmers' decision-making process. Therefore, Chapter 5 derives, after reviewing the scientific understanding of farmer's decision-making process, theoretical determinants that might influence farmers' decisions on the base of these key aspects. They are allocated according the Theory of Planned Behaviour which the literature review has identified as relevant model of farmers' decision-making and is described in further detail in Chapter 5. The theoretical determinants are characterized with keywords based on the findings of Chapter 4. By this, a method of comparison is created allowing to compare the results of confronting the agricultural practice with the theoretical determinants.

The theoretical part of the research ends in Chapter 6 with setting up research propositions that are addressed during the field research on the one hand to verify the existence of determinants that are not only cost related and on the other hand to prove whether the theoretical derived determinants are valid, need to be adjusted or complemented.

Chapter 7 highlights the findings of the field research which is explained in detail in the following sub-chapter. Chapter 8 then discusses these results with respect to the literature findings and the formulated propositions of chapter 6.

Finally, Chapter 9 summarizes the conclusions made in this research and lists those determinants that have been verified by the field research to influence the decision-making process of farmers in the question of whether to in-or outsource machinery services.

## **2.2 Field Research**

Focusing on the second phase, this research switches into a case study research where the agricultural practice in two different regions separate countries is confronted with the theoretical derived determinants. This confrontation is realized by using in-depth interviews which are further described in the next sub-chapter. The objects of these regions are primary the domiciled farms but also some agricultural service providers in order to include an external view on farmer's decision-making process. The case study approach is followed as it enables a detailed and thorough investigation of the motivations, considerations and reasons of a group of people, i.e. farmers (VERSCHUREN and DOOREWAARD, p. 159, 2010).

One region is located in the Netherlands in the province Drenthe called “Gemeente Emmen” and the other in Germany in Lower Saxony, called “Samtgemeinde Emlichheim”. They are located in the neighbourhood divided by the national border and are characterized by a high density of agricultural activities with a wide range of different farm types. It is decided to use regions in different countries in order to enable a cross-national view on farmers managing their agricultural services. This allows investigating whether the examined determinants are similar between countries as they thereby would have a higher potential to be generalized.

### **2.2.1 Interviews**

This research used in-depth interviews, characterized by BOYCE and NEALE (2006) as qualitative research technique with intensive and individual interviews with a low amount of interviewed persons. It is decided to use interviews as data collection method since this allows getting in-depth information of complex situations (KUMAR, p. 142, 2011) such as the managerial decision about the chosen mechanization strategy. As stated earlier, the objects of interviews were on the one hand service providers creating an external view on farmers’ agricultural machinery service decisions and on the other hand active, full-time farmers. More precisely, amongst a set of farmers in these regions that have for the purpose of comparability some form of arable farming within their farm activities, four farmers per region were randomly chosen to be interviewed. They thereby can differ in their farm type as well as the kind of mechanization strategy used. Furthermore, a German and a Dutch contractor as well as one German machine rental manager are interviewed, who in this case are referred to as service providers.

The interviews were conducted in the language of the region and were semi-structured so that they include a list of questions relating to the propositions formulated in Chapter 6 but simultaneously leave enough room for respondents to give open answers. This ensured that also new and practical insights could emerge during the interviews. Farmers and service providers were addressed with different interview questionnaires (see Appendix C and D). Both questionnaires have been improved after pre-testing with two external farmers. Before starting the interview, all respondents have been informed about the content and aim of this research by the same information sheet linked to the questionnaire (see Appendix B). The Service providers, after characterizing their business (part A, Appendix D) were interviewed on how they experience the decision-making process of farmers, in particular which motivation they notice in farmers’ mechanization strategies (part B, Appendix D). Furthermore, they were asked to consider which factors might influence farmers to make

particular mechanization decisions (part C, Appendix D). The questionnaire for farmers was more detailed and started with questions on the farming type and farming size as well as their personal interests on farm. The next questions aimed at identifying whether the farmers in-or outsource typical farm operations (planting, harvesting, etc.) and which particular mechanization strategy thereby is followed (part A, Appendix C). Next, farmers were asked why they have chosen this strategy and which arguments drove them to do so (part B, Appendix C). In particular, it was asked whether lowering the costs was the motivation behind or if also other determinants were of importance (part C, Appendix C). By this, first independent statements on the existence of non-financial determinants could be noticed. Further questions tested whether the theoretical derived or other so far not considered determinants were of importance during the decision-making in conducting agricultural services (part D, Appendix C) by addressing the keywords characterized in Chapter 5.

If the respondents have allowed, the interviews were recorded and shortly after conduction summarized. If there was no such allowance, the content of the interview was summarized based on the notes made during the meeting. The summaries of all interviews can be found in Appendix E and F.

### **2.3 Data analysis**

The analysis of interviews was focused on the propositions introduced in Chapter 6 to which the content of the interviews was compared. In particular, it is analyzed whether the influencing decision factors named by the interviewees correspond to the keywords that characterized the theoretical derived determinants and if needed adjusted or complemented. This comparative analysis of the gathered information has explored the determinants that are important for the farm management's decision in choosing their mechanization strategy. Thereby, the research objective of creating a deeper understanding of the decision-making process in this context is achieved as an overview of determinants that affect farmers' in choosing amongst different mechanization strategies is elaborated.

### **2.4 Validity and reliability of the research**

This research wants to create trustworthy and comprehensible insights into the decision-making process of farmers in the question of in-or outsourcing machinery services. Therefore, its structure, implementation as well its elaboration in form and content has to be valid as well as reliable. The following section describes the approach of this research to satisfy these requirements.

According to DENZIN and LINCOLN (p. 114, 1994), validity and reliability in qualitative researches is reached by meeting the four criteria credibility and transferability, which are comparable to the concept of validity, as well as dependability and confirmability which in turn are comparable to the concept of reliability. Credibility is achieved when the research findings reflect the opinions and feelings of the research objects (KUMAR, p. 172, 2011) and therewith the context of the research. Transferability reflects the extent to which the research findings can be generalized whereas dependability describes whether the results of the research could be observed similarly again (TROCHIM and DONELLY, p.149, 2007). To the latter related is the confirmability which describes whether the findings could be confirmed by others again (TROCHIM and DONELLY, p.149, 2007).

As this research is based on a broad literature study as well as a proper transfer of its concepts into comprehensible, pre-tested interview questions for farmers and their statements furthermore are proved by external views of service provider, the literature findings as well as the results of the interviews consequently are believable and create a sufficient level of credibility.

Furthermore, since the literature study as well as the field research is thoroughly conducted in the context of farmer's decision-making process with relation to the choice of mechanization strategy, the findings can be generalized in such a way that insights into the context of the study can be made. Yet, the sample size of in total eleven respondents restricts the ability to generalize since in-depth interviews are used in order to explore the complexity of this context. However, through the investigation in two regions of different countries findings are less restricted to local conditions. Hence, the transferability of this research is somehow limited, but still remains due to its incorporation of different regions and respondents on a sufficient level for an in-depth analysis of a complex situation.

A semi-structured questionnaire was used to ensure that respondents were faced with identical questions. Moreover, keywords are introduced which allowed a comparison of the field research results amongst the respondents as well as a comparison with the literature findings. By this, an appropriate level of dependability is created.

The broad and systematic literature study, the substantiated derivation of determinants based on the literature findings, the introduction of explanatory keywords mentioned above and the thorough recording of interview results furthermore enables others to follow and understand the elaborated findings of this research creating an appropriate level of confirmability.

Altogether, by having properly addressed the required criteria credibility, transferability, dependability and confirmability, the findings of this research are stated as valid and reliable.

## **2.5 Research assumptions**

This research is conducted on the base of the assumption highlighted below which is taken for granted and therefore is not proved in the context of this research.

### **Assumption 1:**

During the literature review on the decision behaviour of farmers the Theory of Planned Behaviour has been identified as adequate method to model farmers' decision behaviour. Since this method has been proven to be significant valid within several studies, this research assumes the main conclusions of the Theory of Planned Behaviour to be applicable also on the decision to in- or outsource agricultural machinery services. Based on this assumption, the theoretical derived determinants were allocated to the three main aspects of the Theory of Planned Behaviour, which is further described in chapter 5.



### **3. Placing the mechanization decision**

Before examining what determines farmers to choose between the in- or outsource of machinery services, it is important to place this decision-making process within the boundaries of strategic decisions of farms in order to understand that the mechanization evolves based on the farm's strategic orientation. Therefore, after giving a differentiation between the levels of strategies, the decision on how to execute agricultural machinery services is placed at the adequate strategic level of farm's strategy formulation. By this, the starting point for the further considerations on mechanization strategies in the subsequent chapters is set.

MINTZBERG (1994) identifies strategy amongst others as a plan that determines the way of getting from the current to the desired position. Within an economical view, a strategy therefore defines how a firm is planning to achieve market success. Formulating adequate strategies requires the understanding of influencing factors as well as the levels on which strategic decisions are made.

Literature on strategy differentiates three levels of strategies that need to be formulated and implemented in order to be a successful company, namely corporate strategy, business strategy and functional strategy (e.g. HOFER and SCHENDEL, 1978; WHEELLEN and HUNGER, 2000). Strategies that are formulated on a corporate level comprise decisions that frame the overall organization of a firm (SALIMIAN et al, p. 12017, 2012). The strategy on the corporate level thereby creates value as it divides the firm's activities into businesses (COLLIS and MONTGOMERY, 2005). Hence, corporate strategies express the businesses a firm is active in determined by the decision on what to produce and where to market (INDERHEES and THEUVSEN, p.5, 2006). Moreover, corporate strategies take care of the allocation of resources amongst the different business units (JACOBS, 2010). On this level it is already decided whether the company is following the strategy to diversify or to specialize the way of production and whether the object is to grow, stabilize or even reduce business output. According to INDERHEES and THEUVSEN (p.5, 2006), these decisions are also relevant in an agricultural context, as the structural change and the upcoming of new business opportunities enables farmers to rethink their corporate strategy.

After having established the corporate strategic direction, decisions on strategies have to be made on business level. Following COLLIS and MONTGOMERY (2005), these strategies are subjected to the competition on the markets of their businesses. The strategic aim thereby is to achieve competitive advantages in order to market successfully (SALIMIAN et al, p. 12017, 2012). PORTER (p. 102, 1999) describes three approaches to face the competition on markets.

Accordingly, firms can choose between cost leadership, differentiation or focus strategies. Those strategies achieve competitive advantages either by producing at lowest cost, by offering valuable product characteristics that differ from competitors or by focusing on the specific demands of a niche on a certain market (INDERHEES and THEUVSEN, p.5, 2006).

In the farming context, cost leadership is expected to be the common way of facing the competition, because farmers mainly grow products that were traded on an international base where lowering the production costs is the only way to stay competitive. In their research on strategies implemented in the agricultural sector, INDERHEES and THEUVSEN (p.10, 2006) found that more than ninety percent of farmers in the case region of North Rhine-Westphalia indeed followed the strategy to produce conventionally at lowest cost with their products facing international competition. However, that other strategies also play a role can be seen through, for example, a small share of farmers that followed the focus strategy by changing into organic production (INDERHEES and THEUVSEN, p.10, 2006).

The last strategic level is called the functional strategy which is meant to facilitate the business strategies (DAVIS et al., 2003) by defining the operational course of actions within a business unit (INDERHEES, p. 42, 2006) An important object of the functional strategy is to clarify processes and the underlying organization (INDERHEES, p. 42, 2006). This requires decisions for example in the areas of production, marketing, human resource management, financial management (SALIMIAN et al, p. 12017, 2012).

Functional strategies play also a role in agriculture as they need to implement the measures necessary to establish the farm's business. Examples of such strategic decisions on functional level are the kind of forage used in keeping of animals (INDERHEES and THEUVSEN, p.6, 2006) or the equipment used for production (PERRY and OVERTON, p. 17, 2010).

This shows that a decision on machinery use hence is also placed on the functional level. Since all farms are somehow depended on executing farm operations, farmers have to decide for each of these operations a certain mechanization strategy, i.e. whether they want to in- or outsource. The determinants that influence this decision are of interest in this research.

The three levels of strategies outlined above are not isolated from each other. Instead, they are depending on each other meaning that the functional strategy is supposed to reinforce the business strategy which in turn contributes to the overall corporate strategy (SALIMIAN et al, p. 12018, 2012). Important to highlight is that agricultural businesses are not necessarily similar in the upset of these strategies. Due to variation of factors in the environment of farms, different business approaches can be followed. While some farmers may have decided to focus on animal husbandry as corporate strategy, others in turn may be specialized in arable

farming (RIJK, p.4, n.k.). The subsequent strategies of these two exemplary groups are then aligned with their corporate strategies and certainly will differ from each other so that their total strategy setup results in different farm types. Disregarding multifunctional equipment, like tractors, the kind of required tools is depending on the farming strategy followed meaning that the demand for machinery will differ amongst farm types as most machines were specialized for a certain task (WAUTERS and VAN WINSEN, p.1832, 2014). This fact however may suggest that the decisive determinants behind choosing a mechanization strategy may also differ amongst the farm types. A detailed look across the interviewed farm types enables a statement on this consideration later on.

In a nutshell, within this chapter the farm management's decision into a certain mechanization strategy has been placed on the level of functional strategies. Furthermore, it is highlighted that different farm types exist that require different farm operations to be executed. However, all of them need to perform their farm operations. Hence, the decision into a mechanization strategy affects all farm types although the machinery required differs.

In order to understand how farmers can design their mechanization strategy on functional level, the next chapter focuses on characterizing the different mechanization alternatives from which farmers can choose from.

## **4. Agricultural mechanization strategies**

Since this research is aiming at creating deeper insights into the decision-making process of farmers deciding on how to perform agricultural machinery services, it is required to know which alternatives farmers have to choose from. This chapter intends to explain the following listed mechanization strategies.

Furthermore, an assessment of these choice opportunities is included in this research with the weighting up of advantages and disadvantages of the alternatives. This assessment already indicates some key aspects that may influence farmers' decisions. Those key aspects are explored in the end of this chapter and discussed as theoretical influencing determinants in the next chapter.

### **4.1 Mechanization opportunities**

In general, farmers have the possibility to in- or outsource the machinery services. Owning, renting or leasing of equipment in this research is seen as in-sourcing while outsourcing refers to charging of service providers. Additionally, the option for farmers to cooperate in mechanization is considered (KIME et al., p. 4, 2014). The next sub-chapters provide definitions and evaluations of these different strategies.

#### **4.1.1 Ownership**

The first option of executing agricultural machinery services is to buy own adequate equipment. According to (KIME et al., p. 1, 2014) this ownership is thereby characterized by the farmers' provision of capital and labour for the purchase and use of machinery. A farmer, for example, who has decided to harvest his grain with own equipment thus has to buy a combine and needs to have an operator working with the machine.

There are several advantages that convince farmers to buy agricultural equipment. At first, having invested into own machinery secures the control over its employment as well as over the quality it delivers (EDWARDS, p.1, 2009a). This control of employment on the one hand includes the possibility to set the moment of task execution at the discretion of the owner himself. On the other hand, the farmer can dictate the handling of his machines based on personal criteria (EDWARDS, p.1, 2009b). For example, when a farmer assumes that it is at a certain moment the best time for harvesting, he is able to start with the required tasks directly since he has his own machine available. That is why the ownership of machinery allows for the highest flexibility in scheduling farm operations (BLANK et al., p. 37, 1991) which can ease farmers' time pressure in performing agricultural services.

This gained flexibility on the other hand may also have advantageous effects on the quality of performed tasks in two ways. At first, through the possibility of self-depended scheduling of tasks the so called timeliness costs can be reduced to a minimum (EDWARDS, p.1, 2009b). According to LAK and ALMASSI, (p.144, 2011) timeliness is describes the best moment at which farming operations should be executed. Ignoring that time period consequently leads to costs, e.g. through decreases in product quality (LAK and ALMASSI, p.144, 2011). Timeliness costs may be particularly relevant for farmers in regions with difficult weather conditions, where the crop has to be harvested within a short time period. Secondly, assuming that own machinery eases the time pressure by the considerations explained above, a farmer has less pressure to perform as fast as possible and therefore chooses machine settings adjusted to quality and less to quantity output (BLANK et al., p. 38, 1991).

Another positive aspect of owning machinery relates to accountancy. Investments into own machinery are increasing the equipment assets of farms. The NCFMEC (p.5, 2014) states that well cared equipment has the potential to store equity since it holds its real value over a long time. Additionally, it has the ability to serve as collateral for other investments (NCFMEC, p.5, 2014). The last point is however not universally valid, as usually creditors evaluate machinery below its real value (FEIFFER et al., p. 7, n.k.). Hence, although placing machinery as collateral is indeed possible, it is underrated since it is not counting for its real value and therefore might not really be seen as buying motive but rather as concomitant phenomena of purchase.

Nevertheless, investments into own machinery has advantages. The German professional journal TOP AGRAR (p.87, 2011), which interviewed farmers on their reasons to follow a certain mechanization strategy, pointed out that especially independence of others, self-determination of quality and less working pressure are motivations to purchase. Since the equipment of service providers often is paid on time basis and already scheduled for the next customers, machine downtimes are recognized as expensive and time demanding. Service providers therefore force their machines to perform constantly. Hence, controlling own equipment eases the working pressure for farmers as they recognize less stress to keep machines running (TOP AGRAR p.87, 2011).

However, the purchase of machinery also has some disadvantages. Since today's machinery is mostly specialized and has high technology standards, it is also expensive to buy (DE TORO and HANSSON, p.13, 2003). Therefore, a considerable investment has to be made and therefore enough capital needs to be available. Once a machine is purchased the capital is tied and

therefore not available for other, possibly more valuable investment options (EDWARDS, p.1, 2009a).

Another disadvantage of owning machinery that is linked to the required huge investments and that is of particular relevance when purchases are paid with loans is the fact that liquidity problems (EDWARDS, p.1, 2009a) can occur because the investment related cash outflow continues (NCFMEC, p.4, 2014) and might fall together with other payment requirements over time.

The purchase of machinery comes along with the responsibility of ownership (EDWARDS, p.1, 2009a). This responsibility has to be carried by the farmer as owner and is expressed by the necessity to care, maintain and, which is of particular relevance with increasing age of machinery, to repair the equipment in order to enable proper operating. Proper operating in turn is also depending on the availability of adequate service stations around who need to assure assistance in time, in particular when it comes to a total damage (FEIFFER et al., p. 3, n.k.).

It is already mentioned that with ownership also labour needs to be provided in order to get machines working. Labour provision can be a barrier towards ownership of machinery especially in those time periods where other urgent tasks have to be done simultaneously or when the workers could do more valuating farming tasks than driving the machine (FEIFFER et al., p. 1, n.k.). Furthermore it is noted, that labour costs contribute significantly to the total operating costs of machinery (KIME et al., p. 3, 2014) which is of particular relevance when a farmer needs to hire additional staff for operating.

Another drawback that relates more to the technology of the machinery is the fact that owned equipment often is used over a longer time due to financial considerations (see Chapter 5). Any decision into a certain technology thus is lasting over a longer period. However, the risk exists that the chosen machinery is not working as desired (FEIFFER et al., p. 3, n.k.). In this case then, either the machine has to be pulled through its useful life consequently combined with working under irritating conditions or it has to be sold earlier and therefore causes economical losses. Related to this is the drawback of ownership resulting from the fact that during the machine's farm life time, the farm is somehow isolated from the technological progress in farming equipment (FEIFFER et al., p. 2, n.k.) that might yield machines with more efficiency. In the recent years farmers faced the drawback of high investments into new machinery by the purchase of used equipment that already have been utilized at other farms. Used equipment is characterized by partly significant lower purchase prices compared to new machinery which therefore causes lower fix costs (TOP AGRAR p.87, 2011). However, the disadvantage of older

machinery is that the probability of technical defects increases causing higher repair costs (EDWARDS, p.1, 2009a). Therefore, deciding farmers need to evaluate the condition of those machines in order to make estimations of its repair costs. However, it is possible that farmers misjudge the conditions and hence underestimate the required repair costs (EDWARDS, p.7, 2005) which in turn might have consequences on the farm's financial situation, i.e. liquidity.

#### **4.1.2 Renting**

An alternative to owning machinery for executing farm operations is the renting of farm machinery. In this option a machine is rented right before and as long as the agricultural service has to be performed. Lenders, e.g. machinery rentals or manufacturers of agricultural equipment, are then charging on the base of time the machinery has been rented or on the acreage it has performed (EDWARDS, p.2, 2009a).

The alternative of renting has several advantages or beneficial aspects that induce farmers to use it in their mechanization strategy. Starting with the financial considerations, the previous chapter already has highlighted that nowadays farm technology is expensive due to its remarkable performance and efficiency increases. Owning such machinery would require high capital investments including long term financial responsibilities. Renting however is advantageous since it does not require such capital investments (KIME et al., p. 4, 2014) but still allows farmers to achieve the control over equipment during the rental period (EDWARDS, p.2, 2009a) which in turn allows for flexibility in task execution. Expenses are thereby mainly limited to the renting charges, labour and fuel costs because long term investment responsibilities caused by purchase are avoided.

Further advantage that makes the alternative of renting lucrative is the fact that it allows self-determined access to farm equipment. This may be of relevance when farmers need very specialized machinery for certain, probably rarely occurring tasks (KIME et al., p. 4, 2014) or when they are willing to invest into own machinery in the future but are unsecure about the kind of technology to buy. The latter aspect is comprehensible when reflecting the argumentation of FEIFFER et al. (p. 2, n.k.) who referred to the possibility that purchased technology could fail or be inappropriate for the farm's conditions. Renting in such a case then is advantageous because it allows making experiences with a certain technology (EDWARDS, p.2, 2009a) and simultaneously limits the use of potentially inappropriate technology to a limited period of time (FEIFFER et al., p. 2, n.k.). Furthermore, farmers choose to rent machinery, if they need to reinforce their own equipment capacity for short time periods (KIME et al., p. 4, 2014). This argument will be of particular relevance when recent

weather conditions only allowed for short times in which the agricultural services can be executed so that farmers rent additional machinery to increase their performance (EDWARDS, p.2, 2009a).

The last benefit of renting is important for those farms that are unsecure about their future strategic orientation. When farmers want to have own control over machinery but simultaneously are not sure whether they continue the business for which the machine is needed, they avoid long-term investments by renting adequate machinery (FEIFFER et al., p. 3, n.k.).

Nevertheless, renting also has some disadvantages that arise from the fact that the machinery is not the property of a single farmer but rather has to be shared amongst other farmers as otherwise renting would not be affordable for the lender. The biggest disadvantage thereby is the problem that machines are not available for a farmer when it is used already by someone else. In this case then, timeliness cost (see Chapter 5.2) arise if farmers cannot manage access to machinery via other alternatives (EDWARDS, p.2, 2009a). Another disadvantage refers to the maintenance necessity of machinery. It has already been argued in the previous subchapter that proper performances of machines have to be secured by adequate servicing and thoroughly treatment. Since farmers only rent the equipment and do not own it, they also do not feel responsible for the treatment of the machine and its maintenance (EDWARDS, p.2, 2009a). Either this can causes direct downtimes for the farmer himself due to broken equipment or farmers that are going to rent the machine afterwards might pick up a machine that is likely to fall out of order. In order to face this problem, many machinery rentals take responsibility to maintain their equipment which however results in higher rental rates for farmers and thereby decreases the financial advantage of renting (FEIFFER et al., p. 4, n.k.).

#### **4.1.3 Leasing**

Another way of getting access to machinery is to lease equipment. Although with this option a new machine is lent to a farmer by the financing lease provider and therewith seems to be a kind of renting, it differs from it as the equipment is rented over a longer time period (KIME et al., p. 4, 2014) and is controlled by just one farmer. Hence, leasing is a specialized form of renting and therefore requires the upset of a contract between the dealer or even leasing company as lease provider and the demanding farmer as lessee (EDWARDS, p.3, 2009a). Such contracts include, amongst others, information on the exact piece of machinery, the time period of lease and the payment conditions for rental (NCFMEC, p.2f, 2014). Since leasing contracts last several years in which the machinery is used by the farmer, at the end of the



lease period he can decide whether he simply returns the machine or exchanges it with new machinery. Another option is to purchase the equipment under the conditions of a used machine (EDWARDS, p.3, 2009a).

Besides the already explained advantages of renting, such as e.g. the conserving of investment capital (KIME et al., p. 4, 2014) and the access to the control over desired machinery (EDWARDS, p.3, 2009a), leasing has some additional advantages which are not necessarily prevailing in the option of renting or purchasing. According to NCFMEC (p.6, 2014) especially farmers that want to renew their machinery every few years will pay less compared to a loan to purchase and (EDWARDS, p.3, 2009a) further states, that leasing expenses might even be lower than renting machinery for short times seen over a long period. Furthermore, farmers deciding to lease equipment have the benefit to work with new machines that therefore include the latest technology available (KIME et al., p. 4, 2014). Thereby the opportunity exists to configure the equipment according to the farming conditions and requirements of farmers (EDWARDS, p.3, 2009a). Moreover, since the machines are newly created they were delivered with guaranty and potential repairs may be carried out at the manufacturer's expense (FEIFFER et al., p. 3, n.k.). Having own control over leased equipment forces the lessee to be responsible for its maintenance which in turn means that the machine conditions are better known compared to renting, where several farmers rent the same machine in short periods of use (EDWARDS, p.3, 2009a).

Further arguments for leasing are related to the risk of owning own machinery. Since leased equipment is the property of the lease provider, lessees do not have to consider liquidity issues which may result from capital investments for machinery. Moreover, leasing farmers do not have to take care of aging machinery in their assets as the risk of obsolescence causing equipment to become worthless fully falls to the leasing provider as machine owner (EDWARDS, p.3, 2009a).

However, the opportunity of leasing equipment, and this is also valid in case of renting, cannot build up farms' equity which might be the case when owned machinery holds a certain value. Moreover, EDWARDS (p.3, 2009a) states that leasing in the long run is more expensive compared to an ownership. Following the argumentation of FEIFFER et al. (p. 3, n.k.), these higher rates might also be resulting from the routinely trading of new machinery which forces leasing providers to include this as matter of expense in the leasing rates.

So far, the options to own, rent or lease farm machinery were discussed as possibilities that allow farmers to perform agricultural services under their personal guidance and control of the required machines. The control of machinery however comes along with the requirement to

have somebody at hand that can steer the particular machine. However, the possibility exists that farmers do not have enough labour available or do not want to allocate workers for executing a particular task. In such a case, a farmer is obliged to outsource agricultural services.

#### **4.1.4 Service provider**

Outsourcing agricultural machinery services refers to the situation where farming operations are assigned to service providers that have the required machinery in combination with appropriate operators in order to perform farming operations (EDWARDS, p.2, 2009a). These service providers, for example, can be other farmers, neighbours or specialized firms, so called custom hirers or contractors (KIME et al., p. 3, 2014), that have established over time a broad range of machines, personnel and knowledge to offer nearly most of the agricultural services performed on farms. Machinery services completed by a service provider will be charged on the base of time or acreage performed (EDWARDS, p.1, 2009b). For the decision to outsource activities it is important to note that it is affected by the perception of the relationship between the service provider and the farmer as customer (FRANZ et al., p.197, 2010).

