A Discrete-time Survival Analysis of Smallholder Contract Farmers in Malawi

by

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Declaration

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Summary

This study investigates the durability and dynamics of smallholder participation in contract farming arrangements (CFAs) in Malawi, which are seen as a potential way to increase smallholder commercialisation and participation in modern high-value markets. The study finds that while CFA participation can offer benefits, there is considerable variation in participation durations, and high rates of smallholder exit. Factors related to productive resources and farmer performance have a large influence on the likelihood and timing of exit. Policymakers should have a realistic view of what can be expected from CFAs and consider differentiated policy responses for farmers likely to sustain participation versus those at high risk of exit. Developing farmers' capacities, particularly those factors that raise the propensity for sustained participation, should be prioritized to improve smallholder commercialisation through more durable modern-market participation. Furthermore, efforts should be made to further develop Malawi’s non-physical resources.

Opsomming

Hierdie studie ondersoek die duursaamheid en dinamika van kleinskaalse boere se deelname aan kontrakboerdery-reëlings (KBR) in Malawi, wat gesien word as 'n potensiële manier om kleinskaalse kommersialisering en deelname aan moderne hoëwaarde-markte te verhoog. Die studie bevind dat hoewel KBR -deelname voordele kan bied, daar aansienlike variasie in deelname-duur is en hoë vlakke van uittrede voorkom. Faktore wat verband hou met produktiewe hulpbronne en boerprestasie het 'n groot invloed op die waarskynlikheid en tydsberekening van uittrede. Beleidmakers moet 'n realistiese siening hê van wat van KBR verwag kan word en gedifferensieerde beleidsreaksies oorweeg vir boere wat waarskynlik deelname sal volhou teenoor dié met 'n hoë risiko van uittrede, wat waarskynlik steun buite die landbou nodig sal hê. Die ontwikkeling van boere se kapasiteite, veral dié faktore wat die neiging vir volgehoue deelname verhoog, moet prioriteit geniet om kleinskaalse kommersialisering deur meer duursame moderne-markdeelname te verbeter. Verder moet daar pogings aangewend word om nie-fisiese hulpbronne in Malawi verder te ontwikkel.

This thesis is dedicated to my family

Ecclesiastes 9: 10-12

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Chapter 1: Introduction

1.1 Background

Global value chain trends are spurring the need for transformation in many agriculturally dependent African economies (Collier & Dercon, 2014). Across the world, agricultural value chains are increasingly modernising with greater complexity and integration. Participation in these high-value, modernised markets can offer opportunities for improved returns and productivity. However, several constraints impede smallholder participation in high-value markets (Barrett, Bachke, Bellemare, et al., 2012). There are calls for more dynamic models of commercialisation that enable greater integration of smallholders in modern value chains (Collier & Dercon, 2014).

Increased commercialisation of smallholders is suggested to have an important role in agricultural transformation. In the smallholder context, shifts from informal agricultural systems to more formalised agricultural models can yield gains which are not necessarily a strict function of farm size. With more formalised organisation within the agricultural food system, greater value chain coordination can unlock benefits in areas of marketing, logistics, skills, technology, and capital. However, this relies on the presence of appropriate organisational arrangements (Collier & Dercon, 2014). With appropriate institutional arrangements, evidence indicates that increased commercialisation of agriculture could induce positive welfare gains for domestic populations (Ma & Sexton, 2021).

Contract farming arrangements (CFAs) are one institutional strategy often mentioned regarding the involvement of smallholder farmers in modern high-value markets (Barrett *et al.*, 2012). The motives behind smallholder engagement with CFAs can be based on various reasons. For instance, CFAs are an institutional option with which some of the risks and market failures (input and output) commonly faced by smallholders in developing nations can be managed (Bellemare & Lim, 2018).

Several studies have been undertaken to examine the impact of CFAs on participants. Endogeneity and issues of self-selection bias considerably complicate such a task (Meemken & Bellemare, 2020). Self-selection bias refers to the observation that farmers in CFAs are often non-randomly engaged. Factors such as favourable agroecological location, unobservable farmer characteristics, or even firm eligibility criteria may impact the selection distribution of participants (Barrett *et al.*, 2012; Bellemare, 2012; Meemken & Bellemare, 2020). It is impossible to state with conclusive certainty that CFA participants are always better off than non-participants. Nonetheless, there is strong evidence which finds that, on average, CFA participants earn higher incomes, and may experience greater food security and lower-income variability than non-participants (Bellemare &

Bloem, 2018; Bellemare, Lee & Novak, 2021; Bellemare & Lim, 2018; Bellemare & Novak, 2017; Meemken & Bellemare, 2020).