The previous sub-chapter already has indicated the fact that service providers simultaneously offer operators to steer the machines needed (EDWARDS, p.2, 2009a) as one of the main advantages for outsourcing. By this, farmers save at least one person operating the considered machine and may save the necessity to hire additional stuff (EDWARDS, p.1, 2009b). The latter will be one crucial argument for farm managers who else would lack labour resources in case of in-sourcing activities. Furthermore, an operator included in the service eases the workload of farms (FRANZ et al., p.206, 2010) because it creates available time for the farmer (EDWARDS, p.1, 2009b) which in turn can be used for managerial obligations (FRANZ et al., p.206, 2010) or for tasks that create higher profitability than steering a particular machine in that moment. Additionally, farmers can support agricultural services being outsourced by doing necessary complemented work (EDWARDS, p.1, 2009b), such as transporting the grain while harvesting.

Besides the advantage that service providers simultaneously offer operators, further benefits exist that are motivating to outsource farm activities. To start with the financial consideration, outsourcing saves capital requirements for machinery since service providers own their -own equipment (FRANZ et al., p.205, 2010). Additionally, farmers are not tied to obligations for financing their equipment and therefore have less pressure on their liquidity (EDWARDS, p.2,

2009a). Outsourcing because of lowering total operating cost (FRANZ et al., p.205, 2010) thereby will be a further crucial argument in particular for such agricultural services that requires specialized, expensive and only seasonally used machines which one single farmer would not be able to fully utilize (EDWARDS, p.2, 2009a). Moreover, since service providers charge their performances per certain unit, it is easier for farmers to calculate the expenses for agricultural services. Therefore costs can be estimated and controlled better compared with using own machinery (EDWARDS, p.1, 2009b).

Furthermore, advantages of outsourcing are known regarding the management of agricultural services. Performing farm operations regularly has become the business of service providers. Hence, it can be expected that especially contractors have developed a high level of professionalism in scheduling, organizing and executing of agricultural services (KIME et al., p. 3, 2014). This professionalism also holds true for the technology used, as (EDWARDS, p.2, 2009a) states that the contractors' machines usually will be modern and bigger sized than single farmers could afford themselves. This argument is based on the fact that contractors have a range of farmers demanding farm operations requiring them to work at the most efficient and fast way feasible. Faster technology in turn might save additional time for farmers compared to the situation where they perform agricultural services with their own, probably smaller sized technology.

When other farmers are offering agricultural services they want to expand their workload of machinery in order to lower their total operating costs. An advantage of choosing other farmers as service provider origins from the consideration that they are more familiar with the farming situation and conditions of the outsourcing farmer (KIME et al., p. 3, 2014).

Besides the benefit that farmers do not have to care the machinery and the service providers bear the risk of mechanical breakdowns, EDWARDS (p.1, 2009b) highlights another advantage namely that professionally used machines are usually better maintained and kept in a faultless condition in order to maximise functionality which in turn minimizes the probability of machine downtimes on farms. Choosing service providers can also be an argument when certain agricultural services require certificates that farmers do not want to maintain (SCHRÖDER, p.16ff, 2000), for example the permission to apply pesticides. On top of these arguments, especially contractors have the advantage to offer complete working chains of agricultural services (EDWARDS p.1, 2009b) which requires a set of machines available. Famous example of this argument is harvesting maize, where a harvester, several transport vehicles for a continuous flow of chopped material and a heavy machine to compress for silage purposes are needed to execute this working step on farms that usually takes place only

once a year. This example demonstrates at the same time that a farmer would need several operators available if he would like to do it in-source this work.

Amongst these advantages the German professional journal TOP AGRAR (p.89, 2011) has examined the high performance and the delivered quality of service providers as important arguments to outsource work.

Service providers can offer agricultural machinery services only when they have enough customers, i.e. farmers, in order to keep their machines running economical profitable. This, however, implies that those farmers also will demand their services when they assume it is the best time for performing. According to EDWARDS (p.1, 2009b) the more farmers, respectively amount of acreage or hours, are planned for the performance of a machine, the more pressure is created on the actual work. In particular in such times where, for example, difficult weather conditions allow only small time slots for executing farm operations, the demand will be higher than the service provider can offer resulting in scheduling problems (EDWARDS, p.2, 2009a). In this case, those farmers who had requested the service at first will usually get the job done whereas the rest of demand had to be postponed until the next adequate time slot of work. This fact has two implications. At the one hand farmers wanting to perform their operations as early as possible need to schedule the operator long before the actual work is performed (BLANK et al., p. 37, 1991). At the other hand, farmers that only can be served later in time miss the optimum time period of executing the agricultural machinery service (EDWARDS, p.2, 2009a).

Another problematic aspect of outsourcing is the fact that farmers are generally not or just to a certain extent able to influence the quality of performed work since they are not steering the machines themselves but instead are depended on the service provider and his operators' skills (EDWARDS, p.2, 2009a). BLANK et al. (p. 37, 1991) additionally highlight the possibility that contractors try to serve as many farmers as possible by increasing their working speed potentially at the cost of quality.

In a nutshell, the main consequence that farmers deciding to outsource their farm operations have to be aware of every time is that a trade-off between the right moment of performance and the availability of contractor has to be made (TOP AGRAR p.89, 2011). Furthermore, farmers charging service providers were reinforced by modern machinery but depend on the operators regarding quality of performance.

#### **4.1.5 Machine sharing**

Another option of agricultural mechanization strategies that farmers can follow in order to execute their agricultural machinery services is a cooperation of one or more other farmers that together invest into machinery (HEAVRIN, p.69, n.k.). The purchased machines are then shared and not lend between its co-owners which makes it different to renting (see chapter 4.1.2). This strategy can be a mixture of in- and outsourcing since farmers can but does not have to operate machines on their own, for example, when one co-owner is steering the machine on another co-owner's farm (EDWARDS, p.1, 2009a). The costs of owning the equipment thereby is spread amongst the different users and therefore are less compared to single ownership due to the multi-farm utilization (DE TORO and HANSSON, p.13, 2003). A crucial requirement for machine sharing systems to be successful is, however, that participating farmers can build and maintain cooperative environment amongst each other (EDWARDS, p.1, 2009a).

Deciding for such joint machine purchases has several advantages. First of all, it allows being the owner of machines that would not be affordable for one farmer alone (EDWARDS, p.1, 2009a), because every owning farmers adds acreages or work time to the machine so that costs per unit decrease. Sharing the machine investment amongst the co-owners thereby also means that the capital demanded from one single farmer decreases. DE TORO and HANSSON (p.19, 2003) found, while asking cooperating farmers on their motivations to share machines, that they appreciate being less economic vulnerable resulting from the investment and cost reducing effect of joint ownership.

Farmers further were motivated to join a machine cooperation as they allow the purchase of modern and bigger sized technology and hence better machinery when a farmer would buy at his own (DE TORO and HANSSON, p.21, 2003). Those bigger machines in turn allow through their increased performance more efficient use of labour and time (MARRISON, 2011) which, for example, reduces the field time of farmers working with this machine. Moreover, DE TORO and HANSSON (p.13, 2003) found that the aspect of having a kind of teamwork within a cooperation is appreciated. This is due to the fact that cooperating with other farmers in the same business and in particular by using the same machinery allows for sharing responsibilities, such as maintenance and repairs (EDWARDS, p.1, 2009a) which, for example, one farmer likes or has more time to than the others in cooperation. Moreover, farmers mentioned lower risk regarding work time as motivation for participating in a teamwork oriented cooperation (DE TORO and HANSSON, p.21, 2003). Since the other farmers could replace each other, one farmer is more protected against the issues of absenteeism caused

factors like illness or family issues. Moreover, cooperating farmers have the possibility to exchange tasks amongst each other (EDWARDS, p.1, 2009a). Machine sharing might also be designed in such a way that just one or few of the participating farmers are operating the equipment but therefore were charged with lower machine costs when using it for own purposes. In this case then, the other farmers have more time available for their own business but simultaneously have the same advantages as private ownership of machinery would imply. Compared to outsourcing of agricultural machinery services machine shared and operated by other farmers might therefore have a better influence on quality since co-ownership includes the right of co-determination.

Although nearly all farmers interviewed by DE TORO and HANSSON (p.21, 2003) were satisfied with their machine sharing cooperation, they have indicated some disadvantageous attributes that come along with this cooperation. The first aspect comes along with those mechanization strategies where machines are not used by only one farmer, such as renting and outsourcing, and refers to possibility that farmers have to wait with performing their farm operations until the machine is available and not used by another co-owner. This decreases farmer's decision flexibility (EDWARDS, p.3, 2009c) compared to a single ownership situation and thereby increases the possibility that optimal execution periods were missed (KIME et al., p. 4, 2014) in the same way as farmers following renting or outsourcing strategies. Therefore, farmers should be aware of the context that the more farmers are included in the machine cooperation, the more operation costs might indeed decrease, but simultaneously the availability of machines decreases. Another point that comes into play is mentioned by (EDWARDS, p.1, 2009a) and which is also noted as problematic by interviewed farmers in the study of DE TORO and HANSSON (p.21, 2003) is the increasing necessity to organize the use of the owned machinery. Participating farmers need to plan and follow a kind of machine use schedule that determines who is using the machine at what time and for how long. This however requires consensus amongst each other and time for organizing (EDWARDS, p.1, 2009a). Farmers in this context also mentioned that any decision process in relation to the machine takes longer since more deciders were involved (DE TORO and HANSSON, p.23, 2003).

Another aspect that might get problematic refers to the treatment of joint machinery. The necessity to maintain machines also exists in machine sharing arrangements, but the co-owners may not feel themselves responsible for maintenance causing machine problems and at a certain point frictions within the cooperation. Moreover, use and care of the owned machinery may not be equally treated amongst the farmers (ROBERTS, n.k.). Since farmers

know in the forefront which farmers also will participate in the cooperation, they can assess them also in the context of equipment treatment so that the hazard of inappropriate machine is less compared to renting, where farmers do not necessarily know who else will rent the machine.

Further concerns may arise when joint machines are sold as, for example, different ownership shares in the machine need to be considered regarding tax issues (ROBERTS, n.k.) or the various percentages of farmer's use need to be incorporated when calculating the costs.

Up to this point, several agricultural mechanization strategies were described and characterized regarding their advantages and disadvantages known in literature. However, one aspect that recurs often in literature referred to tax benefits coming along with several ways of performing machinery services. For example, KIME et al. (p. 3, 2014) state that outsourcing can save income tax since rental fees are direct expenses lowering income taxes. In contrast, BLANK et al. (p. 34, 1991) highlight tax savings as benefit for owning machinery, as the decline in value due to aging of machinery also is tax deductible. FEIFFER et al. (p. 7, n.k.) however state that those fiscal considerations are basically similar in each mechanization strategy and it depends on the case which option indeed would be better for a deciding farmer. Therefore are those statements of tax benefits not included in the assessment of the different alternatives but nevertheless could motivate farmers to decide in a particular way.

So far, the different mechanization strategies now have been introduced and explained. For the purpose of getting a better overview, all alternatives are concentrated in the following Table 1 including a summary of their assets and drawbacks known in literature.

**Table 1: Overview of mechanization strategies**

<b>Mechanization Strategy</b>		<b>Description</b>	<b>Advantages</b>	<b>Disadvantages</b>
In-sourcing	<b>Ownership</b>	Purchase of required machinery and provision of labour by farmer	control over machine control over quality high flexibility independent of others reduced work pressure	High investment Capital required and tied Affects liquidity Maintenance responsibility Labour and time demanding Tied to purchased technology
	<b>Renting</b>	Rent of machinery for short period from machinery pool charged by rental fee	control over machine control over quality no capital required Access to specialized equipment Trial of new technology Short time capacity increase Flexibility towards strategic changes	No equity build up Limited machine availability Uncertainty about machine condition Increased maintenance costs Labour and time demanding
	<b>Leasing</b>	Renting of new equipment over longer period by one farmer	control over machine control over quality high flexibility No capital required Access to new equipment regularly Guaranty on machine Advantages over renting: mechanical condition known and favourable over long run	No equity build up unless purchase after leasing period More costly than purchase in long run Maintenance responsibility Labour and time demanding
outsourcing	<b>Service Provider</b>	Agricultural machinery services are not executed by the farmer himself, but by service providers delivering required machines and simultaneously operators	No capital required Saves working time/ labour professionalism new technology used high performance maintained equipment complete working chain offered	Limited machine availability Low flexibility Requires early planning No influence on quality Might miss optimal work execution time
In-/ or outsourcing	<b>Machine sharing</b>	Farmers cooperate in agricultural machinery services by purchasing and sharing required equipment together	Control over machine control over quality Earlier affordable, less capital demanding Access to modern technology Teamwork through cooperation Sharing of responsibilities, tasks	Capital required and tied Affects liquidity Limited machine availability Less flexibility Requires adequate organization Longer decision process Maintenance responsibility Treatment of machine

(Source: own elaboration of literature review)



## 4.2 Key aspects of mechanization evaluation

By reviewing the alternatives of mechanization strategies on farms with a focus on their advantages and disadvantages, it can be recognized that some points of arguments recur. These points differentiate the introduced alternatives and hence appear to be key aspects of decisions-making. The following Table 2 depicts these key aspects from the evaluation of alternatives made in the previous sub-chapters and describes them based on their characteristics highlighted in the same chapter.

**Table 2: Key aspects of mechanization evaluation**

Key aspects	Description
Financial consideration	Every mechanization strategy involves financial consequences. While ownership and leasing requires farmers to fund machines over longer period, outsourcing and renting causes costs only for the period a service is performed.
Flexibility	Several agricultural machinery services can only be performed at certain time periods. Missing these time periods would imply reductions in quality and/or quantity which resulting in timeliness costs. Flexibility refers to the extent that farmers can decide when and where agricultural services can be performed. A farmer having his own machines hence is high flexible, while a farmer depending on his operator's schedule is flexible to a lesser extent.
Labour availability	In-sourced machinery services require labour forces for operating. Therefore the farmer himself, his employees or additionally hired personnel need to be provided for executing the service unless they are not outsourced. Labour forces need to have adequate skills and under some circumstances also certificates for operating legally.
Time availability	Performing agricultural services also requires time for the specific tasks in which either other things cannot be done or tasks were completed to the expenses of leisure time by increasing work load.
Quality requirements	The person who has the control over the machine influences the quality and quantity of the service performed, as he can determine factors like way of operating, machine settings, etc.
Machine maintenance	Since agricultural machines were used intensively over more years, their technique had to be maintained and defects to be repaired. Negligence of maintenance results in inadequate working machinery affecting their functionality. Depending on the mechanization strategy, farmers have, should take or do not have the responsibility to maintain the machine.

(Source: own elaboration)

The key aspects listed in Table 2 are relevant arguments for each introduced mechanization strategy since they occur either as advantages or as disadvantages in the assessment. It is obvious that deciding farmers need to make some kind of compromise in these key aspects as none of the previous identified mechanization alternatives includes only advantageous characteristics. It is now of relevance on which ground farmers analyse the different mechanization strategies and which determinants thereby seem to be of importance.

On the base of the information examined in this chapter, the next chapter therefore will focus more on the process of decision-making of farm managers with a particular focus on choosing amongst the mechanization alternatives. The key aspects listed above will be picked up separately in the next chapter where the so far listed information will be elaborated into theoretical determinants that may influence decisions. This in turn means that those determinants affect all mechanization strategies as they are based on these key aspects. In other words, the derived determinants are not only relevant for one or a few mechanization strategies but rather influence the evaluation of all alternatives.

## **5. Theoretical determinants of decision-making**

So far, this research has explained the general understanding of farm's strategic compositions and thereby has placed the decision of how to execute agricultural machinery services into the field of functional strategies (see chapter 3). The issue for farmers hence is the need to get farm operations done for which several alternative mechanization strategies exist. Those are explained and assessed in Chapter 4 by the confrontation of their advantages and disadvantages. At the same time, Chapter 4.2 has elaborated key aspects that may influence the decider in the comparison of these alternatives.

The next steps that follow for a farmer considering how to perform his agricultural services comprise the analysis of the alternatives and the final decision-making. Although previous researches have shown that farmers are not necessarily only economical driven, scientific analysis respectively assessments of mechanization strategies, as it is already stated in the introduction, are mainly limited to financial considerations while other, non-financial influences are less investigated causing a knowledge gap. This research aims to close this gap by exploring all determinants that influence farmers' decision-making process.

In order to meet this object, Chapter 5 elaborates such determinants theoretically by the embedment of the findings of previous chapters and the help of an increasing scientific understanding of farmers' decision-making process which has been developed over the last years. This scientific understanding of farmers making their decision is summarized in Chapter 5.1. The subsequent sub-chapters then derive theoretical determinants which then are confronted with the findings of the interviews made in the agricultural practice.

### **5.1 Scientific research on farmers' decision-making**

This sub-chapter gives an overview of the scientific process of understanding farmers' decision-making and transfers it to the subject of this research, i.e. the decision of how to execute agricultural services.

Following EDWARDS-JONES (2006, p.783), who reviewed the scientific research on farmer's decision-making, traditional understandings of how decisions evolve were based on the purpose that deciders wanted to maximise utility. Since utility was hard to depict in reality, researches used profit as indication for utility and thus assumed farmers seeking to maximize profit (EDWARDS-JONES, p.784).

Transferring this assumption to the question which mechanization strategy should be followed, farmers would analyze all options and choose that one causing the lowest cost for performing agricultural tasks as this is one way to increase profit. From this point of view and

the fact that financial considerations has occurred as key aspect in the evaluation of mechanization strategies (see Chapter 4.2), it is claimed that the financial determinant plays a significant role in farmer's decisions. Therefore, Chapter 5.2 introduces it as the first theoretical influencing factor of farmers making decisions.

However, EDWARDS-JONES (2006, p.784) clearly reviews that the assumption of profit-maximization is not consistently valid. He underpins this statement with the argumentation that profit is not necessarily equal to utility but rather is regarded as well as weighted differently amongst people and thus states that decisions are also influenced by non-financial aspects. In case of mechanization decisions this implies that farmers do not choose options purely based on cost-efficiency but that there are also non-financial determinants playing a decisive role. In the review of BRASE and LADUE (p.26, 1989) it is already noted that such non-economic aspects are accepted to have influences on farmers decisions. Furthermore it states a composition of economic, social and psychological factors as important in affecting farmer's decision-making (BRASE and LADUE, p.26, 1989). GARFORTH (p.66, 2010) also concludes in his study on farmers' behaviour that those cannot simply be predicted on the basis of economical rationality. Hence, any decision explanation restricted to financial motivations is seen as insufficient acknowledging the fact that other factors obviously exist. Economic considerations, however, still have an important role as, according to EDWARDS-JONES (p.784, 2006), they determine the financial constraints to any decision made.

Referring to MURPHY (p. 94, 2012) scientific researches in the field of farmer's decision-making therefore made increasing attempts to explore influencing factors by including decision behaviour findings from other disciplines, like psychology and sociology.

The first researches using this approach found at least five non-financial variables influencing farmers' behaviour in adopting environment schemes (EDWARDS-JONES, p.784, 2006). Three of them are personal related, namely farmer's characteristic that includes factors like age, education, risk attitude and personality, farmer's household influenced by the stage of family cycle, the existence of other jobs and potential work patterns of the spouse, and farm structure expressed by the type, size and financial condition of farming business. The fourth variable called social milieu includes aspects like amongst others the flow of information, social attitudes, opinion of trusted friends, policy environment and institutional impacts. The last variable describes the characteristics of the product or measure itself to be adopted (MURPHY, p. 94, 2012).

Next to these five variables and the financial aspect of adaption decisions, EDWARDS-JONES (p.785, 2006) states that also the psychological make-up of farmers play a role in making

decisions. This psychological aspect is narrowed down to the attitudes of farmers (EDWARDS-JONES, p.785, 2006). Attitude thereby is defined by WILLOCK et al. (1999a) as “a positive or negative response towards an attitude object (...)” or according to EAGLY and CHAKIEN (1993) as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour”. They are formed by individual beliefs based on knowledge and/ or emotions. Research on farmer’s attitudes has received much attention in agricultural science as they are believed to form behaviours significantly (EDWARDS-JONES, p.785, 2006).

Referring to the study of AUSTIN et al. (2005), MURPHY (p. 94, 2012) mentions that attitudes indeed appeared to have influences on farmers’ behaviour and that they correlate with the variables explained before, particularly in combination with questions related to the farmer’s characteristics.

This context of farmer’s personal set-up, attitudes and behaviour therefore has been further developed and has found its modelling in the Theory of Planned Behaviour (MURPHY, p. 94, 2012). As the relations between its different factors have been proven in several studies (MATTARELLI, p.10ff, 2007), this model has managed to achieve important insights in farmers’ decision behaviour (EDWARDS-JONES, p.786, 2006). Therefore, it will be specified in the following section and its insights will be used in the further research.

### **5.1.1 Theory of Planned Behaviour**

The Theory of Planned Behaviour describes an interaction of three main aspects that influence the behavioural intention of farmers, namely attitudes, subjective norm and perceived behavioural control (EDWARDS-JONES, p.786, 2006). According to MATTARELLI (p.7, 2007), this model is an improvement of its precursor Theory of Reasoned Action and has been developed to understand and predict not only those influences on behaviours that are under volition control of the decider but also those that cannot be controlled.

Central in the Theory of Planned Behaviour is the behavioural intention which leads to the actual behaviour and results from the influences of the three main aspects mentioned above (VOGEL, p.6, 1997). The two aspects attitudes and subjective norm were already included in the Theory of Reasoned action. According to MATTARELLI (p.4, 2007), attitudes reflect the decider’s expectation concerning the outcome of the considered behaviour. Those expectations are based on prior evaluations (VOGEL, p.5, 1997), wherein subjective values play a crucial role (MATTARELLI, p.5, 2007). WILLOCK et al. (p. 287, 1999b) highlight the influences by factors like personal goals, farm structure and family situation which relate to

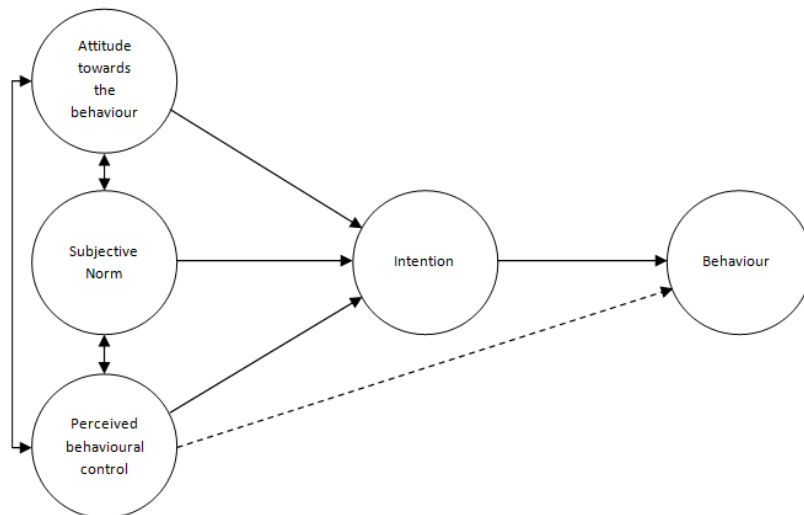
the five variables mentioned earlier. Important for the strength of the aspect attitude hence are the attitudes towards the considered behaviour, the evaluation of its outcome and the degree of conviction whether the outcome occurs (MATTARELLI, p.5, 2007). However, as WILLOCK et al. (p. 288, 1999b) already noted earlier, a prediction of behaviours cannot be based purely on attitudes but also requires other aspects to be considered as well.

One of these additional aspects is the subjective norm which describes the decider's personal understanding of how for him important people think to behave (VOGEL, p.6, 1997). Deciders hence make assumptions, referred to as normative beliefs, about whether for them decisive people endorse or refuse the considered behaviour. The influential intensity of those normative beliefs depends on the motivation of deciders to act as expected (MATTARELLI, p.6, 2007).

However, the Theory of Reasoned Action with its modelling of attitudes and subjective norms was not capable of explaining a range of farmers' behaviours. According to (MATTARELLI, p.6, 2007) this results from the negligence that the decider is not in each case able to have full control over the behaviour itself, especially then when factors like time or opportunities come into play (MATTARELLI, p.6, 2007).

For this reason, the Theory of Planned Behaviour has been supplemented with the aspect called perceived behavioural control. This improved model therewith includes the consideration of available resources to which belong amongst others factors like time and money. Hence, external conditions that strengthen or degrade the intention to behave are included enabling a wider view in understanding decision behaviours. The assessment whether resources act positive or negative towards the behaviour thereby results from the perception of the decider and is based on his personal beliefs (VOGEL, p.6ff, 1997). MATTARELLI (p.10, 2007) mentions, that the behaviour also can be influenced directly by the behaviour control. This is the case, when the behaviour is not only depending on the motivation but also on whether controlling the behaviour is feasible.

In a nutshell, the Theory of Planned Behaviour, which is illustrated in Figure 2, describes the influences on farmers' decision of how to behave.



**Figure 2: Theory of Planned Behaviour**

(Source: adapted and modified from AJZEN (1991))

Central to this theory is the intention to behave in certain way. This intention results from the independent or combined influences of the following three main aspect as indicated by the arrows in Figure 2: the farmer's attitude towards the considered behaviour which depends on the farmer's personality and his assessment of the behaviour outcome, the subjective norm which is the decider's motivation whether to follow the behaviour desired by other people and therewith includes social aspects, and the perceived behavioural control which includes the assessment of available resources on whether they reinforce or limit the intention or the considered behaviour directly.

As mentioned earlier, the Theory of Planned Behaviour has been confirmed in several studies (EDWARDS-JONES, p.785, 2006) and therewith was able to depict the influences on farmer's decision-making of how to behave. For that reason, this research employs the theory as basis framework for the identification of non-financial determinants following the persuasion that the key aspects derived in Chapter 4.2 can be differentiated to the three main aspects of the theory. This persuasion is founded in the variety of key aspects, as some refer either to the availability of resources, like time availability, whereas others are more related to personal attitudes and beliefs, such as flexibility or quality considerations. Furthermore, the Theory of Planned Behaviour includes social influences as expressed by the subjective norm and therefore allows investigating whether they can impact the behaviour in executing agricultural services. The behaviour in the end reflects the chosen mechanization strategy of the farmer.

Therefore, while Chapter 5.2 explains the financial determinant of choosing agricultural services, Chapter 5.3 focus on the non-financial determinants by developing the remaining

key aspects of Chapter 4.2 into theoretical determinants differentiated by the three main aspects of the Theory of Planned Behaviour.

## **5.2 Financial determinant**

Since agricultural machinery has already a major share in total costs of farm businesses (EDWARDS, p.1, 2005), it seems comprehensible that farmers want to minimize those costs. Assuming a decision of mechanization strategies is thus purely based on which of the options listed in Chapter 4 causes the lowest costs (KIME et al., p.1, 2014), it requires the analysis of the total cost implied with the various ways of performing agricultural services. Yet, the question arises how the costs of agricultural machinery are composed. Therefore, this sub-chapter uses the option of ownership as starting point of assessment and explains the scientific known aspects and cost factors that are crucial for farmers to take in to account while analysing the different mechanization strategies. Additionally, it highlights the importance of machine utilization and illustrates its effect on the total costs with increasing utilization.

### **5.2.1 Machine ownership costs**

Referring to KIME et al. ( p.2, 2014), the total costs of operating own equipment is the sum of the ownership costs at the one hand and variable or also known as operating costs at the other hand. They start with the purchase of equipment and occur as long as the machine is owned (LAK and ALMASSI, p.144, 2011). That is why an analysis of these costs needs to include the estimation of cash flows over several years (BLANK et al., p.33, 1991) in order to secure farm's liquidity.

**Ownership costs** are composed of the factors depreciation, interest on investment, taxes, insurances and housing costs. These costs can also be seen as fix costs since they occur whether or not the purchased machinery is used (KIME et al., p.1, 2014). Each of these factors is explained below.

#### **Depreciation:**

Machinery and equipment are assets whose investment values decrease over time. This reduction of value results from the aging of machinery and the therewith associated technical wear as well as technological obsolescence (EDWARDS, p.1, 2005).

Depreciation thereby is the method used to acknowledge this deterioration (LAK and ALMASSI, p.144, 2011) as a non-cash expense (PFLUEGER, p.2, 2005) in accountancy. Additionally, depreciation can be set off against tax liabilities (FEIFFER et al., p. 6f, n.k.) as already indicated in Chapter 4.



The popular method to calculate depreciation is the so called straight-line method. Thereby, the depreciation value is equal to the purchase price subtracted by the salvage value and divided by the useful life (PFLUEGER, p.2, 2005). The salvage value reflects an estimate of the future equipment value often based on the used market. It can also be zero when the farmer decides to use the machinery until it is worn out (EDWARDS, p.1, 2005). According to PFLUEGER (p.2, 2005), the useful life depends on the kind of machinery as well as its handling and usually lies between six or eight years.

### **Interest:**

As already is highlighted several times, the machinery ownership requires a significant amount of capital to be accessible in order to purchase it. If own capital is available and used for purchase, interest rates for lending of these capital should be accounted for as opportunity costs. Yet, if farmers do not have enough own capital available, investments can be financed by loans either partially or completely. In the latter case the lender sets the interest rate while when machinery is financed with a combination of own and loaned capital, the interest rate is an average of both, the equity yield rate and the interest on borrowed capital (EDWARDS, p.3, 2005). However, for farmers it is important to calculate the interest loan high enough to cover the expenditures for interest paid (PFLUEGER, p.2, 2005). According to PFLUEGER (p.2, 2005), the average annual interest to be paid equals the half of the purchase price subtracted by the salvage value multiplied with the interest rate.

### **Insurance, taxes and housing:**

Additional fix costs that occur with the ownership of machinery result from insurances, potential taxes and housing costs. They have, however, less financial relevance than the factors depreciation and interest on investment, but should be included in any calculation as they still cause expenses (PFLUEGER, p.2, 2005).

Farmers that either have to cover insurance liabilities or want to secure their machines against risk factors such as damages, accidents or theft have to carry the cost of those insurances (KIME et al., p.2, 2014). Those costs depend on the investment required, the kind of machine as well as kind of insurance (PFLUEGER, p.2, 2005).

Taxes may occur and have to be considered since owned machinery increases the farmer's property. Tax expenditures resulting from machinery property are estimated around one percent of the machine's purchase price. However, whether and how such taxes occur depends on the country and state where the farmer operates (EDWARDS, p.4, 2005).

Housing costs should be considered when the farmer covers the machinery within a kind of shelter in order to protect it from the environment (KIME et al., p.2, 2014). Covering the

machinery has positive effects on the repair and maintenance costs and results in higher reliability. Moreover, the trade value and hence the salvage value of the equipment is expected to be higher as the machinery is assumed to be in a better condition (EDWARDS, p.1, 2005).

According to PFLUEGER (p.2, 2005), the sum of the insurance, tax and housing costs are roughly estimated at 2% of the machine's purchase price. Adding this sum to the depreciation and interest costs leads to the ownership costs.

The following part deals with the operating costs of machinery.

**Operating costs** are those costs that are implied with the use of a machine (KIME et al., p.2, 2014) and are composed of labour, maintenance and repair as well as fuel and lubrication costs (EDWARDS, p.4, 2005) which are further explained below. They are also known as variable costs and can in contrast to ownership costs be zero in case the machine is not used (KIME et al., p.2, 2014). Operating costs vary with the use of equipment (PFLUEGER, p.2, 2005) and are influenced by its size and efficiency as well as the level of maintenance (KIME et al., p.2, 2014).

**Labour costs** is a crucial aspect in the composition of machine costs as they account for a major share in total costs (KIME et al., p.2, 2014) which is important for comparison with other mechanization strategies (EDWARDS, p.6, 2005). Labour costs usually are based on the hour wages which depend on the operator skills required (EDWARDS, p.6, 2005) and additionally aspects like benefits, taxes and payroll overhead (PFLUEGER, p.2, 2005). Important to incorporate is the labour adjustment factor (PFLUEGER, p.2, 2005) which considers the fact that the amount of working hours usually is higher than the machine performs due to factors like travel time or time for maintaining the machinery (EDWARDS, p.6, 2005). PFLUEGER (p.2f, 2005) therefore estimates the actual labour hours by adding about 10-20% of machine use time.

**Maintenance and repair costs** occur due to the regularly maintenance of machinery and required repairs caused by wear and tear or unexpected damages (EDWARDS, p.4, 2005). These costs vary with the type of machinery, its age and with its level of maintenance. Repair costs are usually lower in machines' younger years but will increase with time due to attrition causing an increasing amount of parts to be replaced (KIME et al., p.2, 2014). Moreover, EDWARDS (p.4, 2005) highlights that on the one hand geographical conditions such as the soil type, terrain or climate influences machine repair costs differently. For example, machine working on rocky soil types probably will wear off faster requiring replacements earlier and maybe more often than the same machine on easier soil conditions. On the other hand

EDWARDS (p.4, 2005) claims local conditions important for repair costs since farmers follow different ways of management and machine treatment.

Repair costs can either be calculated based on own records or if those are not available should be estimated with the help of known averages of same or comparable machines (EDWARDS, p.6, 2005). PFLUEGER (p.3, 2005) introduces several rules of thumbs regarding the calculation of repair costs, such as three percent of purchase price for machines younger than five years but highlights simultaneously that those estimations should be adjusted by acknowledging own conditions and experiences.

**Fuel and lubrication** is required to run and maintain the equipment. Fuel costs relate to the use of tractors or self-propelled equipment and vary with the kind and size of engine, load, operating speed of machine and the field conditions where the machine operates. Fuel costs are calculated by knowing the consumption rate per hour either from personal experiences or by using known averages of same or comparable equipment (PFLUEGER, p.2, 2005). Lubrication costs however are often estimated by using the rule of thumb which charges 10-15% of fuel costs for lubrication of tractors or self-propelled machinery (KIME et al., p.3, 2014) and 5% of purchase price for other equipment (PFLUEGER, p.2, 2005).

Summing up the ownership costs and the operating costs with each of their items listed above allows calculating the **total costs** per unit of owning machinery (EDWARDS, p.6, 2005). With this information it possible to compare the option of owning machinery with the other various alternatives mentioned in Chapter 4 based on their charge rates. The identification of these charge rates has been the subject of many surveys in different countries and therefore should be easily found.

### 5.2.2 Adjusting machinery costs

Within the economically analysis however, LAK and ALMASSI, (p.144, 2011) additionally mention **timeliness costs** as important factor to consider. Timeliness thereby is defined as the optimal time period in which farm operations should be done (LAK and ALMASSI, p.144, 2011) in order to achieve the best results (PFLUEGER, p.5, 2005). Missing this time period, either because of too low performance of own machinery (LAK and ALMASSI, p.144, 2011) or due to a not in time availability of required machines (MUBHOFF and HIRSCHAUER, 2011), results in reduced quantity and/or quality of the crop (SCHULER and FRANK, 2005) and thereby implies the timeliness costs. They can, however, only be estimated and may have a wide variation (LAK and ALMASSI, p.144, 2011). Yet, farmers making a decision should take

into account timeliness costs by adjusting the charge rates of the various mechanization alternatives (PFLUEGER, p.2, 2005).

On top of that, PFLUEGER (p.2, 2005) puts forward to include **opportunity costs** in financial considerations, which arise when farmers' resources were not used in their most profitable way. They may occur, for example, when the capital used for purchasing own machinery would better pay off if it is invested differently (PFLUEGER, p.5, 2005).

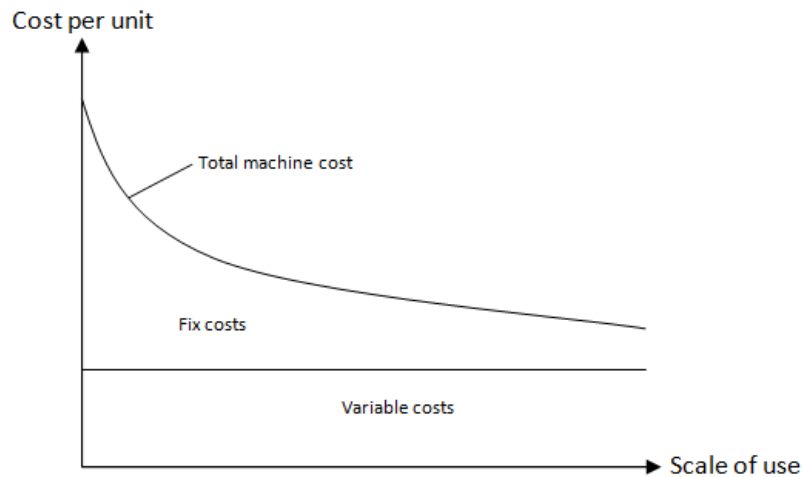
Both, the opportunity costs and the timeliness costs need to be included in the analysis of mechanization alternatives in order to create objective financial assessment.

### **5.2.3 The relevance of utilization**

As it is stated earlier, with the explained cost factors the total machine costs per unit, i.e. per hectare or per hour, can be calculated. For machine ownerships to be cost-efficient, however, it is necessary that the equipment can be utilized adequately as with increasing scale of machine use these costs per unit consequently decrease (GAZZARIN, p.2, 2010).

Utilization thereby describes the relation between a machine's actual use and its practical capability of performance which limits the utilization (LAK and ALMASSI, p.143, 2011). The practical capability of machines is depending on their maximum deliverable units of performance on the one hand and their expected useful life due to technical obsolescence on the other hand (BRANDES and ODENING, p.52, 1992). According to LAK and ALMASSI (p.143, 2011), the optimum utilization ratio depends on regional conditions, like equipment reliability and workability, but is located below the practical capability as thereby the timeliness risk (see Chapter 5.2.1) can be minimized (LAK and ALMASSI, p.143, 2011). According to BRANDES and ODENING (p. 52, 1992), an utilization higher than the practical capability is also possible but results in an earlier deterioration of the machine requiring the depreciation over fewer years which in turn increases the calculated costs per year.

The described cost reduction is based on the fact that the fix costs of ownership are spread over a wider scale of use (GAZZARIN, p.3, 2010) and is illustrated in Figure 3.



**Figure 3: Machine cost curve**

(Source: adapted and modified from GAZZARIN (2010))

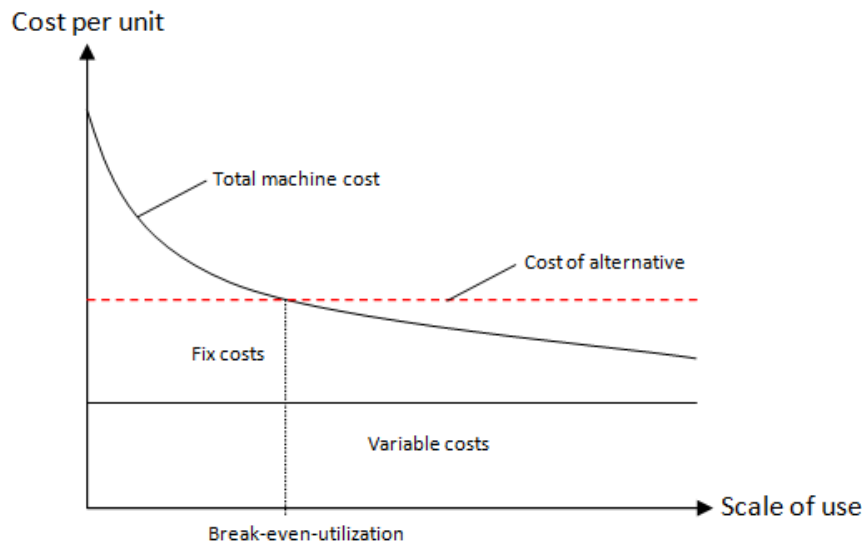
The figure shows that the total machine costs per unit decrease with an increasing scale the machine is used due to the reduction of fix costs whereas the variable costs remain constant per unit.

Based on this relationship of machine utilization and cost reduction farmers owning machinery are reducing the costs the more they can utilize their equipment.

#### **5.2.4 Cost-efficient mechanization strategy**

At this point, all known financial aspects that determine the decision to in- or outsource agricultural services have been highlighted as the costs of ownership are explained which in turn can then be compared to the costs of other mechanization strategies, i.e. the charge rates of custom operators or the rate for hiring machines.

Assuming now a farmer to be purely motivated by cost minimization, he consequently would choose that mechanization alternative that causes the lowest cost in executing his agricultural services. Chapter 5.2.2 already indicates that the cost assessment of owning machinery versus other alternatives depends on its utilization. Figure 4 visualizes this context.



**Figure 4: Comparison of mechanization costs per unit**

(Source: adapted and modified from GAZZARIN (2010))

In Figure 4 an assumed cost line of any mechanization alternative to ownership is added to the already known relationship between ownership costs and utilization. This cost line, for example, could base on the operator's costs for executing a certain machinery service, i.e. his charge rate per unit, and is assumed to stay constant. The figure shows that with a certain scale of use, the total cost of ownership is equal to the cost of alternative and with increasing use even falls below. In this research this point is called the break-even utilization.

According to PFLUEGER (p.3ff, 2005), who is comparing the ownership costs to the option of outsourcing, a machine investment is then economical reasonable when the total costs are comparable to or even below the custom rate of operators. Hence, any purely cost minimization motivated farmer that cannot utilize his machinery in a way that at least the break-even-point in Figure 4 can be reached, leaves the option to invest in own machinery but instead chooses the cheapest alternative, e.g. hiring the contractor.

GAZZARIN (p.2, 2010) additionally mentions that farmers might only consider the variable costs within their decisions as those are really noticeable as expenses while fix cost attributes like depreciation are not. In this case then, the option of ownership would be cost-efficient earlier (see Figure 4). Yet, GAZZARIN (p.2, 2010) contradicts this argumentation as the fix costs are sunk costs meaning that the investment has been done and spent capital is not available anymore and thus still need to be considered requiring farmers to compare options with the total costs of ownership.

The assumption of farmers to be motivated by profit-maximization then leads to the consequence that any decision on mechanization alternatives is traced back on the question: Is

the farmer able to utilize the machine in a way that it is preferable to other options and if not, which other option then causes the lowest cost.

However, Chapter 5.1 already showed that farmers are not deciding purely on economical grounds but instead choose options whose higher costs were accepted as they have advantages in other decision domains. That is why also non-financial determinants come into play and are therefore subject of the next sub-chapter. The financial consideration, however, remains crucial in the assessment of agricultural mechanization opportunities, as it is believed to limit the range of opportunities for deciding farmers (EDWARDS-JONES, p.784, 2006).

### **5.3 Non-financial determinants**

It is already mentioned several times, that non-financial determinants which influence farmers' choice of agricultural services were rarely investigated and therefore are the objective of this research. Hence, this sub-chapter presents non-financial determinants that are derived theoretically based on the key aspects identified in Chapter 4.2. These determinants are furthermore differentiated based on the researcher's persuasion to the three main aspects of the Theory of Planned Behaviour which is explained in Chapter 6.1.1. The following sections introduce the non-financial determinants divided by these three main aspects, namely attitude, subjective norm and perceived behavioural control.

#### **5.3.1 Attitudes**

Chapter 4 illustrates that the opportunities in executing agricultural machinery services a farmer can choose from vary in many aspects and have different impacts on the way of working. Therefore, farmers' attitudes towards the consequences of these options are of relevance. Chapter 5.1 already introduced attitudes to be depending on the evaluation of the outcome of the behaviour, i.e. mechanization alternative chosen. Within this evaluation subjective values that are influenced by several individual related factors, such as amongst others farming strategy, personal goals, farm structure or working situation, shape the attitudes of farmers. From the key aspects summarized in Chapter 4.2, the following determinants can be derived whose importance for the mechanization strategy choice may be affected by the farmer's attitude. In other words, farmers' differing attitudes towards these determinants may result in varying preferences for mechanization alternatives.

**Quality requirements:** The technical machine setting of the agricultural machines and their handling influence the quality and quantity of services performed. The person who is controlling the machinery hence can influence the quality delivered by for example defining the working speed, machine settings and the way how the task is performed. Farmers who

have high quality standards may prefer own, carefully selected machinery in order to have the machine settings and its handling in their own responsibility assuming service providers performing agricultural tasks are focused on speed rather than on quality. Contrary, farmers may appreciate the high standard of technology usually used by contractors or machinery rings assuming them to deliver higher qualitative results compared to own equipment. It depends on the attitude of deciding farmers and how they evaluate the expected quality outcome of the different mechanization strategies.

**Flexibility:** Several farm operations can only be executed within a small period of time. Missing these adequate time periods results in timeliness costs caused by quality or quantity reductions, for example of the harvested crops. An in-sourcing farmer, in particular when having own equipment can decide on his own when, where and for how long a particular farm operation is performed and thus is assumed to be high flexible. This flexibility decreases the more farmers are depending on required machinery that is also used on other farms which is the case with machines of contractors or rentals. It depends on the attitude of farmers how they value the gained flexibility through investing into own machinery.

**Machine maintenance:** Agricultural machinery is exposed to wear and damages. In order to support their functionality, maintenance, technical services and repairs are required. They are, however, costly and time demanding. For a professional service provider the machine maintenance belongs to his business as he makes profit with his performing machines. Farmers, in contrast, usually make profit by selling their agricultural commodities. Having own machinery for them implies to have the maintenance responsibilities on top of their usual business. Hence, farmers regarding machine maintenance as obstacle or already have enough to do on their farm probably will refuse own mechanization and instead will focus on service providers or machine hirers that are assumed to offer technical proper machinery.

### 5.3.2 Subjective Norm

As revealed by the Theory of Planned Behaviour, behavioural decisions are also affected by the social environment of farmers. Thus, deciding farmers reflect the opinions on behaviours of for them important people. How much influence this subjective norm can have thereby depends on the motivation of the farmers to act accordingly. Although the aspect of social environment has not occurred during the assessment of machinery, it has been explored in other researches that have proven its influence. Therefore, social influence is also included in this research as theoretical determinant affecting farmers' behaviour.



**Social influences:** The research from WRO (p.60, 2011) has found that social dynamics influence farmers making their decision. On the one hand, social contacts provide relevant information and determine how these were processed. Family members, friends and farmer colleagues are here important parties to gather and discuss information with (WRO, p.60, 2011). Furthermore, farmers in the same location can observe and assess the results of their peers' activities easily. On the other hand however, this may lead to a prevailing kind of social pressure while farmer's make decision (WRO, p.60, 2011). Both aspects of social influences may affect farmer's decisions in choosing a mechanization strategy. The discussed information from the farmer's social environment and the observation of mechanization strategies followed by other farmers may influence his behavioural intention. For example, farmer colleagues that see the local operator to be a very efficient service provider and claim within conversations with farming colleagues that other mechanization strategies would cause too much effort therefore might create a positive perception towards the operator. Simultaneously, the obviously made observations of these peers might indirectly create the pressure that choosing alternative mechanization options would be regarded as irrational forcing the decider to follow the recommended strategy. Having farmer colleagues thus opens the opportunity to learn from what they have experienced but also might generate a kind of social pressure on decisions (WRO, p.60f, 2011). However, farmers may also want to resist the recommendations of peers in order to demonstrate a self-dependent appearance (WRO, p.61, 2011) or simply by persuasion in the benefits of other mechanization strategies. This relates to the motivation incorporated in the Theory of Planned Behaviour as it determines whether or not the decider wants to follow the behaviour desired by important social contacts. Although social influences are believed to affect farmer's decisions and the extent to which they influence may differ amongst farmers, the study of WRO (p.62, 2011) showed that farmers still decide trying to do the best to their farms. Nevertheless, the study highlighted that social influences need to be considered in farmers' decision-making process.

### **5.3.3 Perceived Behavioural Control**

As mentioned earlier, perceived behavioural control includes the decider's personal assessment of resources that either strengthen or degrade the intention to behave in a certain way. On the base of personal beliefs, the farmer hence evaluates the resources available on his farm and thereby influences his intention how to perform agricultural services. In the following sections, theoretical determinants are introduced that relate to the availability of

resources to the farmer and that are derived from the key aspects of assessing mechanization strategies (see Chapter 4).

**Labour availability:** Performing the farm operations requires operators to handle the machinery. Farmers wanting to incorporate machinery services into their own responsibilities therefore need to have work forces available. Those labour forces can be provided by the farmer himself, his family members, employees or additional hired personnel under the condition that they have required skills and certificates. If those work forces, however, cannot be allocated to perform the agricultural service or farmers are not willing to provide labour for such services, they are forced to outsource the operations as service providers simultaneously deliver adequate operators.

**Time availability:** Performing agricultural services on own responsibility requires available working time for the farmer or his personnel. Farmers, however, are obligated to perform several tasks on their farms that are not necessarily related to the operation of machinery. Additionally, different machinery operations may be placed in the same time period, for example the harvesting of different crops in the same month. If working time cannot be allocated adequately, the farmer's work load increases and at a certain moment either important other tasks may suffer or leisure time is used to finish all obligations on farm.

It depends on the evaluation of the deciding farmer himself whether he experiences the resources labour and time determinants as obstacle against a certain behaviour, i.e. mechanization opportunity, or whether they allow them to further follow his behavioural intention, i.e. desired way of performing agricultural services.

## **5.4 Overview of theoretical determinants**

So far, all of the introduced determinants that may affect farmer's decision-making in the question of whether to in- or outsource agricultural services were derived theoretically in the previous sub-chapters. The following Table 3 gives an overview of those determinants combined with a short explanation. Furthermore, it includes keywords that characterize these determinants based on the knowledge derived in the previous chapters. These keywords serve as indicators within the field research of confronting the farming sector because their occurrence within interviews allows to make conclusions about the determinants relevant for agricultural practice.

In order to explore those determinants that are important to farmers, the next chapter formulates propositions that confront the theoretical determinants with the agricultural practical handling in mechanization decisions.

**Table 3: Overview of theoretical derived determinants**

<b>Determinant</b>	<b>Characterization</b>	<b>Keywords</b>
Financial Determinant	Describes the financial consequences of different mechanization strategies	<ul style="list-style-type: none"> <li>- ownership and operating costs</li> <li>- total costs</li> <li>- timeliness costs</li> <li>- opportunity costs</li> <li>- utilization</li> <li>- capital availability</li> </ul>
Quality requirements	Refers to the expected qualitative outcome of the agricultural services performed	<ul style="list-style-type: none"> <li>- technology standard</li> <li>- machine setting</li> <li>- way of operating</li> <li>- quality delivered</li> </ul>
Flexibility	Describes the extent to which farmers are depending on others in conducting the farm operation	<ul style="list-style-type: none"> <li>- setting own operating time and length</li> <li>- machine availability</li> </ul>
Machine maintenance	Describes the necessity to service and repair machines to ensure functionality	<ul style="list-style-type: none"> <li>- maintenance (time demanding)</li> <li>- repairs (time demanding)</li> <li>- service availability</li> </ul>
Social influences	Refers to the influences of farmers' social environment on their decision	<ul style="list-style-type: none"> <li>- information provision</li> <li>- assessment of peers' activities</li> <li>- recommendation of peers</li> <li>- social pressure</li> </ul>
Labour availability	Describes the necessity to provide operators for conducting agricultural services	<ul style="list-style-type: none"> <li>- labour availability (family members, employees, hired personnel)</li> <li>- willingness to provide operators (allocating own or hire additional personnel)</li> <li>- required skills and certificates</li> </ul>
Time availability	Refers to the time required for conducting agricultural services	<ul style="list-style-type: none"> <li>- available working time</li> <li>- other farm obligations</li> <li>- work load</li> </ul>

(Source: own elaboration)

## 6. Research propositions

The last chapter has introduced several theoretically derived determinants on financial grounds as well as on the base of the three main aspects of the Theory of Planned behaviour, namely attitudes, subjective norm and perceived behavioural control. Those serve as theoretical background to confront the decision-making process of farmers when choosing their way of conducting agricultural services since it is the object of this research to explore the determinants that are of relevance for the agricultural practice.

The following propositions about these theoretical derived determinants that influence the farmer's choice of mechanization strategy are formulated. They serve as guidance in the field research in order to confirm, reject or complete the derived determinants including their characteristics.

### **Proposition 1:**

*Besides the financial evaluation of mechanization alternatives a farmer considers also other non-financial determinants that influence his decision-making.*

As the initial claim of this research is that farmers are not only driven by cost minimization, Proposition 1 proves whether indeed other factors that are not directly cost related influence farmers in deciding amongst mechanization strategies.

Based on this proposition, the literature review has derived the following additional non-financial determinants, which have been allocated according to the three aspects of the Theory of Planned Behaviour.

Accordingly, the following determinants are assumed to be based on the farmer's attitude.

### **Proposition 2:**

*Quality requirements influence the farmer in choosing a mechanization strategy.*

Farmers that have high quality requirements will choose that mechanization alternative that is expected to deliver the best results, which for example might depend on the technology used or the way of operating.

### **Proposition 3:**

*The required extent of flexibility affects the choice of mechanization strategy.*

Machinery services that require being highly flexible in setting time and length of operating are in-sourced.

**Proposition 4:**

*The necessity to maintain machinery affects the choice of mechanization strategy.*

Farmers that do not have enough time or are not willing to service the machinery required will tend to rent or outsource machinery.

The next determinant bases on the perception that farmers develop decisions influenced by their social environment.

**Proposition 5:**

*The social influence of farmers affects their evaluation of mechanization alternatives.*

Recommendations or comments of important people for the farmer about certain mechanization strategies influence farmers in their decision-making process depending on their willingness to act as suggested.

The last determinants are based on the farmer's assessment of his available resources which is referred to as perceived behavioural control in the Theory of Planned Behaviour.

**Proposition 6:**

*The availability of labour limits the farmer in his choice of alternatives.*

Farmers that cannot distribute enough labour forces required for in-sourcing machinery services will outsource their farm operations.

**Proposition 7:**

*The availability of time for farm operations limits the choice of alternatives.*

Farmers with a range of other farm obligations or a high degree of work load will tend to outsource machinery services.

The listed propositions contain the determinants that have been derived theoretical. It is the aim of the following field research to confront these propositions with the agricultural practice in order to elaborate which of the determinants are of importance during the decision-making process of farmers.

## **7. Results**

The object of this study is to elaborate the determinants that influence farmers in their decision of whether to in-or outsource agricultural machinery services. The previous literature study has compiled seven theoretical derived determinants that might affect farmers in their decision-making. The following field research, in which the agricultural practice was addressed, is applied in order to prove these determinants and to examine as well as characterize those that are of importance for farm managers in deciding between in-or outsourcing of machinery services. The base of this field research is build by semi-structured, in-depth interviews which have been conducted with farmers and service providers located in Germany and the Netherlands. This chapter depicts the results of these interviews. Therefore, its sub-chapters provide a brief characterization of the participating representatives of the agricultural practice as well as a summary of the executed machinery services on farms and finally describe the findings of addressing the decision determinants. The respondents were denoted based on their country of origin and their kind of business, i.e. the abbreviation G2 stands for a farmer from Germany whereas SN1 is a service provider from the Netherlands. The summaries of these interviews can be found in the Appendices E and F.