1.2 Research Problem

Despite the apparent benefits of CFA participation, researchers note that smallholder exit rates from CFAs worldwide are often high (Barrett *et al.*, 2012; Narayanan, 2013; Ruml & Qaim, 2021). Yet, research regarding the sustainability of participation in CFAs has not received as much attention in the academic literature. Which prompts the need for greater insight into the dynamics of CFA participant turnover and sustained participation (Barrett *et al.*, 2012; Bellemare & Bloem, 2018; Michelson, 2017; Narayanan, 2013). If participation in CFAs is not durable, it may considerably diminish the efficacy and extent to which CFAs can truly be an avenue for agricultural development and poverty reduction (Narayanan, 2013). Under the neoclassical view of individual rationality, one would assume that smallholders would engage (disengage) in CFAs when the expected net benefits of participation (dropout) are greater than the expected net benefits of dropout (continued participation) (Bellemare, 2012). High dropout rates raise questions about whether there is a divergence between the theoretical expectations and the observed outcomes of CFA smallholder participation? Furthermore, how does this play out over time?

1.3 Study Relevance

The landlocked nation of Malawi, situated amongst neighbours Mozambique, Tanzania, and Zambia, is aptly described by Mangani, Jayne, and Hazell, *et al.* (2020), as being a largely rural and agrarian society. This description is evinced by a rural population which accounted for 82 per cent of the total population in 2021. Furthermore, the importance of the agricultural sector as a major component of the Malawian economy is quite clear. Agriculture was responsible for 76 per cent of total employment in 2019, and about 22.7 per cent of total GDP in 2021 (World Bank, 2023). Most of the agricultural output in Malawi comprises of rain-fed smallholder crop production (Mangani *et al.*, 2020). While there is a heavy economic reliance on agriculture within Malawi, the sector itself is characterised as having low levels of productivity, and commercialisation (MoAIWD, 2018). In their national agenda, Malawi has explicitly stated the objective of a more commercialised and inclusive agricultural sector (NPC, 2020). CFAs are one of the institutional forms whose promotion is considered an important mechanism for achieving this objective (MoAIWD, 2018).

For private sector organisations, the commercial viability of CFA activities is a major concern. Economic and financial considerations are fundamental in guiding business decisions and directly impact an organisation's ability to continue operations into the foreseeable future. When major investments have been made (often in marketing or processing infrastructure), CFAs are often utilised by private sector firms to secure the appropriate quantity and quality of supply to recoup such investments effectively. Nonetheless, short-term accounting considerations alone are insufficient for the commercial viability of CFAs. It is key that producers involved in CFAs continue to provide the reliable supply conditions necessary to recoup longer-term investments and sustain business viability over time (Stringfellow, 1996).

If Malawi intends to expand private sector CFAs for durable agricultural transformation, then insight into the nature and dynamics of participant turnover in CFAs would be highly salient. Such insights may guide efforts for more durable and successful CFA partnerships in Malawi.

1.4 Research Questions

Recognising that the dynamics of CFA participant turnover and sustained CFA participation are relatively understudied within academic research in general (Barrett *et al.*, 2012; Bellemare & Bloem, 2018; Michelson, 2017; Narayanan, 2013), and likewise, to the best of the researcher's knowledge within the context of Malawi, this study explores the following research questions to attend to this gap in the literature:

1. What is the extent and nature of participant turnover in a smallholder contract farming arrangement in Malawi?
2. How do observable factors and characteristics impact the likelihood and timing of smallholder exits in a Malawi contract farming arrangement?

To address these research questions, this study utilised survival analysis methods. Applying a discrete-time proportional hazards model complemented with a series of descriptive statistics. Panel data spanning five years (2018-2022) was obtained from the internal records of a burley tobacco contracting firm in Malawi.

The data included all farmers who had been contracted to grow burley by the firm during the 2018 to 2022 period. The company records provided information covering several farm and farmer characteristics, in addition to variables related to farmers' historical contract performance. The duration of CFA participation was taken as the length of time from when a farmer first appears in the records of the company up until their last appearance. Thus, the data allows for investigation concerning the extent of CFA participant turnover as well as the timing and duration of CFA participation.

However, since the data does not include information on the explicit reason for a farmer's withdrawal from contracting with the CFA, whether initiated by the farmer (voluntary exit) or the firm (involuntary exit) (Narayanan, 2013), indirect inferences regarding the nature of participant turnover are made based on the characteristics and performance parameters which are available. Therefore, this study cautions against making any strong conclusions concerning the prevailing type of exit found within participant turnover in this CFA.