### **7.1 Characterization of respondents**

Starting with a focus on the responding farmers of this research, in total eight farm managers have been interviewed on their decision-making process regarding the followed mechanization strategies on their farm. Four of them are located in the region Samtgemeinde Emlichheim in Germany whereas the other four live in the region Gemeente Emmen in the Netherlands. The youngest respondent was a 21 years old farm manager whereas the oldest interviewee was a 62 years old senior farm manager. All of these farmers were educated as agricultural master which is an agricultural education of about several years allowing the graduate to manage farms as well as to train apprentices. The work experiences of the respondents on their farms lay between three and 45 years.

The farms differ in their agricultural production strategies but all include some form of arable farming. While all German farms were mixed in their operations and thereby often had a focus on milk production and arable farming, only two Dutch farms followed the same strategy whereas the other two farms were specialized arable farms. The area cultivated of the interviewed farms range from 45 to 117 hectares in Germany and from 71 to over 300

hectares in the Netherlands. Typical cultivated crops thereby were besides grass and maize for forage purposes, also maize, potatoes, sugar beets and grain for marketing.

Most of the works on these farms were executed by the farmers themselves, their successive farm managers or family members. From eight farms only two have a non familiar, full-time employee and one farm has each year one trainee available as helping labour force. Table 4 summarizes all characteristics of participating farmers.

The service providers that have been interviewed in order to include a more external view on the mechanization decision of farmers can be characterized as follows.

In total three service providers were interviewed of which two were contractors and one is the head of a machinery rental organisation. Two of them, a contractor and a machinery rental, are active in the German region Samtgemeinde Emlichheim while the third service provider is a contractor located in the region Gemeente Emmen in the Netherlands. Based on the information available to the researcher it was not possible to interview a machinery rental in the Dutch region as there is none existing there.

The respondents were between 42 and 52 years old but have different educational backgrounds. Two of them have about 20 years of work experiences whereas the oldest has worked 31 years in his firm. All of the participating interviewees were employed as operative managers of their businesses and the two contractors were even business owners.

Looking at the kind of service they provide (see Appendix D, Q1-2), both contractors characterize their business in a similar manner. Accordingly, contractors provide the required machinery and simultaneously deliver skilled operators for normally all kinds of agricultural services that accrue on farms. They execute these activities after farmers have contacted them for arranging the time, place and kind of machinery service based on the contractor's schedule. Contrary, the operating manager of the machinery rental describes his service as offering agricultural machines and tractors for rent without an operator. The equipment can be rented for a certain period of time after making an arrangement based on the rental's schedule. For their services, the German contractor has about 250 yearly customers, whereas his Dutch colleague has 50 farming clients. The machinery rental provides his machines to about 600-700 farmers within one year. According to their own reports, the Dutch contractor sees himself as rather small contractor compared to others, while the German machinery renter indicates that their business is one of the biggest rentals in their rural district.

The following Table 4 gives a brief overview of the in total eleven respondents of this research.

**Table 4: Characterization of respondents** (Source: own elaboration of data)

Type of business and region		Respondent	Business information					information contact person				
			Type of business	Size indicators	Full-time labour forces	Cultivated crops/ offered services	Focus or Specialization	Position	age	education	Work experience (years)	Interest within business
Farmers	Germany	G1	Mixed farming operations	45ha acreage 80 dairy cows	Farm manager	Maize and grass (forage)	Dairy farming	Farm manager	45	Agricultural master	26	Arable farming and mechanization
		G2	Mixed farming operations	113ha acreage 100 dairy cows	Father and son	Maize, grass (forage), potatoes	Dairy and arable farming, biogas, chicken	Farm manager	62	Agricultural master	45	Dairy farming and mechanization
		G3	Mixed farming operations	100ha acreage 3.000 pigs	Father, son, employee	Maize	Pig finishing	Farm manager	56	Agricultural master	35	Pig farming
		G4	Mixed farming operations	117ha acreage 60 dairy cows 60 bulls	Farm manager, trainee	Maize and grass (forage), potatoes	Arable farming (potatoes)	Farm manager	46	Agricultural master	27	Potato cultivation
	The Netherlands	N1	Mixed farming operations	71ha acreage 200 dairy cows	Father and son	Maize and grass (forage)	Dairy farming	Farm manager	21	Agricultural master	3	Dairy farming and mechanization
		N2	Arable farming	200ha acreage	Father and son	Potatoes, sugar beets, maize, grain	Arable farming (potatoes)	Farm manager	57	Agricultural master	37	Potato cultivation
		N3	Arable farming	300ha acreage	Father, son, employee	Potatoes, sugar beets, grain	Arable farming (potatoes)	Farm manager	35	Agricultural master	15	Nearly everything
		N4	Mixed farming operations	155ha acreage 90 dairy cows	Father and sons	Maize and grass (forage), potatoes	60% dairy and 40% arable farming	Farm manager	28	Agricultural master	7	Dairy farming
Service providers	Germany	SG1	Contracting business	250 customers	-	All agricult. services	Everything in farming segment	Operating manager	52	Agricultural economist	31	-
		SG2	Machinery rental	600-700 customers	-	All kinds of machines for rent	Agricultural machinery rental except harvesting equipment	Operating manager	42	Agricultural master	19	-
	The Netherlands	SN1	Contracting business	50 customers	-	Several agricult. services	Arable farming (except forage harvesting) and earthwork	Operating manager	44	Intermediate technician	22	-



## **7.2 Accruing machinery strategies**

In the context of the field research farmers have been asked about the machinery services that accrue on their farms. Furthermore, they have been interviewed about how they currently execute these services and which mechanization strategies would be possible alternatives for them. Farmers then should indicate the advantages and drawbacks they notice in following their current mechanization strategies and additionally should specify their motivations of preferring them over the possible alternatives. The following section therefore concentrates on the accruing machinery strategies and then focuses on the motivations of farmers to follow them.

Focussing on the arable farming activities of the farms, all interviewed farmers of both regions have mentioned seed bed preparations, sowing and harvesting as machinery services that accrue on their farm. Additionally, seven of the in total eight farmers indicated plant protection measures as executed machinery tasks on their farm. The remaining farmer G1 also stated plant protection measures as normal farming activity but simultaneously mentions that those do not apply on his farm. A machinery service that is less often mentioned is the application of manure which is an organic fertilization measure. Three German farmers (G1, G3 and G4) and also three Dutch farmers (N1-3) have indicated this kind of fertilization as another activity that has to be executed on their farms. The other two farmers (G2 and N4) did not explicitly talk about fertilization.

Looking at the followed mechanization strategy, nearly every participating farm executes most of the accruing machinery services on their own and thus in-source these activities. The Dutch farm manager N1 even mentioned that almost all activities including the harvest of maize and grass were in-sourced except some rarely accruing activities. In contrast, farmer G1 indicated that the bigger part of his machinery services is outsourced to his contractor. Yet, he simultaneously mentioned that the decision of whether to in- or outsource these activities depends on the actual conditions on his farm. Those farms that execute their machinery services on their own vary in the followed strategy of in-sourcing. While the Dutch farmers and the German farmer G2 possess the machines required for their arable farming activities, the farmers G3 and G4 mention that they work with own but also rented equipment. Farmer G4 states more precisely that half of his in-sourced activities is performed with owned equipment whereas the other half is executed through rented machines. From all interviewed farmers, G4 furthermore indicated that he cooperates with a colleague nearby as he shares the ownership of harvesting equipment for potato and grass.

Those farmers, that have indicated to perform most activities on their own, mainly outsource the harvest of their crops, in particular the forage crops maize and grass. Exceptions to this are the potato farmers (G2 and G4, N2-4) as they all own or share potato harvesters.

The following Table 5 summarizes the accruing machinery services on the interviewed farms and shows in detail which mechanization strategy is employed to perform these activities.

**Table 5: Mechanization strategies on interviewed farms**

Respondent		Accruing machinery services	Followed mechanization strategy	
			In-sourced required machines are ...	Outsourced to ...
Germany	G1	Fertilization*	rented	-
		Seed bed preparation	owned	-
		Sowing	-	contractor
		Harvesting	-	contractor
	G2	Seed bed preparation	owned	-
		Sowing	owned	contractor (maize)
		Harvesting	owned (potatoes and grass mowing)	contractor (maize and grass silage)
	G3	Fertilization*	-	contractor
		Seed bed preparation	owned	-
		Sowing	partly rented	partly farming colleague
		Plant protection and care measures	owned	-
		Harvesting	-	contractor
	G4	Fertilization*	rented	-
		Seed bed preparation	rented	-
		Sowing	rented	-
		Plant protection and care measures	owned	-
		Harvesting	shared (potatoes and grass)	contractor (maize)
The Netherlands	N1	Fertilization	mostly owned	sometimes contractor
		Seed bed preparation	owned	-
		Sowing	owned	-
		Plant protection and care measures	-	farming colleague
		Harvesting	owned	-
	N2	Fertilization	partly rented	partly contractor
		Seed bed preparation	owned	-
		Sowing	owned	contractor (sugar beets)
		Plant protection and care measures	owned	-
		Harvesting	owned (potatoes)	contractor (sugar beets and grain)
	N3	Fertilization*	-	contractor
		Seed bed preparation	owned	-
		Sowing	owned	-
		Plant protection and care measures	owned	-
		Harvesting	owned	-
	N4	Seed bed preparation	owned	-
		Sowing	-	contractor
		Plant protection and care measures	owned	-
		harvesting	owned (potatoes)	contractor

(Source: own elaboration of data. \*only manure application mentioned)

During the interview farmers mostly mentioned identical working steps or respectively machinery services that accrue in the arable farming part of their businesses. Commonly employed mechanization strategies thereby are ownership, renting machines and outsourcing to contractors or in some cases to other farmers. It is interesting to note that the alternative of renting machines is, except farmer N2, not employed amongst the Dutch farmers. Instead, Dutch farms only outsource services to contractors or in-source them by purchasing the required machinery.

In this context, farmers were also asked which mechanization alternatives could be interesting for their farms and whether they plan to improve their actual strategy (see Appendix E, Q3-4). For the German farmers potential alternatives are ownership, renting and outsourcing to contractors. Farmer G3 also mentioned to cooperate with another farmer by sharing machinery. In contrast, the farmers in the Dutch region mainly mentioned outsourcing to contractors as a practical alternative to ownership. Although the option of machine renting is known to at least three of the Dutch farmers, they do not see it as realistic alternative as machinery rentals are rather too far away from their locations. In a nutshell, according to the German as well as the Dutch farmers' own reports, most of their actual performed farming activities were in-sourced. The choice of mechanization alternatives however is for most of the farms an actual decision, as they either recently have or continuously try to improve their mechanization strategy.

The motivations of farmers to follow their actual mechanization strategy were addressed in the next step of the interview (see Appendix E, Q5-7). At first, they have been asked about the advantages and disadvantages of their predominating mechanization strategy and secondly were asked why they had decided for their actual and against the alternative strategies. The following Table 6 lists the motivations given by the farmers.

Accordingly, most of the interviewed farmers are in-sourcing their agricultural services by using different alternatives (see Table 5), in particular in the Dutch region. Amongst all farmers interviewed there were no distinctive motivations identified which seem to be specific for a particular region. Instead, comparable arguments were mentioned in both regions.

**Table 6: Background of chosen mechanization strategy**

<b>Respondent</b> (predominating strategy)	<b>Considered mechanization strategy</b>		<b>Motivation of choice</b>
	<b>Advantages</b>	<b>Disadvantages</b>	
G1 (outsourcing)	Saves own working time	Higher costs	Creation of more time for other farm obligations
G2 (in-sourcing)	Independence/flexibility	Eventually higher costs (high repair costs)	Being flexible in adjusting to weather conditions
G3 (in-sourcing, if time available)	Variation of daily work Machines already owned Time available	Time demanding (compared to contractor)	Creates variety in daily work and machines are available on farm
G4 (in-sourcing)	Flexibility Cost-efficient Control over quality	Time consuming	Being flexible in adjusting to weather conditions (independent from contractor's schedule)
N1 (in-sourcing)	Independent of others Less planning required	Need to cope with machine break-downs	Being flexible Control over quality
N2 (in-sourcing)	Cost-efficient for main crop	(nothing mentioned)	Being independent and flexible
N3 (in-sourcing)	Flexibility	Depending on personnel Not always cost-efficient	Being flexible and independent of others
N4 (in-sourcing)	Flexibility	Accept machine downtimes (used equipment)	Working time was available on farm Gain from advantages

(Source: own elaboration of data)

Looking at Table 6, the advantage mentioned mostly by the farmers is the gained flexibility and independence of others when having own machinery. This flexibility therefore is also the motivation for four of seven farmers who in-source their machinery services as they state that they can easily adjust to the weather conditions and thus can work under the most optimal conditions. Farmer G4 thereby put forward that flexibility gains independence from the contractor's schedule. Disadvantages of in-sourcing that were equally often mentioned are eventually higher costs, the working time required and the necessity to repair machines. In contrast, the motivation of farmer G1 to follow an outsourcing mechanization strategy is the saving of working time which enables him to focus on other farm obligations. He sees higher costs as the only drawback of his decision. Focussing on such a financial assessment of mechanization strategies, it is notable that costs were not mentioned as a motivation to follow a particular decision.

### **7.3 Choice of mechanization strategy**

In the context of decision-making, the next section of the interviews aimed at getting an in-depth reflection of the situation when choosing a mechanization strategy. Farmers as well as the service providers therefore were asked to suppose being confronted with the situation to decide amongst different mechanization strategies. They were faced with several questions that aimed at identifying the determinants they consider when making decisions (see Appendix E, Q8-11).

Being asked about where farmers get the information for assessing the different mechanization alternatives, six (G1, G3, G4, N1, N3, N4) of the eight farmers answered that they inform themselves with the help of media like internet or professional journals. Three farmers (G3, N1, N2) contact professionals by meetings with salesmen or by visiting machinery fairs. The farmers N3 and N4 indicated that they talk with farming colleagues about mechanization alternatives. The German farm manager G2 said that his information was based on own experiences. In contrast, the service providers mentioned that farmers often talk with other farming colleagues or contractors for specific information.

Focussing on the farmer's decision-making process, all respondents were asked whether cost-minimization is the only influencing factor or if this is not the case, which other factors affect the choice of a mechanization strategy. If other factors were mentioned, the interviewees were asked to order them regarding the importance for decision-making. This section of questions thereby has generated list of determining factors that the respondents have identified independently. The following Table 7 therefore summarizes these determinants named by the respondents.

With respect to Table 7, every farmer as well as service provider that participated in this research has negated the question of whether costs are the only determinant that is considered during the assessment of mechanization strategies. Four farmers furthermore stated, that costs rather define respectively limit the range of feasible mechanization alternatives. Farmer G1 even noted that he follows a mechanization strategy that is not cost-efficient for him and thereby implies a certain willingness to accept higher costs with respect to other determining factors.

Regarding the determinants which then additionally influence the decision of farmers, in total four farmers and one service supplier mentioned time availability as important and they thereby argued that farmers without available working time simply cannot in-source activities. In this context, farmer G4 and service supplier SN1 explicitly named labour availability with a comparable argumentation. Four other farmers further mentioned the extent of being

flexible as influencing determinant while referring to their desire of an independent adjustment to actual weather conditions and not being constraint by others' planning. Flexibility however is not named by the service providers. Instead, all service providers refer to quality requirements as a determining factor that drives farmers to in-source activities because, according to the service providers, farmers often assume to deliver better quality in machinery services. In contrast, there was no farmer that had pointed at quality issues. One German farmer and one Dutch service supplier furthermore highlighted the importance of the farmer's personal attitude and they argued that own feelings and the willingness to do machinery work for enjoyment lead to a preference of in-sourcing.

**Table 7: Independently specified determinants**

<b>Respondent</b>	<b><i>Are costs the only determining factor?</i></b> <i>(statements Q9)</i>	<b><i>What else is of importance?</i></b> <i>(statements Q10)</i>	<b><i>Order of importance?</i></b> <i>(Q11)</i>
<b>G1</b>	No, at the moment outsourcing is even more expensive.	Availability of time	1. time 2. costs
<b>G2</b>	No, but they limit the range of possibilities	Flexibility (work on optimal time)	1. flexibility 2. costs
<b>G3</b>	No, surely not.	Available Time Personal attitude towards work (enjoyment)	1. costs 2. enjoyment
<b>G4</b>	No.	Labour availability Time availability	1. time 2- labour
<b>N1</b>	No, but costs are limiting factor.	Flexibility	1. costs 2. Flexibility
<b>N2</b>	No. It is not always only about the price. But the costs limit the range of possibilities.	Quality of work Available Time	1. Time 2. Costs
<b>N3</b>	No.	Flexibility	1. flexibility 2. costs
<b>N4</b>	No. Costs but also other conditions on farm are important.	Flexibility (Planning) Quality	1. costs (limits possibilities)
<b>SG1</b>	No, only determine about 5% of decision	Quality Personal attitude towards work (enjoyment through varying daily work) Time availability	1. personal attitude/ feelings
<b>SG2</b>	No, they also have others factors determining the decision.	Personal attitude towards work (enjoyment) Quality Flexibility	1. costs
<b>SN1</b>	No, even not thoroughly enough.	Labour availability Quality Flexibility	1. costs

(Source: own elaboration of data. Summary of respondents' statement.)

Although the order of importance of the independently specified determinants cannot be compared amongst the respondents since those had different of them in mind, it can be seen that the costs play different roles in one's personal assessment of mechanization alternatives. While three farmers and two service provider named costs as most important, they were of less relevance for the other interviewees.

Focussing on a regional comparison, except the quality of work which only has been mentioned directly by Dutch farmers and all service providers, there were no distinctive differences between the two interviewed regions.

All in all it thus can be summarized that based on a independently mentioning of respondents, besides costs also the availability of time and labour, flexibility, quality as well as personal attributes have been named as farmer's decision influencing determinants.

#### **7.4 Addressing the theoretical derived determinants**

In the last part of the interview it was of interest whether the determinants that have been emerged based on the literature research were also considered in the agricultural practice. Therefore, several questions relating to these determinants were asked to the responding farmers of the interview. The following section is divided to the theoretical derived determinants (see Table 3) and therein shows the results made in the interviews. In the end of this section, Table 8 compares the defined keywords, which have been introduced to characterize the determinants (see Chapter 5.4), with the occurring keywords during the interview.

##### **Financial Determinant:**

Every interviewed farmer clearly stated that the financial assessment is important in choosing amongst mechanization alternatives. However, the answers of which financial cost factors they thereby take into account vary.

Starting with the utilization as keyword, in total five of the eight farmers mentioned the relation of costs per unit with the utilization of the purchased machinery. While three farmers highlighted that they prove whether they could utilize own machines in such a way that costs were reasonable compared to alternatives, two of them directly stated that the utilization is of less relevance for them. Those two farmers either admitted that machines they purchase will not be used as much they could be (G2) or stated that investments into used machinery demand less attention for utilization (N1).

Five farmers mentioned the keyword total costs by highlighting that in their decisions the total costs of the alternatives were considered and then included in their evaluation. In this context,

there was no farmer that referred to all the cost factors that have been introduced in Chapter 5.2. Instead, some farmers put special attention to certain cost factors. Four farmers for example highlighted maintenance and repair costs as a decisive cost component, whereas fuel costs have been mentioned by three farmers. It is of special interest, that two farmers (G2, N1) noted that farmer's labour costs should not be calculated, because they argue that farmers outsourcing machinery services rather would attend those activities and not do other activities so that their working hours were used anyway.

In a nutshell, all farmers indicated that the financial assessment of alternatives is important in their decision-making. This assessment thereby is mostly characterized by the comparison of total costs of the alternatives.

### **Quality Requirements**

All interviewed farmers stated to look at the delivered quality respectively the outcome of the machinery services. Seven farmers thereby stated that they have quality requirements that influence the decision of in-or outsourcing machinery services. Only farmer G3 denied that quality is of importance for his mechanization strategy since he argues that he has only one crop that does not have high quality requirements.

Being asked of how these quality requirements were influenced, all farmers highlighted that the machine settings and the way of operating these machines are important for a qualitative outcome. In this context, the farmers G1 and N2 referred to the advantage that ownership allows for controlling the quality on your own. Contrary, farmer G4 states that quality always has to be controlled even when services are outsourced and farmer G3 highlights that the choice of service provider already is a kind of quality control for him as he employs firms with professional personnel.

The answers of farmers vary in the question of whether the technology of machines influences the choice of mechanization strategy. In total five farmers indicated that the technology affects their mechanization decision. While the farmers G1 and G2 thereby state to rent machines as they thereby have access to newer technology with high performance and qualitative outcomes, the farmers G3 and G4 rely on contractors as they have the newest technology. Contrary, three Dutch farmers mention that technology is of less importance in their decision of whether to in-or outsource machinery services and similarly argue that even older technology can be used as long as farmers are satisfied with the qualitative outcome and the functionality of the machines.



To sum it up, for all farmers the delivered quality is important for machinery services and this quality is influenced by the machine settings and the way of operating. The technology of machinery is regarded differently amongst the interviewed questions and results either in different preferences or is not considered at all as long as quality is satisfying.

### **Flexibility**

Flexibility is mentioned by all interviewed farmers as determinant that influences their decision of whether to in-or outsource their work. Flexibility thereby is characterized by all farmers as being independent in setting the own time of work execution and is achieved by having the required machines available. The farmers thereby highlight that being fully flexible requires the investment into own machinery.

Almost all farmers talked about the flexibility in relation with the prevailing weather conditions and explained that they ideally want to start their work when these conditions are optimal. They furthermore stated that depending at the schedule of others, like the contractor or the machinery rental, hinders farmers in being flexible.

In this context, all farmers either directly or indirectly argued that the flexibility is determining the mechanization decision as it influences the quality of work. They thereby mention being flexible as particular important in the working steps of forage harvesting and/or the application of plant protection measures. They explained that these machinery services require optimal weather conditions to achieve the best results.

Although all interviewed farmers indicated that being flexible is desired, some farmers noted that this is not always feasible. Accordingly, flexibility is on the one hand limited by too high costs of ownership when the machines cannot be utilized (G3, N2-4) or on the other hand by not having the required time or labour available to operate the machines (G1). Farmer G3 in this context mentions that flexibility costs money but that these might be neutralized to a certain extent.

In a nutshell, all interviewed farmers indicated that flexibility determines the choice of mechanization strategy. Being fully flexible thereby is desired as it influences the quality of outcome with respect to forage harvesting and plant protection measures. However, farmers indicate that being fully flexible is not always possible.

## **Machine Maintenance**

Focussing on the machine maintenance which is characterized by the keywords of maintaining (all farmers) and repairing (G1, G3, N1-2) machines to ensure their functionality, six interviewed farmers clearly indicated that the machine maintenance is not a determinant of their decision of whether to in-or outsource machinery services and stated that they simply do this work if needed. The remaining two farmers also tend to deny the machine maintenance but simultaneously admitted that this depends on the machine considered as they would not purchase rarely used equipment which require a lot of maintenance and repairs. Several farmers in this context highlighted that they look for such equipment that can minimize the maintenance and repair requirements.

## **Social Influences**

Concrete questions about the influence of farmers' social environment in the choice of mechanization strategies delivered a range of social contacts that were noted as important information providers and discussion partners.

Accordingly, information about mechanization alternatives were gathered mainly from the experiences of farming colleagues or in some cases also of sales men. When it comes to the discussion and evaluation of such information, the interviewed farmers vary in their answers. While three farmers (G1, G2 and G4) clearly stated that they assess information and finally make decisions on their own, the other five farmers noted family members or employees (G3, N1-4) as decision influencing persons.

Moreover, all farmers mentioned that they look at the mechanization strategies followed by others mainly in order to get impressions and ideas if there is anything in their actual mechanization strategy that could be improved. Most farmers furthermore stated that they include recommendations and hints of farming colleagues into their assessment of mechanization alternatives. Only farmer N4 clearly denied that his decisions are influenced by other farmers.

It is of special interest that in total four farmers noted to include other farmers' recommendations only after having made a pre-judgement (see Table 8, "pre-judgem.") of these farmers and their farms. They particularly highlighted that not every farmer and farming situation is valuable for getting recommendations (G1, G2, G4, N1). Farmer N1 even mentioned that he has made some bad experiences with such recommendations and therefore nowadays is more reluctant with including them into his decision-making process.

All farmers similarly stated that such recommendations of farming colleagues are not creating a social pressure to follow the same mechanization strategy. Contrary, farmer G3 notes that he usually likes to do things that were usually not done by others.

In a nutshell, all interviewed farmers indicated that their decisions evolve and were influenced in the context of their social environment.

### **Labour availability**

Being asked of whether the availability of labour plays a role in the choice of mechanization strategy, every interviewed farmer clearly underlined the importance of labour availability as determinant and confirmed that it influences their decisions since in-sourcing requires operators to steer the machinery.

The keyword available labour thereby has been mentioned by all farmers. While five farmers mentioned to have enough personnel available which enables them to in-source their activities (G4, N1-4), farmer G3 decides situational whether he can in-source activities. The farmers G1 and G2 even reasoned that they do not have labour free to think of in-sourcing.

Most farmers thereby also talked about the keyword willingness to provide labour forces for machinery services but differ in their way of managing this availability. Farmer G3 notes that he will not allocate labour to perform machinery services as long as there are other, more urgent farm obligations in that moment and therefore rather will outsource this work. Farmer N2 highlights in this context that when labour is not available but farmers still in-source too much work, they run the risk to neglect other farm obligations. Farmers G2 and G3 state that they outsource machinery services when they do not have enough labour available as they are not willing to provide labour for example by hiring additional personnel. G3 thereby argues that rather asks his contractor as this is easier to manage for him. Farmer G1 and N2 argued that they do not see enough utility compared to the costs of hiring additional staff and therefore rather outsource work if the labour availability limits their possibilities. In contrast, the farmers G4, N1 and N3 mention that they easily can provide labour forces for their machinery services.

The determinant labour availability has also been characterized with the keyword skills during the interview. Six farmers highlighted the importance that labour forces have to be adequately skilled when considering in-sourcing. Farmer G3 for example mentions that he will not in-source activities which his labour forces are not capable of. Some farmers furthermore stated that the hiring of skilled personnel is already or will get problematic in the future (N1, N2). Farmer N2 thereby notes that skilled personnel is expensive and often wants to have full-time jobs.

To sum it up, farmers clearly stated that labour availability is an important determinant in the question of whether to in-or outsource machinery services. The interviews furthermore showed that not all farms have labour available forcing them to outsource activities. Moreover, the willingness to provide labour for in-sourcing activities differs amongst these farms. Most farmers thereby also stated that skilled labour forces are required for in-sourcing.

### **Time availability**

The time that is available for farm activities is named by all interviewed farmers as determining factor in the in-or outsource decision of farmers. They clearly stated that it time is required for performing machinery services on your own. The time availability on farms thereby differs. While some farmers mentioned that activities have to be outsourced when there is no time to steer the machines (G1-4, N2) the others stated to rather in-source activities because they have time available (N1, N3, N4).

Four farmers (G2, G3, N1, N4) highlighted the keyword other farm obligations. Accordingly, they mentioned that other activities on farm may exist which have a higher priority in being performed than in-sourcing of machinery services. Farmer G2 and G3 even stated that neglecting such more urgent farm activities would cost more money than it would be gained with in-sourcing machinery services. Farmer N1 admits that such farm obligations exist on his farm and that they can cause them to delay their machinery activities as their animal keeping has priority.

The keyword work load has been mentioned by the farmers G1 and N3. While for farmer G1 a too high work load was the reason to outsource more work recently, farmer N3 in contrast is willing to deal with a higher work load in times of working peaks.

In a nutshell, time availability is seen by all farmers as determining factor. All farmers similarly state that labour forces need to be available when farmers want to in-source activities. This availability however is limited when other farm activities need to be performed and therewith compete with the considered machinery service.

The following Table 8 confronts the keywords of the theoretically derived determinants (see Chapter 5.4) with those keywords that have been mentioned during the field research and therewith summarizes the main findings which have been described in the previous sections. If additional or respectively new keywords have been named by the respondents, the line 'other keywords' is included. Furthermore, the lines 'relevant?' are included to show the farmers' answers of whether the considered determinant is of relevance in their decision-making process. This line however is not included at the determinant of social influences since the question of its relevance is not explicitly asked here.

**Table 8: Confrontation of keywords from literature and interviews**

Determinant	Relevance / Keywords	G1	G2	G3	G4	N1	N2	N3	N4
<b>Financial determinant</b>	<b>Relevant?</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	Ownership costs	depreciation	-	-	-	depreciation	-	-	depreciation
	Operating costs	-	fuel, labour, R&M	-	-	fuel, R&M	R&M	-	fuel, R&M
	Total costs	-	X	X	X	X	X	-	-
	Timeliness costs	-	-	-	-	-	-	-	-
	Opportunity costs	-	-	-	-	-	X	-	-
	Utilization	X	X (less important)	-	-	X (less important)	X	X	-
<b>Quality requirements</b>	Capital availability	X	-	-	X	-	X	X	X
	<b>Relevant?</b>	<b>Yes</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	Machine setting	X	X	X	X	X	X	X	X
	Way of operating	X	X	X	X	X	X	X	X
	Technology	X	X (performance)	X (performance)	X (quality)	no influence	no influence	X	no influence
<b>Flexibility</b>	Quality delivered	X	X	X	X	X	X	X	X
	<b>Relevant?</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	Time & length	X	X	X	X	X	X	X	X
	Machine availability	X	X	X	-	X	X	X	X
	Other keywords?	weather conditions	-	weather conditions	weather conditions	weather conditions	weather conditions	weather conditions	-
<b>Machine maintenance</b>	Being flexible is important for?	forage harvest (quality)	forage harvest (quality)	plant protection (quality)	forage harvest (quality)	forage / plant protection	plant protection (quality)	plant protection	forage harvest (quality)
	<b>Relevant?</b>	<b>No</b>	<b>No</b>	<b>Yes (it depends)</b>	<b>No</b>	<b>No</b>	<b>No (it depends)</b>	<b>No</b>	<b>No</b>
	Maintenance	X	X	X	X	X	X	X	X
	Repairs	X	-	X	-	X	X	-	-
<b>Social influence</b>	Service availability	-	X	-	-	-	-	-	-
	Info. provision	colleagues	colleagues	colleagues	colleagues	-	colleagues	colleagues	colleagues
	Info. discussed with	nobody	nobody	son, employee	nobody	family, sales man	sales man	father	family
	Peer assessment	Yes (impressions)	Yes (impressions)	rarely	Yes (impressions)	Yes (impressions)	Yes (impressions)	yes	Yes (impressions)
	recommendations	Yes (pre-judgem.)	Yes (pre-judgem.)	Yes	Yes (pre-judgem.)	Yes (pre-judgem.)	Yes	Yes	no
<b>Labour availability</b>	Social pressure?	No	No	No	No	No	No	No	no
	<b>Relevant?</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	Available labour	X	X	X	X	X	X	X	X
	Willingness to provide labour	X	X	X	-	X	X	X	-
<b>Time Availability</b>	skills / certificates	X / -	- / -	X / -	X / -	X / -	X / -	X / -	- / -
	<b>Relevant?</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>
	Available time	X	X	X	X	X	X	X	X
	Other farm obligation	-	X	X	-	X	-	-	X
	Work load	X	-	-	-	-	-	X	-

(Source: own elaboration. X: has been mentioned; (...): additional comments; R&M= repair and maintenance costs)

To sum up the findings of Table 8, it can be seen that from in total seven theoretical derived determinants, four are defined by all responding farmers as relevant for their decision-making in choosing mechanization strategies. The determinant quality requirement is also characterized as relevant by seven farmers. In this context, farmer G3 admits that quality requirements only would be relevant if he would have other crops than maize as it has been the case a few years ago.

Farmers were not asked whether their social environment is an important determinant. The relevance of this factor however can be recognized since the farmers mention several social contacts influencing their mechanization decision.

The determinant machine maintenance has, according to the findings of Table 8, no relevance since farmers stated that the necessity to maintain machines is not influencing their mechanization decision.

The last question of the interview asked whether there are additional factors or aspects important for their decision-making process in choosing a mechanization strategy which had not yet been mentioned during the interview. Most farmers negated this question. Farmer G1 however mentioned the readiness to assume risk of farmers important as it would influence the farmer's attitude towards certain alternatives. Farmer G3 furthermore referred to the farmer's interest which influences farmers in making their preferences.

At this point, all findings of the interviews with the farmers and service providers as external experts have been described. The next chapter will discuss these findings with respect to the propositions of Chapter 6.

## **8. Discussion**

The analysis of the interview data has delivered several findings regarding the characteristics of respondents, the accruing machinery services as well as followed mechanization strategies of the participating farmers. Furthermore, and this is of particular relevance for the objective of this research, the data has also enabled to get insights in the decision-making process of farmers choosing their mechanization strategy. Due to the fact that most farmers have indicated to continuously think about improving their mechanization strategy, it can be claimed that this research is conducted apparently in an actual field of mechanization decisions.

The following section discusses the results of the interviews with respect to literature findings of this research. Therefore is divided into the sub-chapters that focus on the followed mechanization strategies and the elaboration of those determinants that are relevant for the agricultural practice. In particular, it is investigated which determinants influence the decision-making process of farmers when deciding of whether to in-or outsource machinery services.

At this point it already can be noted that the results of the field research base on the characteristics of respondents and therewith its sample size. The respondents however guaranteed valuable results since all had at least several years of work experience. Moreover, different farm strategies and farm types were part of the sample enabling a broader view on the choice of mechanization strategy. The approach of including farmers as well as service providers for an external view on the research objective thereby has delivered additional insights and on top of that showed consensus in the answered given by both parties. Furthermore, since respondents were located in two regions of different countries the risk of a regional dependence in answers was decreased. This therewith created regional comparison did not show substantial differences with respect to decision-making process in choosing mechanization strategies. However, if differences have been identified, they explicitly were addressed in the following discussion.

### **8.1 Followed mechanization strategies**

The approach of this study is the derivation of theoretical determinants from key aspects of mechanization decision which are based on the assessment of the mechanization strategies of in-or outsourcing explored from literature (see Chapter 4). Before looking at those determinants of decision-making, the following section first of all discusses whether the data

obtained from the interviews corresponds to this literary assessment of mechanization strategies as otherwise the confirmability of this research is reduced (see Chapter 2.4).

The results show that farmers indicated to mostly follow the strategy of in-sourcing their machinery services since they perform most activities either with owned or rented equipment. By consulting Table 6, the farmers motivated this strategic choice by the gained flexibility and independence of others', in particular the contractors' schedule. Hence, it already can be seen that flexibility plays a crucial role in the decision-making process of farmers.

Although the farmers stated to mostly in-source activities, they also said that some machinery services were outsourced. Accordingly, the harvest of crops, in particular of maize and grass, is performed by contractors. This might be caused by the fact which also has been noted in literature namely that for these working steps whole working chains for harvest as well as transport are required and therefore would be too costly to be in-sourced. This claim can be confirmed by the statement of three farmers (G2, N2, N4) who in a similar manner argued that in-sourcing such harvesting work would economically not be reasonable on their farms. By this, two valuable insights are achieved. At first, also within one farm different mechanization strategies can be followed simultaneously and secondly, decision on mechanization alternatives seem to be made within a certain financial limit.

The results further show that the known mechanization alternatives to owning are renting as in-sourcing and employing contractors as outsourcing strategy. The interviewed service providers also confirmed this since they named the same alternatives. At this point, the research has found a regional difference as the option of renting was known but not regarded as feasible for most of the Dutch farmers. It seems that machinery rental systems are less common in the Dutch region of Gemeente Emmen, because the Dutch farmers indicated that rentals were too far away to be used. That may be one of the reasons why ownership as in-sourcing strategy is commonly used amongst the responding Dutch farmers.

A comparison of the literary known mechanization strategies with the results of the interviews furthermore showed that not all alternatives were equally common. Accordingly, only one farmer (G4) has a joint ownership of machines with a farming colleague and such a machine sharing is known as alternative only by one other farmer (G3). However, both farmers did not further characterize this mechanization alternative. For this reason, it can only be concluded that this strategy is known but rarely pursued. In contrast, the alternative of leasing has not been named at all by the respondents. This might be due to the fact that this alternative is literary known as more costly compared to the purchase of machines. However, this research was not able to explore why leasing was not an option to the respondents but only can



conclude that no farm uses leased equipment. All in all however, most of the identified mechanization alternatives are known by the interviewed farmers and if more farmers were interviewed the other alternatives might have been mentioned more often. Hence, the mechanization strategies introduced in the literature part can be claimed as being pursued in the agricultural practice based on the results of the field research.

Focussing on the assessment of the followed mechanization strategies, farmers indicated besides the already mentioned gained flexibility and independence also control over quality as well as an easier planning as further arguments for in-sourcing. During the interviews also additional arguments occurred such as access to new technology when referring to renting or contractors. Farmers furthermore named time, labour and repair requirements as disadvantages of in-sourcing. This coincides to a large part with the arguments found in literature. The only aspects that were not mentioned are the financial disadvantages of high investments, liquidity issues and that equity cannot be build up. Those arguments might either be of less relevance or simply were not considered by farmers at the moment when research was conducted. However, it can be claimed that most of the arguments identified in the literature review on mechanization strategies which are listed in Table 1 were also named during the interviews.

The approach of this study in order to explore the decision-making determinants is based on the key aspects elaborated from the literary assessment of mechanization strategies. Since the field research has confirmed most of the arguments of this assessment and has not observed any contradictions concerning pursued mechanization strategies, this approach is seen as justified to be followed. Moreover, this implies that, as stated in the end of Chapter 4, those determinants that are of relevance to the agricultural practice affect all mechanization strategies as they in fact based on these key aspects. This in turn means that no determinants exist that only relate to a certain mechanization strategy since nearly all arguments identified in literature occurred.

Therefore, the next sub-chapter discusses which determinants are of relevance for the agricultural practice during the decision-making process of choosing machinery strategies.

## **8.2 Elaboration of relevant determinants**

This section discusses the findings of the field research with respect to the literature findings of this research. This section is subdivided based on the propositions of Chapter 6 which in turn address the theoretical derived determinants.

**Proposition 1:** *Besides the financial evaluation of mechanization alternatives a farmer considers also other non-financial determinants that influence his decision-making.*

The initial claim of this research is that farmers are not only driven by cost minimization which would demand them to choose mechanization strategies causing the lowest costs. Although this statement has already been confirmed by several other studies, this research has investigated if farmers in the decision on mechanization strategies also have other non-financial determinants playing a role; because if this would not be the case, the exploration of further determinants would be redundant and no further insights in the decision-making process of farmers could be made in this research.

Therefore, farmers have been asked whether farmers only consider costs in the evaluation of mechanization alternatives. The result clearly show (see Table 7) that farmers indeed have also non-financial determinants playing a role since all farmers mentioned that such a decision is not only based on the evaluation of costs. Moreover, this can be confirmed by external view of the service providers since they also claimed farmers to be not only driven by costs considerations. Hence, it can be stated that the research on non-financial determinants has been proved to be of relevance.

Nevertheless, a financial determinant still is important for the evaluation of mechanization alternatives. This can be seen already in Table 7 as farmers as well as services providers mentioned other determinants additionally to the financial determinant. On top of that, the explicit question to farmers of whether a financial consideration is of importance during their decision-making process has been answered by all farmers identically as they clearly underpin its importance. Therefore, the financial determinant can be claimed as the first determinant relevant for agricultural practice. Hence, Proposition 1 is confirmed in the context of this research.

However, when it comes to the characterization of this determinant with respect to the keywords defined in advance, farmers named much less keywords than are known to literature.

The utilization of machines as well as the consideration of total costs have been noted most by farmers and hence seem to be most relevant in financial considerations. Those farmers that named utilization as keyword defined it in a similar manner by referring to the total costs per unit which decrease with increasing scale of use. This corresponds to the explanation of the literature. However, farmers differ in how they regard the importance of utilization. While some farmers mentioned that certain utilization is required for achieving reasonable costs, others in turn mentioned that they rather do not pay much attention to the utilization as they

purchase used equipment. The latter aspect can also be traced back in the literature review where the purchase of used equipment is seen as advantageous since it demands less capital (see Chapter 4.1.1). This in turn can decrease the costs per unit through less ownership costs and thus requires a lower utilization to achieve comparable costs. Nevertheless, in both considerations, either with new or used equipment, utilization should still be considered in order to have an impression of the costs per unit.

Farmers furthermore mentioned sporadically some specific attributes of the ownership and operating cost components, such as depreciation, fuel or repair and maintenance costs. Other cost factors, such as timeliness costs, opportunity costs, capital availability and liquidity issues were except some isolated statements not mentioned at all. This either might be due to the fact that farmers do not consider these attributes during their decision-making process, or they did not think about these items during the interviews as the questionnaire was not formulated adequately. However, according to literature all these cost factors are relevant for calculating the total cost. Hence, when farmer mention the total costs as important for alternative comparison, all these cost factors should be considered for calculating costs objectively. They therefore should remain within the characterization of the financial determinants although farmers did not mention those cost factors explicitly.

This research has allocated, except the financial determinant, the theoretical derived determinants based on the Theory of Planned Behaviour (see Chapter 5.1.1) to its three aspects that influence farmers' intention of behaviour, i.e. chosen mechanization strategy. At this point the following considerations regarding the allocation of the financial determinant into the Theory of Planned Behaviour can be made. Focussing on the cost factors, the different assessment of utilization by farmers can be seen as one example which shows that farmers' evaluation of the financial determinant seems to depend on their attitude towards considered mechanization alternatives. Another example which would regard the financial determinant as related to farmer's attitude can be recognized in the assessment of labour costs since some farmers even indicated that they would not calculate costs for their own labour hours although this remains with regard to the objectivity of cost calculation rather questionable. Yet, the financial determinant might also be allocated to the aspect of perceived behavioural control since farmers furthermore indicated that costs limit the range of feasible mechanization alternatives and therewith can be seen as farms' resource that either strengthen or degrades the intention towards a certain mechanization strategy. Therefore, it is assumed that the financial determinant plays a role in both aspects of the Theory of Planned Behaviour. On the one hand farmers' attitude influence the evaluation of costs and in particular

determines the maximum of total costs farmers are willing to accept for pursuing a certain mechanization strategy. On the other hand, the financial situation of the farm, e.g. available capital and liquidity issues, determine whether alternatives are seen as feasible or not.

The participating farmers are not comparable in terms of cost calculations. Table 4 already shows that they have different farm strategies, sizes and certainly also will have different machinery. Therefore, at this point an objective cost comparison cannot be made although this would achieve valuable insights with regard to their attitudes in costs evaluation. Nevertheless, it can be claimed that the financial determinant as it is characterized in literature is of importance in farmers' decision-making process.

**Proposition 2:** *Quality requirements influence the farmer in choosing the mechanization strategy.*

This research has claimed quality requirements as first non-financial determinant to be of importance in the decision-making process of farmers. Indeed, during the independently specification of additional determinants, some farmers as well as all service providers have stated quality issues as important. Furthermore, almost all farmers indicated quality requirements as relevant for their decision-making. Only farmer G3 mentioned that this determinant is less important for him due to the relatively low quality requirements his crop has. Yet, he furthermore admits that if he would have other crops quality would play a bigger role for him. Thus, in fact all farmers agreed that quality is a non-financial determinant that is relevant in the choice of mechanization strategy so that Proposition 2 can be approved based on this research. However, the extent to which it influences might differ depending on the cultivated crops.

When it comes to the characterization of the determinant quality requirements based on the keywords, farmers agreed that the delivered quality is important in the evaluation of mechanization alternatives. Furthermore, they all explained that this quality is influenced by the machine settings and the way of operating and some of them thereby explicitly refer to crop losses. Thus, machine settings and way of operating are hence keywords with which the quality requirements can be adjusted. Some farmers stated that they see in-sourcing as the best way to influence the quality. Contrary, farmer G3 refers to the professionalism of the contractors through which good quality can be expected if an appropriate contractor is chosen. It seems that farmers thus have different experiences and preferences towards the question how the highest qualitative outcome can be achieved. Although this question remains unanswered in this research, this discussion of farmers again demonstrates that quality

requirements affect farmers' decision-making process. However, by referring to farmer G4 it can be concluded that farmers should control the quality regardless of the chosen strategy.

Another keyword that has been addressed by literature as well as in the interviews is the influence of technology with respect to the delivered quality in the choice of mechanization alternatives. Five farmers stated that technology affects their choice of alternatives as they prefer new technology with high performances while the other three indicated that even with older machines good results can be achieved. Hence, again farmers have different opinions about the influence of technology. However, they somehow all agreed that the technology used needs to function reliable and should deliver good quality. Thus, it can be claimed that this keyword is of relevance for the characterization of the determinant quality requirements. Accordingly, farmers consider technology as they want machinery services to be performed with equipment that delivers adequate quality of work and has a reliable functionality.

On the base of the Theory of Planned Behaviour, the determinant quality requirements has been allocated to be depending on the farmer's attitudes. By looking at the previous considerations this allocation can be confirmed. Attitudes indeed are the driver of farmer's decision-making since the interviewed farmers evaluate the expected qualitative outcome of the mechanization alternatives differently and thus influence their intention to choose a certain mechanization strategy.

**Proposition 3:** *The required extent of flexibility affects the choice of mechanization strategy.*

Flexibility is seen as another non-financial determinant that influences farmers' decision-making process. This can be confirmed since all farmers have indicated flexibility considerations as relevant within their evaluation of mechanization alternatives. On top of that, four farmers as well as two service providers have independently specified flexibility as additional determinant that is considered by farmers. Therefore, Proposition 3 can be approved based on the findings of this research.

Similar to the defined keywords found by literature, all farmers characterized being fully flexibility when time and length of performing machinery services can be determined independently. Almost all farmers further described that this flexibility is achieved when the required machines are available. Some farmers specifically stated the contractor's or rental's schedule as reason that hinders being flexible. Two of three interviewed service providers even admitted that it is not always feasible to satisfy the time planning of farmers. Hence, it can be stated that farmers see the highest flexibility in having machines purchased and therewith fully under own control. However, within this research it is not possible to further

rank the other mechanization alternatives with respect to their degree of flexibility. It might depend on the situation, i.e. the actual schedule, whose machine availability is better.

Almost all farmers furthermore stated that being flexible has its relevance in their decision-making due to the fact that machinery services exist which require to be performed during optimal weather conditions. All farmers thereby refer to the working steps of forage harvesting and plant protection measures and then often stated that flexibility influences the quality of these machinery services. Therefore, weather conditions can be seen as another keyword that describes the determinant of flexibility. On top of that, the importance of working under optimal weather conditions seem to depend on the cultivated crop since for example all dairy farmers highlighted that an on time harvest of their forage crops increases their forage quality. Farmer G3 even confirms that the importance of flexibility in relation to the weather conditions depends on the crops since he mentioned that his previous crops required him to be flexible. The extent of being flexible in performing machinery services however is limited. As some farmers mentioned, considerations of costs, required time and/ or labour may hinder the feasibility to be flexible.

Most farmers furthermore confirm that flexibility affects the quality of their crops as it allows adjusting to the prevailing weather conditions. Hence, there is a relationship between the determinants of quality requirements and flexibility in such a way that the higher the flexibility the better quality requirements can be met. It might be concluded that these determinants therefore could be combined. However, farmers mentioned both to be of relevance so that the degree of being flexible indeed is seen as another determinant.

In this context it is of interest that farmers acknowledge being less flexible might somehow decrease the quality of their crops, in particular when forage is not harvested on time. Yet, during the interview farmers did not assess such quality losses from a monetary point of view. Only farmer G3 hypothetically mentioned that flexibility causes higher costs which could be neutralized somehow by achieving better quality. Farmers hence are either not willing or not able to estimate the costs that arise due to decreases in delivered quality. It however is comprehensible and also indicated in literature (LAK and ALMASSI, p.144, 2011) that the estimation of such timeliness costs is difficult. This might be one reason why farmers did not refer to timeliness costs during the characterization of the financial determinant.

Hence, farmers see or respectively do not see based on their attitudes additional utility in being flexible which is rather subjective noted than monetary calculated. With respect to the Theory of Planned Behaviour, this would confirm the allocation of flexibility to the determinants based on the attitudes. In other words, it depends on the attitude of farmers

whether they regard flexibility as important for the machinery services considered and furthermore, whether they are even willing to accept potentially higher costs to be more flexible. Yet, the being flexible seem to be depending on the perceived behavioural control since farmers indicated that other determinants obviously limit the extent of being flexible, such as amongst others the financial determinant.

**Proposition 4:** *The necessity to maintain machinery affects the choice of mechanization strategy.*

This research has claimed machine maintenance as another non-financial determinant that was characterized by the keywords of the necessity to maintain and repair owned machinery. Furthermore, it was expected that the accessibility of technical service stations belongs to this determinant and therewith also influences the decision of farmer whether to in-or outsource machinery services.

All farmers have admitted that an ownership goes along with the obligation to maintain and, as additionally mentioned by some farmers, repair the equipment. However, the accessibility of service stations was mentioned only by one farmer. It seems that the latter is either not characteristic for the machine maintenance or which is more comprehensible, not regarded as problem for farmers as service stations might be located in the near.

Although farmers therewith have characterized the determinant almost as the literature review has proposed, in fact all farmers negated that the necessity to maintain machinery has influence on their choice of mechanization strategy. Almost all farmers clearly stated that machinery maintenance is not relevant in their decision-making process as it is seen as a task that belongs to the ownership of equipment and not as a factor that hinders farmers to in-source activities. It cannot be argued that farmers denied the existence of this determinant due to their interests since only three farmers indicated to like doing works related to mechanization. Even if more would have this interest, it still would be questionable whether the maintenance of machinery is seen as activity that is willingly done. Thus in fact, machine maintenance cannot be seen as determinant meaning that Proposition 4 cannot be hold based on the findings of this research. Instead, the perception of machine maintenance is limited to the attempt of farmers to purchase machinery that is reliable in its functionality and acceptable in its performance. Therewith it is more related to the keyword technology of the determinant quality requirements.

**Proposition 5:** *The social influence of farmers affects their evaluation of mechanization alternatives.*

The Theory of Planned Behaviour has introduced social influences as another non-financial determinant that affects farmers' decision-making mainly through information provision and discussion. In order to prove whether this is also the case in decision on mechanization strategies, the interviewed farmers have been asked whether their social environment has any influence on their choices.

The results show that farmers were provided with information about mechanization strategies on the one hand from media, such as professional journals or the internet. On the other hand and therewith more related to social interactions, farmers indicated to gather information from farming colleagues, sometimes also sales men or by visiting fairs. Once provided with the information, most farmers indicated to discuss their findings with family members or employees and admit that those can influence their decision. There are three farmers that claimed to make decision on their own without a discussion with other social contacts. However, those stated that their decision base on information that were gathered also from other social contacts. Additionally, almost all farmers indicated to assess mechanization strategies followed by others mainly in order to get impressions and to identify possible points for improvement. Therefore, by recognizing these several ways of social interaction it can be claimed that the social influence of farmers affects their decision-making process also with respect to the choice of mechanization strategy. Accordingly, Proposition 5 can be approved since at least information were provided by the social environment and in most cases also were discussed.

Besides the information also recommendations of farming colleagues have been identified by farmers as useful. However, it is interesting that four farmers indicated to decide about their usefulness after a pre-judgement of the recommending farmer. It seems that two criteria are important to value recommendations. At first, the farming situation has to be comparable and secondly, the recommendations must be trustful. If especially the latter criterion is not met, those farmers do not value the references of others. This fact can be found back in the statements of four farmers where in particular farmer N1 mentioned that he has bad experienced with acting on recommendations of others without proving their value. Therefore, although the other farmers did not explicitly mention it, the pre-judgement of the recommending peer is useful to highlight in order to prevent disappointments or even wrong decisions.



The literature review also has paid attention to the fact that farmers through all sorts of recommendations and hints of others might feel pressured to follow the mechanization strategy that is claimed to be the best. The results show that farmers contradict to feel pressured. Contrary, they state to choose those alternatives that best fit on their farms. It can be criticized that farmers answered in this way as they do not want to admit being steered by others. Yet, besides the expectation that the interviewed farmers answered straightforwardly, this critique could also be refuted due to the fact that interviewed farmers with comparable farming situations, such as the dairy farmers, mostly follow different mechanization strategies and thus obviously not feel pressured to choose a certain strategy. Moreover, as mentioned by farmer G3 and therewith relating to literature, some farmers have even the motivation to do things different than usual. Thus, social pressure is not of importance in the decision on mechanization strategy.

The determinant social influence therefore relates to the information provision by social contacts, in particular through recommendations of comparable as well as trusted farming colleagues and the discussion of the information with for the decider important people such as family and employees.

**Proposition 6:** *The availability of labour limits the farmer in his choice of alternatives.*

The availability of labour is introduced as further non-financial determinant that relates according to the Theory of Planned Behaviour to the availability of resources on farm. The availability of labour is already highlighted in the part of the interview where farmers and service providers could individually specify further determinants relevant for the choice of mechanization strategy. Moreover, farmers clearly confirmed that this determinant is of relevance in their decision-making process. Therefore, Proposition 6 can be confirmed based on the findings of the interviews.

Similar to the keywords defined by literature, this determinant is characterized by all farmers through the question of whether labour forces were available to in-source activities as all farmers. Farmers thereby also confirmed that machinery services on farms without available personnel cannot be in-sourced. It is beyond the context of this research to assess whether the farms would have labour available although farmers have indicated their work forces on farm. However, farmer G1 can be used as one example that out-sourcing is necessary if not enough labour is available since he is the only labour force on his farm and indicates that most is done by contractors.

For in-sourcing activities however the willingness to provide labour forces is required. Particularly when not enough work forces are available on farm to in-source, the results of interviews show that the willingness to hire additional staff however seems to be influenced by two conditions. The first condition relates to the farmer's personal will to manage labour forces and the second condition relates to the farmer's assessment of cost-benefit analysis. Especially the latter condition is recognized as reason to prefer outsourcing to contractors when not enough utility is seen in additional personnel.

The labour availability by most farmers is furthermore characterized with the keyword skills which are required to perform the services considered. Although most farmers that ins-source machinery services indicated to have access to labour forces at the moment, they highlighted that this gets increasingly difficult. It seems that adequate agricultural staff becomes rare. This however might result in increasing labour costs in the future which in turn might additionally influence farmers' mechanization strategy. Literature has identified required certificates for performing machinery services as another keyword. This keyword however is only mentioned by one service provider and not by farmers. Hence, it seems that the availability of farmers is not linked to certificates or that farmers do not see problems to maintain them. Therefore, this keyword is not proved as characterizing attribute of labour.

Furthermore, since all farmers indicated that the labour availability either enables or hinders and thus limits the in-sourcing of machinery services, the allocation of the determinant labour availability to the aspect Perceived Behavioural Control can be maintained based on the findings of this research.

**Proposition 7:** *The availability of time for farm operations limits the choice of alternatives.*

The availability of working time is the last non-financial determinant that has been derived in the literature part of this research. Already during the independently specification of determinants, about half of the interview respondents mentioned the availability of time as important aspects that were considered during the decision-making process on mechanization strategies. On top of that, all farmers clearly stated this determinant to be relevant when it was addressed in the interview.

As confirmed by the explanations of all farmers, this determinant is characterized by the working time that is available to perform machinery services. Literature furthermore defined that this working time can be limited due to other farm obligations or an already high work load through which farmers are not willing to further increase their in-sourced activities. Although both keywords have been mentioned by the interviewed farmers, they seem to be

less commonly apparent. For the keyword work load this might be due to the fact that it only might be named by such farmers that are working close to their borders of a too high work load and therefore prevent additional required working time. In contrast, the keyword other farm obligations might not been named that often by farmers because their reference to available working time might already imply the existence of other activities that need to be conducted.

However, due to these considerations and the fact that both aspects indeed have been named, all keywords were seen as accepted to characterize the determinant.

The determinant time availability has been allocated to the Perceived Behavioural Control. Since farmers referred to the available working time in such a way that it limits the range of feasible mechanization alternatives, the working time can be seen as resource for the farm and therewith corresponds to the definition of Perceived Behavioural Control. Therefore, also Proposition 7 finally can be confirmed.

In general, allocating the determinants based on the Theory of Planned Behaviour, which is assumed to be applicable for this research, was regarded as useful for the exploration of determinants. Although this research has not proved it, the applicability of this theory can be underpinned by the following three arguments. At first, literature identified the Theory of Planned Behaviour as proper method to investigate farmers' decision-making process. Secondly, the previous discussion affirmed a relation between the definition of this theory and its aspects, i.e. attitudes, subjective norm as well as perceived behavioural control, and the significant determinants. Thirdly, some farmers in particular during the last question of the interview pointed at the importance of the farmer's attitude that influences their preferences towards the different mechanization strategies and therewith highlight an important aspect of the Theory of Planned Behaviour. Based on these three arguments it can be claimed that this theory is appropriate for achieving insights in the farmer's decision-making process of whether to in-or outsource agricultural machinery services.

### **8.3 Limitations**

This research is subject to a certain number of limitations which must be taken to account when referring to its findings as they might have influence on the justification of conclusions made. The following sections outline these limitations.

At first, this research derived theoretical determinants that deliberately and exclusively originate from the assessment of mechanization strategies found in literature. However, it might be argued that through the complexity of literature relevant arguments which not occur in the cited references are not considered in this research. As a consequence, those arguments could not be elaborated into determinants and finally proved in the field research. Although the interviewed farmers, who were due to this reason ask to independently specify additional determinants, did not highlight those, the possibility cannot be ruled that other determinants exist which were not explored. Not regarding those possible additional determinants however might distort the findings and therewith limits the validity of the research.

Another limitation comes along with the fact that the elaboration of determinants is focussed on machinery services that relate to arable farming and therewith to the cultivation of forage and market crops. Other machinery farm operations that surely will exist are less highlighted here and therefore might have either identical or different determinants. Especially in the latter case, the findings of this research cannot be translated to those farm situations but rather would demand further research.

Moreover, this research used the mentioning of keywords as indicators for the characterization as well as relevance of determinants for farmer's decision-making process. The problem here is to define thresholds for the amounts of enumeration of keywords that justify the statements made related to the relevance and characterization of determinants. Although those amounts certainly indicate the importance and on top of that might include additional information, their interpretation by the researcher and the readers might be differently. Hence, this partial subjective evaluation that cannot be fully prevented is another limitation of the research that however comes along with this research as it is designed as qualitative, theory building approach.

Furthermore, this research is limited to the elaboration of determinants that were confirmed by the agricultural practice to be relevant. However, based on this research it is not possible to order these determinants with respect to their importance or chronology. However, it is expected that they were considered rather simultaneously by farmers. On top of that, this research has not investigated the determinants with respect to possible interrelations. At

certain points however, those are indicated. Therefore, the possibility cannot be ruled that defined determinants might even be identical and thus should be proved in further researches. The last limitation is results from the rather small sized sample of in total eleven interviewed respondents from which are eight farmers and three service providers. Although this sample size is already chosen relatively high with respect to the complex context of this research, it still causes a restricted external validity. Therefore, this small sample size can be regarded as further limitation of the research.

Altogether, this research entails a range of limitations that need to be considered when its findings are discussed. Nevertheless, this research enables a sufficient level of validity and reliability so that its conclusions deliver further insights in the decision-making process on mechanization strategies. The conclusions are summarized in the next chapter.

## 9. Conclusion

The understanding of the decision-making process of farmers in choosing their mechanization strategy until now was limited to financial consideration and it was not investigated whether also other determining factors were relevant for farmers causing a knowledge gap in this field of farm management. Therefore, the object of this research was to create a deeper insight into the decision-making process of farm managements in the question of whether to in- or outsource agricultural machinery services by exploring and explaining the determinants that influence this choice for agricultural practice.

In order to achieve deeper insight, this research has investigated the mechanization strategies that can be pursued to perform machinery services on farm. It thereby was of interest which strategies exist and what determines farmers to chose between these strategies. Therefore, this research on the one hand made use of a range of scientific as well as professional literature establishing a theoretical fundament for a better understanding of the agricultural practice in choosing mechanization strategy. On the other hand, it has confronted this understanding with the interview data obtained from well educated professionals of two different regions with several years of work experiences in the agricultural field. By this, the following conclusions can be drawn.

This research has found that the interviewed farmers in the German region Samtgemeinde Emlichheim as well as the Dutch region Gemeente Emmen are mainly in-sourcing their machinery services. The main arguments for this are the gained flexibility and independence in executing those farm operations. Except of leasing equipment, farmers as well as service providers of both investigated regions thereby indicated similar mechanization alternatives as to be applicable on their farms, i.e. owning, renting, employment of contractor or machine sharing. Renting however was less pursued in the Dutch region due to a lack of machine rentals in the near. The research furthermore has found that different mechanization strategies can be pursued at one farm since they are chosen per machinery services required. Especially the harvest of crops thereby was predominantly indicated to be outsourced to contractors. All in all it can be concluded that the literature study on mechanization strategies corresponds to the findings made in the field research.

Furthermore, with respect to the research objective and therewith the investigation of farmers' decision-making process, the central research question aimed at identifying the determinants that influence farmers to choose amongst the mechanization strategies. The Theory of Planned Behaviour, which is assumed to be applicable in the context of this research, thereby has delivered valuable insights as it has proved that farmers make decision based on their

intention which in turn is influenced by their attitudes, their subjective norm and their perceived behavioural control. Based on this, seven propositions have been formulated which incorporate seven theoretically determinants that were derived from the assessment of mechanization alternatives and expected to influence farmers decision-making process.

This research thereby has substantiated that farmers indeed make their decisions not only based on financial assessments of the mechanization alternatives but that also other non-financial determinants influence the intention of farmers to pursue a particular mechanization strategy. Accordingly, the further research on the formulated propositions was justified so that they were confronted with the agricultural practice, i.e. farmers of both regions. Based on this confrontation, six of the in total seven formulated propositions have been assured. By this, six determinants have been elaborated in this research as influencing farmer's decision-making process. The following Table 9 specifies and briefly describes the proven determinants based on the keywords confirmed by farmers. This table furthermore allocates the determinants to the aspects of the Theory of Planned Behaviour.

**Table 9: Determinants of decision-making process**

<b>Determinant</b>	<b>Description</b>	<b>Influenced by</b>
<b>Financial determinant</b>	Farmers compare the total costs of machine ownership to the costs of alternatives per unit. Those total costs depend on the machine's utilization and are composed by ownership, operating, opportunity and timeliness costs. Farmers furthermore assess whether they have enough capital available for purchase of machinery.	Attitude and Perceived Behavioral Control
<b>Quality Requirements</b>	Machine alternatives are evaluated based on the delivered quality which in turn can be influenced by machine settings and the way of how they were operated. The used technology is demanded to function reliable and deliver qualitative results.	Attitude
<b>Flexibility</b>	The mechanization strategies differ in their extent of flexibility. The highest flexibility is achieved by having machines available as thereby time and length of performing machinery services can be determined independently. Being flexible is especially important for forage harvesting and plant protection measures as their quality is depending on the prevailing weather conditions.	
<b>Social influence</b>	Social contacts influence farmers as they provide information in particular by recommendations of farming colleagues and the assessment of peers' mechanization activities. The thereby gathered information is discussed with for the farmer decisive people, e.g. family members.	Subjective Norm
<b>Labour availability</b>	The feasibility of mechanization strategies is limited due to the available work forces on farm and the willingness to provide them for machinery services. For in-sourcing of machinery service it is furthermore required to have labour forces with adequate skills.	Perceived Behavioral Control
<b>Time availability</b>	The choice of mechanization alternatives is influenced by the available working time on farms which in turn can be limited due to other more important farm obligations or the work load of farmers.	

(Source: own elaboration)

Furthermore, this research has not found substantial differences in the decision-making process of farmers between the German and Dutch region. By this, it can be concluded that the identified determinants are within the context of this research not limited to regional conditions. Hence, it can be stated that these determinants can be generalized to a wider extent although they only found on a sample size of eleven respondents.

Therefore, it can be concluded that this research was able to create deeper insights in the decision-making process of farm managements in the question of whether to in- or outsource agricultural machinery services since it has explored that the financial determinant, quality requirements, flexibility, social influences as well as labour and time availability influences this choice for the agricultural practice. Since it was possible to prove additional five non-financial determinants influencing farmers' choice amongst mechanization alternatives, it furthermore can be concluded that the defined knowledge gap is reduced but however might not be stated as closed due to the limitations of this research.

### **9.1 Recommendations for further research**

Since this research faces some limitations, further research in the context of farmers' decision-making process in choosing mechanization strategies is required. In particular, further research is necessary to improve the validity and reliability in order to increase the transferability of the findings since those within this research are based on a rather small sample size.

Moreover, further research should investigate the possible interrelations of the elaborated determinants in order to explore possible causal relationships between determinants and occurring mechanization strategies. The thereby achieved findings then for example might allow the development of decision criteria based on the determinants that in turn could be used to support deciding farm managements in their choice of adequate mechanization strategy.

Furthermore, since this research is mainly focused on mechanization decisions, further research could investigate whether the explored determinants in this field are also transferable in other fields where strategic decisions of farm managements are required.

### **9.2 Recommendations for managers**

Although the findings of this research are restricted due to the mentioned limitations, this research delivers useful insights in the decision-making process of farmers in choosing the mechanization strategy so that the following recommendations can be given to managers of agricultural businesses, in particular to farm managers. Accordingly, farm managements that



are actually confronted with the question of whether to in-or outsource they machinery services should take into account the different mechanization alternatives that are identified and proved within this research. They thereby especially should acknowledge that all of them have different advantages and drawbacks and due to this fact should be aware of the consequences caused by choosing a particular mechanization strategy. Furthermore, based on the findings of this research, managers should consider the identified determinants relevant for the decision-making process. Those determinants should be evaluated with respect to the conditions on farm, in particular since they on the one hand strengthen or limit the range of feasible mechanization alternatives and on the other hand achieve valuable information especially by other social contacts as well as require a personal decision based on the attitudes of the deciders. In doing so, the adequate mechanization strategy for executing machinery services can be found easier.

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## **Appendices**

### **Appendix A: Definition of concepts**

#### **Definition of concepts**

The following concepts are used frequently during this research but may be not commonly understood. Therefore, the following definitions are given to clarify their meaning in this research.

#### **Agricultural machinery services:**

Every farm type has to conduct working steps for that agricultural machinery is used. Such farm operations are here referred to as agricultural machinery services or simply as agricultural services. Some examples where machinery is commonly used are sowing, harvesting or feeding animals.

#### **Mechanization strategy:**

ABDULQUADRI and MOHAMMED (p.538, 2012) define agricultural mechanization as “(...) the application of agricultural engineering principles and technology, by the use of mechanical systems in the process of food, feed, fibre, fuel production, protection, processing, handling and storage.” On farming level, farmers apply those agricultural engineering principles to which belong amongst others tractors, combines or forage systems etc. either by own or rented machinery (in-sourcing) or they can outsource it to agricultural service providers, such as contractors. In this research, those different mechanization opportunities are referred to as mechanization strategy.

#### **Determinants of decision-making process:**

Determinants are in this research seen as set of factors that influence farmers to make a particular decision into a mechanization strategy. The exploration of these determinants is the object of this research. The assessment of those determinants however may be different amongst the farmers resulting in different strategies followed.

## **Appendix B: Interview information sheet**

The following information sheet was available for all interview participants and the researcher has summarized its content verbally to the interviewee before the interview has started.

### **Information sheet:**

**Interview in the context of the Master Thesis of Egbert Wesselink**

**November 2015**

#### **Information about the Research Content:**

##### **Problem Definition:**

In times where agriculture is affected by volatile commodity prices and increasing production costs, it is increasingly important for farm managements to improve their operational efficiency. Agricultural mechanization hereby acts as important factor in the farming business as it causes about 20% of farms total costs (LIPS and BUROSE, p.40, 2012). It is known that farmers have the possibility to either in-or outsource their agricultural machinery services. The choice between these options is crucial for the farm management as the existing alternatives may affect the related costs, productivity, flexibility and quality differently.

From a scientific view, the managerial decision amongst the existing alternatives of in-or outsourcing is only highlighted from a financial point of view in which farmers were trained in how to choose the cost minimizing alternative. However, further research in the decision-making process of farmers in other fields has identified, that farmers are not only driven by cost minimization, but that they also make decision based on other non-financial aspects.

The problem is that this new scientific understanding at the moment is not applied in the context of farmers' mechanization strategies. This causes a knowledge gap as it is not known which determinants influence farmers in choosing their mechanization strategy. An overview of such decision influencing determinants however could deliver crucial knowledge for different people, such as actual deciding farmers thereby getting a better theoretical fundament in choosing their mechanization strategy, the agricultural engineering industry getting a better insight in farmer's decision behaviour or maybe even entrepreneurs looking for offering system solutions to practical agriculture. This research wants to close this knowledge gap by better understanding farmer's decision-making process in choosing agricultural machinery services as it is an important operational field of agriculture with a high potential to save costs but simultaneously the requirement to deliver qualitative and efficient work.

##### **Research Objective:**

Therefore, the objective of this research is to create a deeper insight into the decision-making process of farm managements in the question of whether to in- or outsource agricultural machinery services by exploring and explaining the determinants that influence this choice for agricultural practice. The question that is central in this research hence formulates as follows: What are the determinants of farm management when deciding how to execute agricultural machinery services?

##### **Aim of the interviews:**

In its literature review, the research has derived several theoretical determinants that might affect farmers when they choose their mechanization strategy. The aim of the interviews is to elaborate those determinants that in practice are of importance for farmers when they decide amongst the mechanization alternatives. For this, several farmers in two regions of different countries as well as service providers for getting an external view on the farmer's decision-making process were addressed.

##### **Reference:**

LIPS, M. and BUROSE, F. (2012): Repair and Maintenance Costs for Agricultural Machines. Published in: International Journal of Agricultural Management, Lips.3d, 17/4/12.

## Appendix C: Questionnaire Farmers

The following questionnaire has been used during the interviews with all farmers.

### **Information about the farm**

Name farm: \_\_\_\_\_

Place: \_\_\_\_\_ established in: \_\_\_\_\_

Farm type<sup>1</sup>: \_\_\_\_\_ Farm size: \_\_\_\_\_

Farm specialization(s)<sup>2</sup>: \_\_\_\_\_

Name contact person: \_\_\_\_\_

Age: \_\_\_\_\_ Education: \_\_\_\_\_ on farm since: \_\_\_\_\_

Position within farm: \_\_\_\_\_

Points of interests on farm: \_\_\_\_\_

Recording of interview allowed? \_\_\_\_\_ yes \_\_\_\_\_ no

### **A. Introducing Questions:**

1. Do you conduct agricultural machinery services on your farm? If so, which ones?
2. How do you conduct these services?<sup>3</sup>
3. Are there possible alternatives for your actual way of conducting machinery services?
4. Do you plan to improve your actual mechanization strategy?

### **B. Background questions to the actual mechanization strategy**

5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?
- 6a. Have you followed another mechanization strategy before?
- 6b. Why did you decide to follow this mechanization strategy?
- 6c. Why did you decide against the possible alternatives?
7. How did you experience your mechanization strategy until now?

### **C. Choosing the mechanization strategy**

8. How do you get the information about the possible mechanization alternatives?
9. Do you evaluate these alternatives only based on their expected costs?
10. If not, which other factors do influence you while choosing the mechanization strategy?
11. Do you consider some of these factors more important than others?

### **D. Addressing the theoretical derived determinants**

#### **Financial Determinant**

12. Is a financial assessment of the possible mechanization alternatives important to you?
13. Which financial aspects do you consider during such an assessment?

#### **Quality Requirements**

14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?
15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?
16. Do these quality requirements influence the evaluation of mechanization strategies?
17. Does the technology of machinery have influence on the mechanization alternative?

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<sup>1</sup> Farm types: arable farming, different forms of animal husbandry (dairy, ...), mixed farm

<sup>2</sup> Please indicate, if possible, the relative business importance of each specialisation

<sup>3</sup> Alternatives: In-sourcing (ownership, renting or leasing), outsourcing (service provider) or machine sharing

**Flexibility**

- 18. *Is it important for you to be independent in conducting machinery services? (time and duration of operation)*
- 19. *Is this independence of special importance for a certain working step?*
- 20. *How does this independence influence the choice of mechanization alternatives?*

**Machine Maintenance**

- 21. *Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*
- 22. *Does this necessity influence the assessment of mechanization alternatives?*

**Social Influences**

- 23. *Are there any persons in your environment that can influence your decision on the mechanization strategy?*
- 24. *Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*
- 25. *Do you assess comparable mechanization strategies followed by colleagues?*
- 26. *To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*
- 27. *Do you feel pressured to follow such recommendations?*

**Labour Availability**

- 28. *To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

**Time Availability**

- 29. *How does the time availability influence your choice of mechanization strategy?*

- 30. *In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

## Appendix D: Questionnaire service providers

The following questionnaire has been used during the interviews with all service providers.

### **Information about the service provider:**

Name firm: \_\_\_\_\_

Place: \_\_\_\_\_ established in: \_\_\_\_\_

Business type<sup>4</sup>: \_\_\_\_\_

Specialization(s)<sup>5</sup>: \_\_\_\_\_

Name contact person: \_\_\_\_\_

Age: \_\_\_\_\_ Education: \_\_\_\_\_ employed since: \_\_\_\_\_

Position in firm: \_\_\_\_\_

Recording of interview allowed? \_\_\_\_\_

### **A. Introducing questions**

1. Which kind of agricultural machinery services do you offer? How would you characterize it?
2. How many customers do you have on average per year?
3. Did the amount of customers change over the past years? If so, which reasons do you see behind?
4. Is there any farm type that employs your service most?
5. Which alternatives do farmers have when they do not choose your service?

### **B. Background questions o mechanization strategy**

6. Which advantages and disadvantages do you see in your way of providing a service?
- 7a. In your opinion, why do farmers choose your service?
- 7b. In your opinion, what are the reasons to not choose the possible alternative(s)?

### **C. Choice of mechanization strategy**

Think about a farmer that has to choose his mechanization strategy:

8. Where do farmers get information about the possible alternatives to conduct their required machinery service?
9. Do you think farmers assess these alternatives only based on the expected costs?
10. If not, which other factors do you think are important for their decision-making and how do you characterize/describe them?
11. Are some of these factors more important than others?
12. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?

\_\_\_\_\_

<sup>4</sup> Type of service provision: Contractor, machine ring/ rental

<sup>5</sup> Specialization in machinery service offered, if present

## Appendix E: Summary interview farmers

**Answers from Farmers:** four respondents from Germany and four from the Netherlands

**Interviewee:** Germany 1 -G1-

Farm information			
Name farm:	Farm Goormann	Place:	Ringe
		Established in:	Family-run since generations
Farm type (size):	Mixed farming operations (45ha, 80 dairy cows, labour forces: farm manager)		Focus on:
			Dairy farming
Information about contact person			
Name:	Hermann Goormann		Position:
			Farm manager
Age:	45	Education:	Agricultural master
			Work experience:
	26 years		
Interests on farm:	Arable farming and farm mechanization		
Recording allowed?	yes		

### A. Introducing Questions:

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: When looking on our dairy segment, my cows are fed by a contractor. Focussing on our arable farming, seed bed preparations I am doing on my own while sowing is outsourced. Plant protection measures do not apply on my farm. The harvest of my forage crops is also conducted by a contractor. The application of liquid manure I am doing on my own with rented equipment.

*Q2. How do you execute these services?*

A: That hardly depends on the situation on my farm. The harvest as well as feeding of cows is done by contractors. The same is true for sowing. I would say the most operations are outsourced.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: Yes, I could do more with own equipment or I could rent machinery more often. But it is likely that I will even outsource more operations.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: I have recently changed my mechanization strategy regarding the feeding of cows, so at the moment I am kind of satisfied.

### B. Background questions to the actual mechanization strategy

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: For example the feeding of my cows. The disadvantage to do this with a contractor is that is more costly compared to do it with own mechanization. However, the main argument behind is that I can save a lot of time. Available time is actually where I think about most on my farm because I do not have enough of it.

*Q6a. Have you followed another mechanization strategy before?*

A: Yes, I have fed my cows with own machinery.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: I have outsourced this work, because time savings played an important role in my decision. The thing is, I run stuck with my available time on farm so that other important obligations on farm were neglected.

*Q6c. Why did you decide against the possible alternatives?*

A: I needed to outsource that work because it demands a lot of time and my quality of life suffered due to the fact that I had nearly no leisure time remaining.

*Q7. How did you experience your mechanization strategy until now?*

A: I am fully satisfied with this decision because it works out well.

### C. Choosing the mechanization strategy

*Q8. How do you get the information about the possible mechanization alternatives?*

A: I am reading a lot of professional journals where mechanization questions sometimes are addressed.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

A: No, it is not only depending on the costs. Think of my feeding of cows. I have the required machines already on my own farm which would make their use even more cost efficient for me. However, I outsource this activity because I have no time to do it and I cannot create time.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: As I said: time. Time is my problem. I would do it on my own because I like that work, but I needed to save time and there is this possibility that someone offers feeding cows. Hence, due to my restricted time I have chosen the probably more expensive option of outsourcing.

*Q11. Do you consider some of these factors more important than others?*

A: Yes, available time is for me more important than the costs of alternatives as my time is limited.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes the costs play a role. We have the lucky situation here that we have a machinery rental in the near. In my situation, hiring their equipment in each case is cheaper than own equipment. Moreover, they offer the newest technology which I simply could not afford to buy on my own.

*Q13. Which financial aspects do you consider during such an assessment?*

A: The utilization. The more I can use the machine the lower the costs get for me. I am always looking for technology that is affordable and works reliable, so that there are no big maintenance and repair costs involved. The professional journals do have good information about the technology of machines. For example, a couple of years ago I bought a feeding machine with a certain technology behind that at least survived four times the life cycle of its competitors technology that would have cost the same regarding the depreciation.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, the quality of delivered work has to satisfy me otherwise I will not ask that particular contractor again. I need to have good quality of forage, for which I need a particular kind of technology, because with this quality I can make money later on.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: One thing I directly can recognize is the crop loss while harvesting grass. This is a lot influenced by the operator and also by the machine settings.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes. For example, due to my quality requirements I do some steps of the grass harvesting by myself with rented machinery, because I know that the rental has qualitative machinery in a good working condition.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: Yes, the technology that is available on our machinery rental is much better regarding crop loss compared to the technology I could afford for myself.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Yes, of course. We are depended on the prevailing weather conditions. That is the reason why I have had the machinery for harvesting grass on my own. The time spans for conducting this work adequately are relatively small and with own machinery I was more flexible and could minimize my crop losses. That is why I would like to still do it on my own, but it was not possible to continue, because I had not enough available time so that the contractor had to do this work for me. However, being flexible influences the quality of work executed but the time factor plays against being flexible.

*Q19. Is this independence of special importance for a certain working step?*

A: Yes, flexibility is crucial in forage harvesting because the right time of conducting the work has big influences on the quality of forage.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: The thing is that I have no choice. I am not independent since I have not enough time to do everything on my own. I am depending thus on the schedule of contractor and the availability of machines at our machinery rental. That means I also have to make compromises in my own planning if my contractor for example says: I cannot help you today. I have to conform to my contractor.

### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: It is of course nice if it is not necessary to maintain a machine.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: No, if owning a machine would be better for me, the maintenance is not a factor to say I would not buy it. I still would buy the machine even when this requires maintenance and repairs.

### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: If I would have more labour forces available, I would reflect the decisions with the person and the chance would be higher that I decide to invest into own machinery so that the contractor does not need to do my work. But for now, I make the decisions on my own.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Yes, then we talk about how we do machine work at the moment and which experiences we have with it. But I have to say this happens not very often. Back in my school time me and my friends talked a lot about mechanization strategies.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, but my decision does not depend on that assessment. I give a look at how they are doing things and then I prove whether their strategy would be an option for me or not.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: The recommendation of certain colleagues has big influences on my decision while the opinion of others has nearly no influence. The farming situation of my colleague needs to be comparable with my farm. You have to think about with whom you are talking and who are you asking. It has to be a person from which I think I could learn things from. So, I am starting with a personal assessment of my colleague first.

*Q27. Do you feel pressured to follow such recommendations?*

A: Definitely not, I always do things that work out the best for me.

### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: Labour availability plays a big role, because if I would have personal available, I would have the possibility to calculate whether in-sourcing would be cost-efficient for me. The limiting factor time would be eliminated when I would have an employee. However, I do not see enough utility to invest into personal, because an employee has earn more for the farm than he costs, and I do not see this at the moment. This cost-benefit analysis does not work in my situation right now. Moreover, a person that is really skilled is also costly. Others are easily to hire, but you do not want them.

### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: It influences nearly everything. I have too little time available. That is why a lot of options do not apply to me. The fact that I already have such a heavy work load really annoyed me over a longer period. Think of yesterday (Sunday): while others have leisure time, I had to manage my cows. That's something that irritated me over a long period until I recognized: We are working in order to live but we are not living in order to work. When you are young, you do not think about this, but as soon as you get older, you start to think about such a sentence and you want to minimize your work load.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

The readiness to assume risk plays a role in a lot these questions. It lies in the nature of human being. Younger people are more willing to bear risks and they have to be in order to invest. But when the farmer gets older, he is more risk averse because he wants to protect his actual situation. Hence, the willingness to deal with risks influences the farmer's attitude towards certain options and this also applies in the question of mechanization.



**Interviewee:** Germany 2 -G2-

<b>Farm information</b>			
<b>Name farm:</b>	Farm Stegeman	<b>Place:</b>	Volzel
		<b>Established in:</b>	1970
<b>Farm type (size):</b>	Mixed farming operations (113ha, 100 dairy cows, labour forces: father and son)	<b>Focus on:</b>	Dairy farming, arable farming, biogas and chicken
<b>Information about contact person</b>			
<b>Name:</b>	Gerrit-Jan Stegeman	<b>Position:</b>	Farm manager
<b>Age:</b>	62	<b>Education:</b>	Agricultural master
		<b>Work experience:</b>	45 years
<b>Interests on farm:</b>	Dairy farming and farm mechanization		
<b>Recording allowed?</b>	yes		

#### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: We perform all agricultural activities on land on our own, except the sowing of maize. The cultivation of grass we do also on our own except grass chopping which is done by a contractor.

*Q2. How do you execute these services?*

A: Most of our machinery activities we perform with our own machinery but we also hire contractors for some working steps, such as harvesting maize or grass.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: We could ask contractors or we could rent machinery from our machinery rental.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: We definitely do not want more own machinery. Maybe some replacement investments.

#### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: Think about the mowing of grass. The problem is that you cannot come first in the planning of your contractor. Therefore we have this machine on our own in order to be independent in setting the time. Renting machinery would be more efficient, but if you miss

only one cut because the machine is not available, own machinery has already paid off. But if you look at the costs, especially because of high repair costs, having own machinery would not be the most cost efficient alternative. However, you must have the machine to be flexible.

*Q6a. Have you followed another mechanization strategy before?*

A: Not really. Except the harvesting of grass which we have done with own equipment.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: Because we want to be flexible. As soon as one farmer wants to cut grass, every farmer wants to, because they all have the same weather conditions.

*Q6c. Why did you decide against the possible alternatives?*

A: Their cost-benefit analysis does not work for us. For example an own silage trailer is simply not realistic to buy as the required technology with adequate performance would be too expensive for us. We have had a used machine that was too small for our purposes so that we had to harvest over a longer period resulting in quality losses of our forage.

*Q7. How did you experience your mechanization strategy until now?*

A: It is a good decision and we will keep it this way. However, we do not want more machines because you have to maintain them also.

#### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: That is mainly based on our own experiences with equipment that we have purchased.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

No. Of course, we have to stay within a certain limit regarding the costs, but sometimes you have to accept higher costs in order to ensure that services could be performed on time. However, costs need to be kept within boundaries. Other activities we can perform with our own used equipment and that is for sure cheaper than a contractor could do it for.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: That you can perform your work on time. That means the flexibility is also important.

*Q11. Do you consider some of these factors more important than others?*

A: Yes, maybe the flexibility is a way more important than the costs as long as they can be hold within an acceptable range.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, of course.

*Q13. Which financial aspects do you consider during such an assessment?*

A: We think of fuel, labour and repairs costs and things like that. But mainly the total costs of owning a machine are important. But, the labour costs you actually do not need to calculate because when you outsource that work, you will not do anything else but rather will help with the work. (...) We rather do not look at the utilization because we know that our own machinery will not be fully utilized. But if you want to be flexible you cannot look at that.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, quality is of importance. Think of harvesting potatoes, there the machine settings plays an important role because you want to catch even the last potato from the land. We do this on our own because thereby we think we can best adjust the machine settings. However, at other services, contractors also can deliver good work if they want to since they have adequate machinery. Yet, we also look at the cleanliness in certain working steps and that was one reason to in-source activities again, especially if they are related to our animal keeping. If you have done that work on your own you know what and how it is done.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: The machine settings are of importance. Also the way of operating, especially when you want to have proper forage. But the outcome hardly depends on the operator, because when you have these unskilled operators, the quality suffers extremely.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes, definitely. When you do that work on your own you have the control over quality.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: Yes, the performance of the machine is important, the way they work and their delivered quality has influence on the choice. For these reasons we often rent machinery because they have these attributes. If you rent machinery you normally have new technology available, which surely would not be affordable for yourself.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Yes, for a certain extent indeed.

*Q19. Is this independence of special importance for a certain working step?*

A: Yes, especially during the forage harvesting because the right time influences the quality. That is the reason why we have a grass cutter on our own. However, looking at the availability of a silage technique of our contractor we are fully satisfied as he always has time when we want to harvest grass as long as you plan together with him in advance.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: You have to own certain machinery in order to be flexible.

##### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: That is no problem for us. It is not a factor to say we do not want to have own equipment. However, it is important for us that we have a service station nearby.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: No, it does not influence our decision, it just belongs to having own machinery. However, you have to maintain your equipment adequately.

##### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: Not really, we are relatively independent in our decisions. It is more about getting information from others.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Yes, we talk about that. For example, why somebody bought this machine, or why somebody would not buy a certain technology again.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, we look at how others execute their services and how it works, because from copying you can learn a lot.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: They can influence our decision, yes. But it depends who is recommending. You have these colleagues that always praise their mechanization strategy.

*Q27. Do you feel pressured to follow such recommendations?*

A: No, not really. We do what we think is best for us.

#### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: The availability plays a role. For that reason we do not want to further in-source, because we have not enough workers available. We could hire additional personal but the contractor comes with operators which is easier for us in managing.

#### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: You need to calculate the time. If you do not have enough time, you cannot do things on your own. You need time for other farm obligations, especially when you have animals. They need to be well cared otherwise the quality suffers and in the end you lose more than you win with own machinery.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: I think we have talked about everything.

**Interviewee:** Germany 3 -G3-

Farm information			
Name farm:	Farm Kaalimink	Place:	Ringe
		Established in:	Family-run since generations
Farm type (size):	Mixed farming operations (100ha, pig finishing, labour forces: father and son, one employee)		Focus on:
			Pig farming
Information about contact person			
Name:	Albert Kaalimink	Position:	Farm manager
Age:	56	Education:	Agricultural master
		Work experience:	35 years
Interests on farm:	Pig farming		
Recording allowed?	yes		

#### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: Yes, of course. Everything that belongs to the cultivation of maize. Seed bed preparations, sowing, plant protection measures and harvest of maize. We try to hold these activities as short as possible.

*Q2. How do you execute these services?*

A: We do the growing on our own with own and rented machinery. Manure application and harvest is outsourced to a contractor.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: You could completely outsource the work to the contractor or you could cooperate with colleagues. But as I have a certain pool of own equipment, it is cheaper for me to in-source as long as there is time for it.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: No.

#### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: Outsourcing frees up my time that is the main advantage. Time is our limiting factor as our working time is allocated to our keeping of animals. You need time especially in the peak times of sowing and harvest in April and October but you cannot create more time. And when we have no time available, I call our contractor or a maybe colleague. However, I try to do things on my own because it acts also as kind of variation of our daily work and makes fun, especially since I have the machines available. If one of these factors misses, fun, machine or time, then we outsource the work and that is certainly not uneconomical.

*Q6a. Have you followed another mechanization strategy before?*

A: No, I try to do things on my own. But we have had another crop in our cultivation that required a lot more working time. For this reason we stopped with that crop and concentrated on maize.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: Because I either already own required machines or I can easily rent them from our local machinery rental. And because it is a variation of my daily work. That are decision factors why I in-source machinery services. But we also outsource other activities, like the application of manure. There are four reasons why we hire a contractor for this: 1. He has the adequate technology where I am convinced of 2. The same machine for owning would be too expensive 3. It is too time-consuming and 4. There is an extra payment of the government for this certain technology which is only accessible if a licensed contractor performs this service.

*Q6c. Why did you decide against the possible alternatives?*

A: For the reasons mentioned in the previous question.

*Q7. How did you experience your mechanization strategy until now?*

A: I will continue this way. If I could, I would extend my time for sowing in April but our weather conditions do not allow that. It would be nice if I could allocate one day per week for arable farming, but that is not possible.

#### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: From fairs, professional journals or farming colleagues.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

A: No, surely not.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: Time and personal attitude towards the work considered. The idea to have done the work on your own and the fun you have at this work plays a big role. I would call it fun factor. Do I enjoy this work without increasing costs too much? The costs need to stay within a certain range.

*Q11. Do you consider some of these factors more important than others?*

I think the biggest role plays the costs. If in-sourcing is too expensive the enjoyment could even be as high as possible but that will not work then. So, possible higher costs will be seen in relation to the utility of in-sourcing work.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, of course.

*Q13. Which financial aspects do you consider during such an assessment?*

A: The costs must stand in relation to the utility to have from it. You need to calculate what is economical for you. I thereby consider the total costs.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, the delivered quality is important to me. I look for example at the way of operating when the contractor comes. Especially crop losses are things that one could prevent. However, my contractor usually has qualified personal so that there is not much to criticize. That is the reason why I hire a specialized firm. The choice of firm thus is already a kind of quality choice.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: Yes, that are these things like way of operating or proper machine settings. But that does not really apply to me as I have a chosen for a qualified firm and I expect them to work on optimum in these points.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: No, not really because I could not do the services better than my contractor as he has excellent technologies. By the way, the cultivation of maize has not those big quality requirements, so that I can be easily pleased by service providers. If I would still cultivate grain, then I would have completely different thoughts as I would be more depending on the weather conditions.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: Yes, the contractor comes with newest technology that would not be affordable when I would buy it on my own.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Not really important but only because I have maize. But if I would still have potatoes or grain, then the reason of being flexible is nearly compulsory to invest into own machinery. Think of plant protection measures, which often need to be done in the late evening hours in order to have good weather conditions and to achieve good results. Then you cannot call your operator for a few hours of spraying. He would tend to come by day when the conditions are less optimal. But at the cultivation of maize this things are not so important.

*Q19. Is this independence of special importance for a certain working step?*

Independence is secondary-rated in the cultivation of maize, whereas it plays bigger roles in the cultivation of potatoes or grain for example. There you are more depending on the weather conditions.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: Flexibility definitely costs money, but if I can hit the right time to execute my work, these additional costs could be neutralized again. But you do not really have them in the cultivation of maize. Things would be different if I would have other crops.

### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: When I look for own machinery, I always pay attention to purchase qualitative machines so that I can minimize repairs as far as possible. Cheap and mainly old machines will annoy me at a certain point because they probably will require a lot of repairs which costs money but also time. And as usual, machines broke down exactly then when you need them and as I said, that is when I do not have too much time for repairs. Hence, I am looking for reliable technology which is also service reduced, so that in working peaks there is not much maintenance for me. Because I could manage this with my machines until now, the necessity to maintain is rather secondary-rated for me.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: Yes, it is, but it depends on the machine we consider. For example a maize planter is maybe cost-efficient for me to own, but it requires a lot of maintenance for which I have no time.

### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: Yes, at the moment my employee, because we discuss alternatives based on the time we have. Furthermore, my family for sure has influence, especially my son because he will continue my business so that his opinion is also important to consider.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Not often, only every now and then with certain colleagues. Then we talk about their opinions and their experiences with certain alternatives or machines. It is about: how is your experience with this or that technology, for example.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: It is not like I am assessing what others are doing. It is more that when I know that somebody has experiences with a machine that I have in mind to buy, I would contact him

and directly ask him. When I see others working, however, I do not explicitly make my opinions of their method.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: If there are concrete recommendations then they will be included in our decision.

*Q27. Do you feel pressured to follow such recommendations?*

A: No, rather the opposite. I rather like to have something that others do not have.

### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: Of course, if my employee is not available for example by breaking his leg, then I need to reallocate my resources so that our important work can still be conducted. Hence, the labour availability plays a big role. It is easy, when we have other urgent things to do, I will outsource machinery work. I also pay attention that our employees get jobs they are adequately skilled for. So it is also important for me that if I will in-source work, that I have people that are able to operate the required machines.

### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: Of course, to a large extent. If time is not available, I need to look for alternatives one of which in my case is the contractor. By the way, compared to the man hours of usual employees, we have no time available because we already exceed those hours with all the work we could and have to do on our farm. However, you perform activities by working additional hours on the costs of leisure time, especially those machinery services. Maybe it is also a kind of hobby to us. And as long as there is the possibility to in-source machinery services, we try to do it on our own. But we have to pay attention that our focus lays on animal keeping. That is where we make most money and where we have to care about. We have to prevent that our animals suffer because we want to in-source our machinery services.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: We have talked about it a bit: I think the fun factor or maybe call it farmer's interest is an important factor to consider, because it acts like a kind of hobby or a kind of balance to his daily work.

**Interviewee:** Germany 4 -G4-

Farm information			
Name farm:	Farm Breman	Place:	Weusten
		Established in:	Family-run since generations
Farm type (size):	Mixed farming operations (117ha, 37 dairy cows, 60 bulls for fattening, labour forces: farm manager and one trainee)		Focus on:
			Arable farming (potatoes)
Information about contact person			
Name:	Geert Breman		Position:
			Farm manager
Age:	46	Education:	Agricultural master
			Work experience:
			27 years
Interests on farm:	potatoes		
Recording allowed?	yes		

#### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: Yes. Seed bed preparations, sowing, plant protection and care measures and harvest.

*Q2. How do you execute these services?*

A: I would say we mostly in-source those activities with approximately 50% rented machinery to which belong the potato planter, soil tillage implements, slurry tanks and the other 50% machines we own or have in cooperation with another farmer. To these machines belongs amongst others one sprayer which I own for myself and a potato harvester as well as a silage trailer in joint-ownership.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: For example the contractor I ask when I have time shortages.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: Yes, I am considering to improve my machine technology.

#### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: The advantages of having your own equipment are the flexibility and the cost-efficiency in harvesting potatoes. Furthermore, I can influence the quality of my crops better since I spray for myself, because I can see the actual situation on my crop fields. The problem however is, that in-sourcing is very time-consuming.

*Q6a. Have you followed another mechanization strategy before?*

A: Sometimes we use contractors when we have time shortages. But normally we do it on our own.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: Mainly because of optimizing the quality of our forage by being flexible in setting the time of performing tasks.

*Q6c. Why did you decide against the possible alternatives?*

A: Because when you work with a contractor you are depending on his schedule and that restricts my planning.

*Q7. How did you experience your mechanization strategy until now?*

A: I am satisfied so far.

#### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: In the first instance by reading Landwirtschaftsblatt (German professional journal) or respectively by searching on the internet.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

A: Not only based on the costs but also in terms of available labour in my farm. That determines whether we can or cannot do services on our own.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: The available labour forces and the time we have to do such work.

*Q11. Do you consider some of these factors more important than others?*

A: I think the time is more important than the labour forces.



#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, as long as any alternative is economically feasible, they are possible for me.

*Q13. Which financial aspects do you consider during such an assessment?*

A: Modern machines are capital intensive. I consider mainly the total costs of ownership.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes I do. Modern technologies achieve good harvesting and storage qualities which is especially important in the cultivation of potatoes. I recently recognized that when I could not harvest on my own because my machine was not able to cope with the wet conditions on land and I ask contractors to help me. The quality is depending on the technology of the machine. That is the reason that I will not ask a certain contractor again as his potato harvester did not convince me. I am still busy to clean the potatoes he has harvested for me. For this reason I always say to my trainees, that they have to prove the quality of work they deliver. The same is true when you outsource your work. You cannot sit down in the kitchen but you rather have to control their work regarding machine settings, etc. Monitoring still have to be done no matter whether you in-source or hire a contractor. For example, if the contractor's operator drives in such a way that he damages my potatoes. These are incidents you have to prevent. So the way of operating also is important for me when work is executed.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: It has to be a pleasure for me to work with the technology that means, it has to be easy in handling and it has to function when I need it. And of course, the outcome of work needs to satisfy me.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes, they do.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: Yes, because certain technologies do not fit on my farm.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Yes, because for example by this the forage quality can be improved to a large extent.

*Q19. Is this independence of special importance for a certain working step?*

Yes, during the forage harvesting because this enables you to get forage with the best quality which is depending on the weather conditions.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: The execution of services can when looking at the weather conditions be done on time by own machinery. That is why we have invested into own machinery.

##### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: Most of my machines do not require much service so that a big part of maintenance is already covered. Other things that accrue have to be done, that is as simple as it is.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: No, this necessity has no influence on my decision. It is certainly not a reason to prefer outsourcing.

##### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: No, not really.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Yes, of course. It is an exchange of experiences. Think of forage harvesting. We make analysis of our forage and such analysis results were compared to other farmers following different strategies.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, I think so.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: If the farming colleagues are better than I, I have to start thinking about improvements. But that depends which opinion I have on these colleagues.

*Q27. Do you feel pressured to follow such recommendations?*

A: No, not necessarily. If I am not convinced, then I am not willing to do the same. I do what I think is best for me.

#### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: It plays a role because the availability determines what I can do on my own. We work with trainees. Sometimes they are skilled and sometimes they are not. If they are skilled, I have wider base to say we can in-source more activities. The availability of adequate personal, meaning labour forces which are skilled and capable of working e.g. with machinery, plays thus a role. At the moment I have no problem to get such personal, but in the long run I think this gets more difficult.

#### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: You have to continuously increase performance in order to stay economical and you have to try to do your work within a minimum of time. Time is a very important factor that is limited. Think of harvesting maize. In the past we harvested maize based on mutual support of neighbours. Now, this work is done by our contractor who directly delivers operators, because there is no time available to help my neighbours.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: No, I do not think so.

**Interviewee:** Netherlands 1 -N1-

Farm information					
Name farm:	Farm Lambers	Place:	Nieuw-Amsterdam	Established in:	Family-run since generations
Farm type (size):	Mixed farming operations (71 ha, 200 cows, labour: father and son)			Focus on:	Dairy farming
Information about contact person					
Name:	Hinderikus Lambers		Position:	Farm manager	
Age:	21	Education:	Agricultural master	Work experience:	3 years
Interests on farm:	Dairy farming and mechanization				
Recording allowed?	No. Summary is therefore based on researcher's notes				

#### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: Yes. Machinery services on our farm consist of seed bed preparations, manure application, sowing, plant protection measures and harvesting.

*Q2. How do you execute these services?*

A: Except some manure applications and plant protection measures we do everything with own equipment. Even harvesting grass and maize.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: Of course, we could work more with a contractor, but we think that is too expensive. Or we also thought to sell our maize planter and rent such machines, but machinery rentals are less known here and thus the next is a kind of too far away.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: Yes, we continuously think about it. For example we decided in the year 2009 to in-source harvesting.

#### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: We are independent from others, that is our main advantage I think. We can decide in the morning whether we harvest our grass today or not whereas if you have others doing this job, you need to plan several days before and it is still a question at which time the contractor will be here. That is why we decided to buy a self-propelled harvester because this enables us to

increase the work for this machines (This machine can be used for grass and maize harvesting purposes simultaneously) and thereby lowers our costs of owning machinery.

*Q6a. Have you followed another mechanization strategy before?*

A: Yes, before 2009 we had another grass harvesting technology, i.e. silage trailer, but that machine got too small for our work.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: We needed to increase our performance and for nearly the same money you need to invest for a good silage trailer, we could purchase used maize and grass harvesting equipment.

*Q6c. Why did you decide against the possible alternatives?*

A: The problem always is the time of executing this work. With own machinery we are much more flexible and on top of that we have control over the quality. We think that we could deliver the best quality if we work on our own, because we have made some bad experiences with the way of operating of contractors, especially during the application of manure. Of course, you need interest for machines, because you need to be able to cope with situations when machines break down.

*Q7. How did you experience your mechanization strategy until now?*

A: We like that we are able to do the most things at our own.

#### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: A lot of information we find on the internet. But also machinery salesmen and dealers have valuable information. Some information also can be found in professional journals. Sometimes we ask friends but farmer colleagues we ask rarely, because we have made bad experience with asking persons you do not know in advance.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

A: The costs play a role, yes. We try to be cost-effective but we want to do the most things at our own and that is not necessarily the cost-effective option.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: Yes, that is the flexibility. We want to adjust ourselves to the actual weather conditions.

*Q11. Do you consider some of these factors more important than others?*

A: I think that the costs are the limiting factor. If the flexibility would be economical not feasible, in-sourcing would not be an option.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, it is a major point as it limits the possibilities.

*Q13. Which financial aspects do you consider during such an assessment?*

A: We mainly look at the total costs and of course they are composed of things like fuel, repairs and maintenance costs and depreciation. Actually, the labour costs we do not consider, because we say, that we are here anyway and we do not pay ourselves. The utilization of course is an attribute of less importance to us, because we buy used machinery. What is important is the performance of the machinery. What is the use of a cheap machine with which you have to work twice as long? That does not work.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, the machines must work ideally under optimal weather conditions. Because contractors have to satisfy a lot of farmers within these weather conditions, they often start working and continue their activities under conditions which are not ideal for the quality of outcome.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: The quality of our forage must be good. And this is extremely influenced by how you operate the machines in terms of settings and way of driving. And of course, we do not want grass to be harvested when it is too wet, for example because the operator comes too late or too early.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes, indeed. But sometimes you have no choice. Think of spraying. A dairy farm normally has not much to spray. However, you need good equipment for this and that would be not enough used and therefore too expensive for us.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: No, not that much, because even older technology is capable of delivering good results, at least we think so.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: It is an important point. Is the weather nice, you want to start your work. You cannot wait until the machines are available then. We do not want to be depending on the contractor's schedule.

*Q19. Is this independence of special importance for a certain working step?*

A: Yes, it enables harvesting forage with a better quality. For plant protection measures it is also of importance, but as I said, we cannot afford our own machine for this.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: By being flexible you can decide when and where you want to work. This is not possible with contractors or it requires planning too much days in advance. That is why we decide to do our work on our own with own machinery.

##### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: We have our own machinery and we of course need to maintain and repair them, especially since we have a lot of used machines.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: It is not a factor to say we do not start to do things on our own. But it is rather an attribute of cost-calculation.

### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: Yes, of course my family. But to a large extent also the salesman.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Not really, maybe with friends working for contractors for example. But not with farming colleagues, because we have no comparable farmers in our near.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, we look at others and if we see something that works better we check whether we could improve it.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: Back in time we did. But recently we made some bad experiences with recommendations of others, so we were now more reluctant therein. The thing is also, there are not many farmers that completely in-source their machinery activities, so we have not much people to ask. However, you can learn from others but that certainly requires an pre-evaluation of that farmer.

*Q27. Do you feel pressured to follow such recommendations?*

A: No, we do what we think is best for us.

### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: You need to have enough labour forces, but we have no problem to find them. However, we recognize the problem to find skilled people who are capable of driving machines adequately.

### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: Normally we have enough time, but our dairy cows have priority in our daily activities. That means that in the morning and evening the care of our cows comes before driving the machines. That is why our machines sometimes are standing while others already or still work. This actually can make stress sometimes.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: No, I do not think so. We covered a lot of aspects.

**Interviewee:** Netherlands -N2-

<i>Farm information</i>			
<i>Name farm:</i>	Farm van Dijk	<i>Place:</i>	Emmen
		<i>Established in:</i>	Family-run since generations
<i>Farm type (size):</i>	Arable farm (200 ha (potatoes, sugar beets, maize and grain), labour: father and son)	<i>Focus on:</i>	potatoes
<i>Information about contact person</i>			
<i>Name:</i>	Piet van Dijk	<i>Position:</i>	Farm manager
<i>Age:</i>	57	<i>Education:</i>	Agricultural master
		<i>Work experience:</i>	37 years
<i>Interests on farm:</i>	Everything around potatoes		
<i>Recording allowed?</i>	yes		

### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: We have to prepare our seed beds including fertilization, seed, spray and care our crops. And of course in the end we need to harvest them.

*Q2. How do you execute these services?*

A: Most of these activities we do with our own equipment except the application of manure.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: We could work more with contractors, but we actually think to increase our in-sourced tasks. Sometimes we rent machines at a German machinery rental such machines that we simply do not use enough to be economical for owning, but this rental is not really nearby.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: No, maybe we even do more on our own, but that is uncertain.

### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: The advantage is that we could control our costs. Potatoes are our main crop on which we could invest in machinery because it can be utilized. This is not the case with the other crops.

*Q6a. Have you followed another mechanization strategy before?*

A: Think of our grain. Back in time we have had a combine, but as soon as you have to repair such a machine you could also let the operator harvest your grain. It was an old machine which increasingly required repairs so we decided to sell it. We did not bought one again

because good equipment is often very expensive and the old machines again require repairs and maintenance.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: Because of these high repair and maintenance costs which are not reasonable compared to the acreage we harvest. Therefore we harvest our grain with the local contractor.

*Q6c. Why did you decide against the possible alternatives?*

A: Focusing on grain, it is purely based on financial considerations. The utilization here is too low to run an own combine. This is not the case with our potatoes. Here we own most of the required machines, because we are flexible then. You are then your own boss, you can decide on time and this is not the case when you outsource. We have experienced that often, that farms with bigger orders come first. What follows is that we have to fit in the schedule and not uncommonly have to wait for a couple of days. And this definitely can be traced back in the quality of our crops.

*Q7. How did you experience your mechanization strategy until now?*

A: We think it is a good decision to in-source but it is unfortunately not always possible.

### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: You look at the possibilities that are available and then ask their providers if you have questions, e.g. how much does it cost to rent this machine? And then you start calculating. However, it is often the case that if you have time available, it rather soon is feasible to in-source activities. This is not the case if you would need to hire additional personnel.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

No, not always. Also the quality and available time. It is not always only about the price. However, the costs, of course, limit the range of possibilities. For example, we have thought about transporting our potatoes on our own. But that requires trucks which need to be maintained and operated again. We would also need to hire an additional worker which we could not employ the whole year round. And by all of this at a certain moment the costs would be too high compared to the price of shipping.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: Yes, that is time and the quality of executed work.

*Q11. Do you consider some of these factors more important than others?*

A: Yes that depends on in which part of the year the activities are located. It is difficult to assess, because in one year you have more to do than in other years. But I rather think that time is more important than costs. But, you decide a lot based on emotions and feelings.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, definitely.

*Q13. Which financial aspects do you consider during such an assessment?*

A: You compare the costs of outsourcing to the costs that would arise if you do it on your own. How these are composed depends a bit on which services you consider. We mainly consider the costs of maintaining and repairing the machines, because everything you have need to be maintained. New machines are capital intensive and old ones you do not want to have. And of course we have to look at the utilization. Several machines we need infrequently, so that it is cost-efficient to rent such machines. In such cases you could better use the capital for other things. But, what you must not forget is that you have per year a limited range of capital available. And with this capital you also need to improve your business, for example you have replacement investments for a continuous changeover.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, definitely.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: We look at the way of operating so that a good outcome is realized. There are drivers that get stuck on our land where it is not necessary. That worsens our field. If you do things on your own, you have own control over this and also about the machine settings. The contractor

often tries to maximize his performance and do less care about machine settings than we do. Because we do it on our own, we are able to care more about a qualitative outcome.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes, of course. That is the reason why we changed some strategies recently. But sometimes it already helps to change your operator.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: Not necessary. It does not matter if the technology is older as long as it delivers good quality and runs reliable. Then it is not necessary to buy new machines. It always depends on the outcome of work. However, old machine has to function. It is not useful if you have to repair things twice a day.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Yes. That is why we have a lot of own machines, because thereby we are independent from others in our work. Flexibility is definitely a reason to in-source the machinery services of your main business.

*Q19. Is this independence of special importance for a certain working step?*

Yes, for example the plant protection measure is an important working step amongst our crops. For a good quality of your crop it is important that you have an eye on your crop which is possible by spraying on your own. Outsourcing spraying is not always wise, of course there are contractors that are good in this work, but you need to be flexible here as you are to a large extent depending on the weather conditions and a qualitative way of execution. If you cannot manage to get an operator who simultaneously makes good work, you can lose a lot of money. Because with plant protection you earn a lot of money, if you do it right. That is why we do this on our own. And of course, you need to spray your fields more often. This adds up the total hectares and so increases the utilization so that an own sprayer is quite fast cost-efficient utilized.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: Yes it does. It is not only the decision of when you start but also of when to stop with work in relation to the actual weather conditions. We will not harvest while it rains, but the contractor for sure would continue. Flexibility is an important factor for mechanization decisions. I think about 70-80%. It is not always the price that determines the mechanization decision.

#### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: That depends on the machine considered. There are machines we use that rarely, that we do not want to be responsible for its maintenance, because it is also too costly compared to our use of it. However, if we can buy reliable technique for a good price, maintenance and repairs is not a factor to say we do not do it.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: It depends. For machines we rarely use, this necessity is an intention to rent such machines, but that is a cost calculation also. But for machines we can really use, maintenance and repairs is part of our work and definitely not a reason to outsource such services.

#### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: Of course. Good sales men can give valuable information or mechanics also. Farming colleagues maybe. Because you hear a lot of other farmers about how things work.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Yes, sometimes. If we have seen some kind of mechanization, we talk with such persons that have experience with it. It thereby is about the functionality and quality also.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, we compare indeed sometimes and get impressions, of course.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: Of course, normally you can learn from experiences of other farmers and then you should listen to their recommendations or hints

*Q27. Do you feel pressured to follow such recommendations?*

A: No, we do what fits to our way of business.

#### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: Definitely a valid factor. You have to have the workers available. If you do not have them and still want to do things on your own, you neglect other things and that is dangerous if those are important. So, you have to have good personnel. The problem is their availability. The thing is good workers are already employed or want to have a full-time job which we cannot offer at the moment. Others you can get, but they often have less of those skills we need.

#### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: It is an important factor, because you can buy all kind of machines but you need time to run them.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: That is a good question, but I do not think so because we talked about these aspects like costs, quality, time, available workers and of course being independent.



**Interviewee:** Netherlands 3 -N3-

Farm information			
Name farm:	Farm Lohuis	Place:	Erica
Established in:		Family-run since generations	
Farm type (size):	Arable farming (300ha (potatoes, sugar beets and grain) labour: father and son and one employee.		Focus on:
potatoes			
Information about contact person			
Name:	Bert Lohuis		Position:
Age:		35	Farm manager
Education:	Agricultural master		Work experience:
Interests on farm:		15 years	
Nearly everything.			
Recording allowed?		yes	

#### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: We perform seed bed preparations, sowing, plant protection and care measures and harvesting.

*Q2. How do you execute these services?*

A: We do everything on our own except the manure application.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: We could outsource more for example to a contractor.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: No, we plan to continue with doing everything on our own. But we do think about replacement investments.

#### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: One advantage of in-sourcing is that we can start when we want to, so we are flexible. But the disadvantage then is that you are depending on personnel and it is maybe not always the cost-effective way.

*Q6a. Have you followed another mechanization strategy before?*

A: No, not really.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: It is because of being flexible.

*Q6c. Why did you decide against the possible alternatives?*

A: Yes for the same reason: we do not like to depend on others concerning the activities on our farm.

*Q7. How did you experience your mechanization strategy until now?*

A: Good. We see that it works.

#### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: We read professional journals, we have consultants and of course by other colleagues.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

No.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: That is again the flexibility. Think at harvesting grain. We own a combine but I do not think that is very economical. The thing is when we want to harvest everybody wants to and the result is that you do not get a machine.

*Q11. Do you consider some of these factors more important than others?*

A: Yes, the flexibility plays often a bigger role.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, of course.

*13. Which financial aspects do you consider during such an assessment?*

A: The costs depend on the utilization of the machine. But we buy a lot of used machinery which costs within a few years already halve of their original prices. And when we think we need to replace machines we look at the salvage value of our equipment and based on that we decide to invest or to continue another year with the same machine.

### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, the works machines perform have to be of good quality.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: An important requirement regarding the quality is the machine setting and the way how machines are operated. Also crucial is the way of driving of operators, because it influences the quality of our fields and crops. For example not faster than required and never use the same track.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes that plays a role. We choose those opportunities that deliver the best quality. For example this year we were not satisfied with the way of manure application of our operator, so I think we are going to change this system for the next year.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: Yes, that influences our decision.

### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Yes it is. As I said, when the weather conditions are such that a certain activity can be performed, then this is valid also for other farmers. And if you have to share the contractor with them you are depending on his schedule. Therefore, we have the machines on our own.

*Q19. Is this independence of special importance for a certain working step?*

Yes, think of spraying but also harvesting. We can start and stop our work when we think we have to. But as soon you are outsourcing, you are depend on somebody else and his schedule and this is unfavourable, especially regarding those important activities like spraying and harvesting.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: This flexibility determines our decision to a large extent, because we buy machines on our own since we want to be independent and thus flexible. But, we are able to in-source due to our size of farm which is not necessarily possible at each farm.

### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: Maintenance does not really play a role. Of course, when you buy a machine you try to go for the most service-friendly machine, but you still keep the necessity to maintain equipment and that is no problem for us.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: Not in such a way that we say we outsource work, but rather that we care about which kind of technology or brand we are going to buy.

### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: Yes, my father. And furthermore you are asking around for advice, of course.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Yes we talk with other farmers about mechanization. For example we ask which technology works better and where we should care about.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, we look at it if we drive along but it is not like that we really assess it. But, with our consultancy we evaluate options other farmers follow, yes indeed. So in that sense, yes we do. But that is more when practical problems on our farm arise.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: The recommendations of others play an important role. If somebody has experiences and you have rather none, then you care about these recommendations a lot.

*Q27. Do you feel pressured to follow such recommendations?*

A: No we do not. We do what best fits to our farm and even more what feels best for us. You know, it is also a lot about how you feel with a certain decision. We may for example have a kind of too large combine for our grain acreage, but it feels good to know that you can handle the work with it.

#### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: Of course you have to have personnel available, but we always have them. That is not really a problem for us. Fact is that we need good and skilled workers but luckily we can find them easily. That allows us to do that much on our own.

#### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: A big role, because you have these working peaks in which work has to be conducted, for example planting potatoes in spring. But we increase our time availability by increasing our machine performance. Actually, for example, we think about buying a bigger potato planter to increase our performance. By this the period of planting potatoes gets shorter and we have more time for other crop obligations. Nevertheless we make a lot of working hours during such peaks, sometimes nearly 100h per week I think, because what you want to do with your own possibilities needs to be done also. Those are then times with a high work load but you as farm manager deal with it. And as long as our employee can also accept those long workdays, we have no problem.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: No, I do not think so.

**Interviewee:** Netherlands 4 -N4-

Farm information			
Name farm:	Farm Haasken	Place:	Nieuw-Amsterdam
		Established in:	1963
Farm type (size):	Mixed farming operations (155ha arable farming, 90 dairy cows, labour: father and son, several family members)		Focus on:
			60% dairy and 40% arable farming
Information about contact person			
Name:	Wim Haasken	Position:	Farm manager
Age:	28	Education:	Agricultural master
		Work experience:	7 years
Interests on farm:	Dairy farming		
Recording allowed?	yes		

### **A. Introducing Questions:**

*Q1. Do you conduct agricultural machinery services on your farm? If so, which ones?*

A: We harvest potatoes on our own while they are planted by our contractor. Harvesting and planting of sugar beets is also done by our contractor. Plant protection and care measures we do on our own. Grass harvesting is done by another contractor because that mechanization requires a lot of capital but is just a short period of work. Maize harvesting we also outsource and maize planting we do on our own. The whole seed bed preparation we do also on our own.

*Q2. How do you execute these services?*

A: I think most of the machinery services we do on our own.

*Q3. Are there possible alternatives for your actual way of conducting machinery services?*

A: We could call contractors or we could rent machinery. But then a contractor is easier for us, because a rental is not nearby.

*Q4. Do you plan to improve your actual mechanization strategy?*

A: We sometimes think of harvesting grass on our own, but for a good machine you need to invest so much money which would pay the costs of outsourcing we now have for about 10 years. And the thing is this arable farming is our secondary business, so we need time to invest in our animal care. Here you are busy with at least two times a day. But still, we think about our mechanization strategy and we tend to in-source more.

### **B. Background questions to the actual mechanization strategy**

*Q5. Which advantages and disadvantages do you see in your actual way of conducting machinery services?*

A: The advantage of in-sourcing is that you can always use the nice days as you are flexible with own equipment. The disadvantage is that you have to accept machine downtimes because we cannot afford to buy new machines. But we can repair machines easily at our own because we have built a new machine garage and within a day of break-downs you can repair already a lot.

*Q6a. Have you followed another mechanization strategy before?*

A: Yes, back in time we outsourced the harvest of potatoes and grain.

*Q6b. Why did you decide to follow this mechanization strategy?*

A: Because we had working time available since me and my brother finished our agricultural education and then you can buy machines and gain from the advantages of owning, such as flexibility.

*Q6c. Why did you decide against the possible alternatives?*

A: Because of the things mentioned in the previous question. We have had the time and labour available.

*Q7. How did you experience your mechanization strategy until now?*

A: We see that our strategy of in-sourcing works well, but we recognize that we are indeed very busy especially in the working peaks.

### **C. Choosing the mechanization strategy**

*Q8. How do you get the information about the possible mechanization alternatives?*

A: For example we get information on fairs. But we do not ask sales men too often because then you do not come to work through all the coffee you have to drink. We are also member of consultancy services where you get a lot of information on mechanization strategies. And we talk with farming colleagues.

*Q9. Do you evaluate these alternatives only based on their expected costs?*

No. Costs are of course important but also the conditions on your farm.

*Q10. If not, which other factors do influence you while choosing the mechanization strategy?*

A: The conditions play a role such as the Flexibility. For example, when you have a day of nice weather but you cannot get an operator, you can better do things on your own if you have the machine. A contractor wants to be informed up to a week in advance but you as a farmer do not know how the weather in one week will be and harvesting under unfavourable weather conditions can be traced back in the quality.

*Q11. Do you consider some of these factors more important than others?*

A: The costs are the most important I think because they limit the range of feasible alternatives.

#### **D. Addressing the theoretical derived determinants**

##### **Financial Determinant**

*Q12. Is a financial assessment of the possible mechanization alternatives important to you?*

A: Yes, definitely.

*Q13. Which financial aspects do you consider during such an assessment?*

A: The purchase price of required machines is important. And these things like depreciation, fuel costs and repair costs. But, for example contractors want to have about 300€ per hectare of harvesting potatoes and if you have 40 hectares then at a certain moment it is easy to calculate that buying a machine is cost-efficient. But you can buy cheap machines but also very expensive ones, and that would calculate differently.

##### **Quality Requirements**

*Q14. Do you pay attention to the delivered quality of machinery services and how is this quality influenced?*

A: Yes, we look at the quality of course. But whether we can do things better than a contractor is also depending on his schedule or time respectively. It is important that you do not change your contractor too often because he gets to know your field and the conditions on these fields so that they at a certain time also learn how to operate the best.

*Q15. Which requirements do you have on the quality of work delivered? Which of them are the most important to you?*

A: We want to have good quality of products and this depends on the machine settings. But I expect from our contractors that they look at that. Nevertheless, our main contractor also has times where he is busy and then his quality delivered is not as it should be.

*Q16. Do these quality requirements influence the evaluation of mechanization strategies?*

A: Yes, if we are not satisfied, we are going to do that work on our own. So definitely, quality has influences on the decision. But as I said, this depends then again on whether we have time to do additional things. But in most cases you can also demand from your contractor to improve his work and in most cases they will change something then.

*Q17. Does the technology of machinery have influence on the mechanization alternative?*

A: The technology of machine has rather no influence at our decisions. For example, we have an old technology of potato harvester, but we are pleased with its functionality and it gets the same results as newer technologies.

##### **Flexibility**

*Q18. Is it important for you to be independent in conducting machinery services? (time and duration of operation)*

A: Yes, of course that is important to us. It is a reason to do the work on our own.

*Q19. Is this independence of special importance for a certain working step?*

A: Yes, for harvesting our potatoes for example. And it is even more important for the forage quality of our grass as it needs to be in the silage before the rain comes.

*Q20. How does this independence influence the choice of mechanization alternatives?*

A: Flexibility is desired but in the case of harvesting grass not feasible for us, because you need a range of machines which requires simply too much capital which we do not have. So, to do this on our own is no option for us and we stay depend on our contractor's schedule. This is not the case with harvesting potatoes, because potatoes demands less capital in our situation but much more working time, so there is potential to be cost-efficient compared to outsourcing. So, costs are always limiting our range of opportunities.

### **Machine Maintenance**

*Q21. Which role plays the necessity to maintain and repair the machinery in choosing the mechanization strategy?*

A: Not a big role, because we are not scared to maintain our machines.

*Q22. Does this necessity influence the assessment of mechanization alternatives?*

A: No, it has not.

### **Social Influences**

*Q23. Are there any persons in your environment that can influence your decision on the mechanization strategy?*

A: No, not really. It is more that we reflect options within our family. But we definitely are not looking at other farmers and buy new machines whenever they do.

*Q24. Do you discuss about mechanization strategies in conversations with other farmers? If so, which aspects are addressed?*

A: Yes, that indeed. Why they do particular things and how these are working and why we are not doing things at our own and things like that. It is about exchanging information. And we are member of an economical consultancy group together with some other farmers. Here we come together and we talk about such mechanization alternatives and you can directly see the financial situation behind as it is handed out on paper. There you see one has much more depreciation on machines than the other or more fuel costs, or expenses for contractors, for example.

*Q25. Do you assess comparable mechanization strategies followed by colleagues?*

A: Yes, we do that. We see the advantages other have, for example my colleague has invested into own equipment for grass harvesting. He is able to start this work when he wants to which we cannot since we cannot get the contractor on time. Regarding planning of work he definitely can work the best, because he can always start at the optimal time. That are aspects that make you start thinking, but again the costs limit the opportunities.

*Q26. To what extent does the assessment or recommendation of a colleague influence your choice of mechanization strategy?*

A: Not really much, because we do not see much value in that.

*Q27. Do you feel pressured to follow such recommendations?*

A: No, not really. It is not like we are copying others. We look which works best for our farm.

### **Labour Availability**

*Q28. To which extent does the availability of labour play a role in the evaluation of mechanization alternatives?*

A: That has much impact, they need to be available as otherwise you cannot do the things on your own. If you do not have them available, you are forced to ask somebody else to do your work.

### **Time Availability**

*Q29. How does the time availability influence your choice of mechanization strategy?*

A: That also has big influences, because we are also a dairy farm which means that we have other important obligations in the care of our cows. Let me explain, we regularly need to milk twice a day, and we need to feed our cows and that costs time. If I would do it on my own I would be busy almost the whole day and then I cannot do others things like harvesting potatoes. So those are crucial considerations whether you have enough time or not. We have working time available because we are more people on our farm. And in busy times we also work additional hours or even Sundays if we think it is necessary, for example as the rain comes the next day. Of course, thereby you lose leisure time but we do not care about that a lot because we work for our own farm. If I would be a employee at another farm things would be different but now I am doing these for our family business. It feels better to have your crops harvested than having free time on a Saturday evening, for example.

*Q30. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: No.

## Appendix F: Summary interview service providers

**Answers from service providers:** two respondents from Germany and one from the Netherlands

**Interviewee:** Service provider from Germany 1 -SG1-

<i>Firm information</i>			
<b>Name firm:</b>	Contractor Roofls	<b>Place:</b>	Osterwald
		<b>Established in:</b>	1959
<b>Firm type (yearly customers):</b>	Agricultural contracting business (250)	<b>Focus on:</b>	Everything in farming segment
<i>Information about contact person</i>			
<b>Name:</b>	Gerd Roofls	<b>Position:</b>	Operating manager and business owner
<b>Age:</b>	52	<b>Education:</b>	Agricultural economist
		<b>Work experience:</b>	31 years
<b>Recording allowed?</b>	yes		

### A. Introducing questions

*Q1. Which kind of agricultural machinery services do you offer? How would you characterize it?*

A: We are providing services in the agricultural segment. Mainly we are providing machines together with specialized personnel for operating them. And we start our work as soon as farmers ask for our service.

*Q2. How many customers do you have on average per year?*

A: We have approximately 250 customers per years.

*Q3. Did the amount of customers change over the past years? If so, which reasons do you see behind?*

A: We recognized that this amount has decreased a bit and we think that is caused by the structural change within agriculture. That means continuing farms increase in size while smaller farmers stop

producing. But this does not mean that we have less work. It is rather that those farms outsource more than they start to do machinery services on their own. But we also recognize farms that increase their in-source activities. Those are especially farms that increased their part of arable farming. We can state that we service providers grow with our farms if you look at the farming segment, this is not the case when you look at contractors that specialized in things like earthwork.

*Q4. Is there any farm type that employs your service most?*

A: We work more for dairy farms.

*Q5. Which alternatives do farmers have when they do not choose your service?*

A: Farmers that do not choose service providers to execute their machinery services are renting machines from the local machinery rental. This is rather the case than they buy machines. There is this saying: “when you rent a machine you do not have to invest and thus save your liquidity” and this is also what I have heard from farmers here. However, I see renting as a method to face working peaks.

### B. Background questions o mechanization strategy

*Q6. Which advantages and disadvantages do you see in your way of providing a service?*

A: Because contractors are specialized in providing machinery service we usually have high performance machines. We are low-priced, not cheap. I do not want to be cheap because that does not help our business. However, having high-capacity machines is crucial in our business.

*Q7a. In your opinion, why do farmers choose your service?*

A: Again, it is the performance we have by our high-capacity machines and because we are low-priced.

*Q7b. In your opinion, what are the reasons to not choose the possible alternative(s)?*

A: That’s the same, farmers that call us want to have their jobs quickly done.

### C. Choice of mechanization strategy

*Q8. Where do farmers get information about the possible alternatives to conduct their required machinery service?*

A: Farmers talk a lot with each other.

*Q9. Do you think farmers assess these alternatives only based on the expected costs?*

A: No, definitely not. I would say that costs play a role in the decision for hardly 5%.

*Q10. If not, which other factors do you think are important for their decision-making and how do you characterize/describe them?*

A: In the dairy segment I do not think that there are farms that try to in-source work. That are rather those farms that have some focus on arable farming and think that they could achieve a higher quality compared to outsourcing. They do things on their own because they say that there is nobody that can satisfy their quality requirements. Another thing is that especially those farmers that are bound to their

animals want to do things on their own because they want to have some variety in their daily work so it is a kind of fun-factor or gives them a better feeling. Most of those farmers then choose for renting because they are not bound to the machine and can decide next time to outsource work again. That depends a lot on time and the capacities they have. For example dairy farms that have milking robots now also say they have capacities free and therefore say we want to do things on our own.

A big point is the plant protection measure and that relates to the quality. Me as a farmer would say, I will do this work on my own because by this I can see the conditions of my crop on the field, how they grow, the level of weed infestation etc. and I can decide how I have to react. However, others say we have to outsource these measures because we do not have the certificates required for this job and then they need to rely on their contractor.

*Q11. Are some of these factors more important than others?*

A: That depends I would say. Feelings play in the background of decisions to a large extent.

*Q12. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: No, I have nothing to add.



**Interviewee:** Service provider from Germany 2 -SG2-

Firm information						
Name firm:	Machinery Rental Ringe	Place:	Rine	Established in:	1968	
Firm type (yearly customers):	Machinery rental (600-700)			Focus on:	Agricultural services except harvesting	
Information about contact person						
Name:	Jan Robbert		Position:	Operating manager		
Age:	42	Education:	Agricultural master		Work experience:	19 years
Recording allowed?						Yes

#### A. Introducing questions

*Q1. Which kind of agricultural machinery services do you offer? How would you characterize it?*

A: We are a machinery rental. We offer respectively rent agricultural machinery and even tractors for a certain price without personnel to operate those machines for a certain period of time, because we are not a contractor.

*Q2. How many customers do you have on average per year?*

A: I think between 600 and 700 customers.

*Q3. Did the amount of customers change over the past years? If so, which reasons do you see behind?*

A: The amount has increased, because we have a good supply. We have a broad range of relative new machines.

*Q4. Is there any farm type that employs your service most?*

A: The members of our rental organisation, but there is not a farm type that uses our machines most.

*Q5. Which alternatives do farmers have when they do not choose your service?*

A: Of course the famous alternatives are contractors or they could buy the machines on their own. At some places there are also more machinery rentals and sometimes the machinery dealers also offer machines for rent.

#### B. Background questions o mechanization strategy

*Q6. Which advantages and disadvantages do you see in your way of providing a service?*

A: The advantage is that we have modern technology available with a high performance. Often we are cost-effective compared to owning. This is because we can achieve a higher utilization of the machines. At a certain farm size however owning is affordable. Furthermore, there are machinery services that the farmer wants to do on his own due to quality reasons or because he wants to have variety of his daily work. Another rather small advantage is that we normally bill just once a year whereas contractors send their bills right after the work has done.

Disadvantage for our customer is that he needs to conform to our schedule that means he has to return the machine within the arranged time. You cannot always get our machines directly when you want to.

*Q7a. In your opinion, why do farmers choose your service?*

A: Yes, of course due to these advantages and because we try to orient ourselves on the needs of our farmers.

*Q7b. In your opinion, what are the reasons to not choose the possible alternative(s)?*

A: Farmers rarely rent machines from machine dealers because their motivation behind is selling machines. And we are low-priced as we are a non-profit organisation. So, we are lower priced than a contractor because he simultaneously needs to pay his operator.

#### C. Choice of mechanization strategy

*Q8. Where do farmers get information about the possible alternatives to conduct their required machinery service?*

A: Farmers ask around when they have questions. Often they call us and want to know which machines they could use best in their particular situation, especially in the field of soil tillage where you have several machines available. And when you ask a contractor in most of the cases he answers in such a way that he directly can execute the job as it is his business.

*Q9. Do you think farmers assess these alternatives only based on the expected costs?*

A: No, there are also other factors determining the decision.

*Q10. If not, which other factors do you think are important for their decision-making and how do you characterize/describe them?*

A: One factor is that farmers want to sit on the tractor again and that improves in a way their quality of life. And of course there are activities that the farmer wants to do at his own, because he thinks that he can do things better. Another thing is the flexibility. Normally, we are more flexible than a contractor in terms of machine availability. However, sometimes our machines are fully booked so that the farmer has no other option as to call the contractor, if he does not have the machines on his own and wants to have the services executed directly. The question is, whether the contractor also has time then. But normally we are flexible.

*Q11. Are some of these factors more important than others?*

A: I think important are the costs when you have to decide between us and the contractor.

*Q12. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: If you look at farmers that already use our machines, then the factor time is not important for their decision anymore, because then it is obvious that they have time, otherwise they would not be here.

**Interviewee:** Service provider from Netherlands 1 -SN1-

Firm information			
Name firm:	Contractor Tietema	Place:	Nieuw- Amsterdam
Established in:	1952		
Firm type (yearly customers):	Agricultural contracting business (50)		Focus on:
			Everything in farming segment except forage equipment
Information about contact person			
Name:	Henk Tietema		Position:
			Operating manager and business owner
Age:	44	Education:	Intermediate technician (dutch: MTS)
		Work experience:	22 years
Recording allowed?		Yes	

#### **A. Introducing questions**

*Q1. Which kind of agricultural machinery services do you offer? How would you characterize it?*

A: We offer all kinds of agricultural machinery services except forage harvesting. Normally, farmers call us and ask whether we could perform a particular work for him. Then we provide the required machine together with one of our operators.

*Q2. How many customers do you have on average per year?*

A: We have about 50 farmers as customer and approximately 25 construction companies for earthwork where we also are specialized in.

*Q3. Did the amount of customers change over the past years? If so, which reasons do you see behind?*

A: The amount of farmers decrease since farms get bigger. This means that they also increase the acreage they work on.

*Q4. Is there any farm type that employs your service most?*

A: The arable farmers ask most for our services, but that is because we have no equipment for forage harvesting which is often demanded by dairy farmers.

*Q5. Which alternatives do farmers have when they do not choose your service?*

A: The only alternative then is to in-source these activities. Such a option as machinery rental is not really available nearby.

#### **B. Background questions o mechanization strategy**

*Q6. Which advantages and disadvantages do you see in your way of providing a service?*

A: An advantage is that we can react flexible, because we are a rather small company. However, a disadvantage of our size is that if someone calls for working on for example 30 hectares that demands time. And when in this time another farmer calls who wants to do the same work, yes then he needs to wait. In fact, as contractor you have a kind of planning problem, sometimes you cannot help everyone and sometimes you are very flexible. So that depends but time and planning are definitely aspects which are problematic for farmers when asking contractors. Furthermore, we have reliable technique but I cannot say that farmers could not afford the same machines due to our rather small size we also cannot go for new machines always. However, technology is not so important as long as quality can be delivered.

*Q7a. In your opinion, why do farmers choose your service?*

A: I think one main reason is that farmers can save working time when they ask us, because even a farmer can only be on one place simultaneously. So working time, but also costs is a reason to outsource. The latter is for farmers more important and I would advise them to look more at the costs.

*Q7b. In your opinion, what are the reasons to not choose the possible alternative(s)?*

A: In our case that is the same as the previous question.

#### **C. Choice of mechanization strategy**

*Q8. Where do farmers get information about the possible alternatives to conduct their required machinery service?*

A: I think farmers talk a lot with each other. But also, I noticed often that farmers come to look at certain technologies or machines where it is in action. For example, I have had several farmers looking how I harvest sugar beets and then they compare it to their situation.

*Q9. Do you think farmers assess these alternatives only based on the expected costs?*

A: No, they do not. And I also think that they do not do it regularly and thoroughly enough, because if they would they could earn more by outsourcing.

*Q10. If not, which other factors do you think are important for their decision-making and how do you characterize/describe them?*

A: Available labour is a crucial point. A lot of farmers have to outsource and by this save labour forces, because employing personnel also increased in costs in such a way that a lot of farmers cannot afford own employees anymore. In those cases they are even forced to outsource more. Another factor is the quality. There are differences in the quality when you compare in-sourcing with outsourcing. But this depends on the attitude of the farmer and which norms he has regarding the quality of work. You have farmers where no crop losses may arise and others where you think the machine setting could be adjusted more adequate. You know, you have these farmers that are not technical and that cannot adjust machine settings. So it depends also on the skills of the operator and the way he works with the machines and how

he drives with them, of course. But we have the advantage that we know our farmers and their fields so we also know the conditions there.

Another point is the flexibility which is for certain working steps very crucial, for example spraying. Some farmers want to spray in the morning, but you as a contractor only can serve one farmer at a time. That means working with contractors for farmers comes along with a certain necessity to plan your activities.

*Q11. Are some of these factors more important than others?*

A: I think that costs are the most important.

*Q12. In the end, is there any aspect or factor that is relevant in the question of farmers' mechanization but has not been mentioned so far?*

A: I think that mechanization at some point also gets too expensive to stay modernized with their equipment. The modernisation of machinery continuously takes place and farmers are not able to utilize these new advantages, for example this expensive area specific fertilization. For a single farmer this is not affordable, but we as contractors can purchase such equipment and offer it to a broader range of farmers and thereby could utilize it better.

## **Appendix G: Personal Declaration**

I hereby affirm that I have prepared the presented paper self-dependently, and without the use of any other tools, than the ones indicated. All parts of the text, having been taken over verbatim or analogously from published or not published scripts, are indicated as such. The thesis has not yet been submitted in the same or similar form, or in extracts within the context of another examination.

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(Place, date of submission)

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(Student's signature)