1.5 Ethical Considerations

Economic research falls within the domain of the social sciences, which by its very nature involves the study of human behaviour and interactions. Therefore, it is important to be conscious of the ethical implications of this research project. Namely, accounting for potential ethical concerns arising within the design and conduct of the study, as well as with the use and reporting of research findings (Zikmund, Babin, Carr, *et al.*, 2013). In the next sections, the application of several established ethical principles are discussed as they pertain to the context of this study.

The time and resources involved, topic sensitivity, data confidentiality, and organisational anonymity are prominent concerns for getting organisational consent and data access. Participation in this study was purely voluntary, and individuals, or in this case, organisations, had the right to decline to participate and withdraw from participation (Saunders, Lewis & Thornhill, 2016).

The researcher obtained informed consent from the participating firm before undertaking the research. Using Stellenbosch University's "Request Letter for Institutional Permission", it was ensured that the participants understood the purpose of the study, how the researcher intended to conduct the research, and the implications of participation (Zikmund *et al.*, 2013). Furthermore, this study received ethical clearance from the Research Ethics Committee (REC) of Stellenbosch University under project number 25167.

This study used secondary data—specifically, historical company records. One of the advantages of using secondary data in research is that it has already been collected, albeit for purposes other than the intended study. If secondary data does exist, it is typically already in a structured format. Thus, it is considered more efficient and less expensive than the time and resources involved in collecting primary data from organisations (Zikmund *et al.*, 2013).

Company records will contain details which may be considered sensitive and private, and the characteristics of that information must be respected and maintained. It was deemed necessary by the participating organisation that a non-disclosure agreement (NDA) be signed to safeguard confidential information. In this way, having a formal document which legally obligates the researcher to confidentiality. An important consideration involves determining which information necessitates confidentiality and which does not (De Cleyn, Meysman & Braet, 2015). The contents of the NDA clearly outlined what information had to be protected to the satisfaction of the disclosing organisation. As a general rule of thumb, data should remain confidential if its disclosure would significantly harm the business's commercial activities. For example, technical or business information which gives an organisation a commercial advantage over competitors (Verma, 2002). Only the researcher had access to the data in this study, and the data was not shared with anyone else. Information was secured on a password-protected drive to prevent unauthorised access (Saunders *et al.*, 2016).

Data was transformed into an anonymised format in the analysis and the reporting of findings so that any personal identifiers were removed. New arbitrary identifying codes were assigned to subjects for analysis. Additionally, study variables were broadened in some instances to preserve important data characteristics whilst obscuring sensitive properties. These steps were undertaken to ensure that the data used in this analysis was non-attributable and respected the privacy and confidentiality of stakeholders (Saunders *et al.*, 2016). Location data was only used to control for district-level differences. Locational data is sufficiently aggregated to ensure that it could not be used to identify individuals.

1.6 Thesis Outline

Chapter 2 explores the theoretical aspects of contract farming and contract farming participation. The overview of contract farming participation literature in Chapter 2 is followed by an explanation of the methodological approach used in the study in Chapter 3. After explaining the research methods, the data source and explanatory variables used in this study are described. Descriptive statistics follow afterwards to get an initial look at the patterns and the dynamics of participation within the set of farmers analysed. The investigation then turns to a presentation and discussion of the survival analysis results in Chapter 4. In Chapter 5 a conclusion to the research is provided with a synthesis of the key takeaways and implications. Chapter 5 closes with an outline of the study’s limitations and suggested avenues for further research.

Chapter 2: Theoretical Framework

2.1 Contract Farming Theory and Rationale

Contract farming (CF) can be characterised as an agreement between buyers and farmers, typically on the basis of a forward contract, to supply and purchase agricultural products. Central to a CF agreement is that the buyer commits to the purchase of the specified commodity at a particular date. At the same time, the farmer commits to the timely production of the commodity, according to the parameters of quantity and quality specified by the agreement. Often the contractor will also commit to assisting the producer by providing inputs and technical support. It is important to note that there can be great variation in the terms and structure of different CFAs. Yet, they all share in common the attempt of buyers and sellers to collaborate in a mutually beneficial manner (Eaton & Shepherd, 2001).

The observation that considerable economic gains can arise when individuals specialize and cooperate in a self-interested manner, is one of the key tenets of economic theory. Economic organisation emerges as a consequence of individuals' actions as they attempt to coordinate their specialised activities to achieve desirable economic outcomes. The functionality of a given form of economic organisation is judged on how effectively it enables the agents involved to meet their economic objectives (Milgrom & Roberts, 1992).

Globally there have been significant changes in the structure of agricultural value chains. A number of factors have driven these changes, including increasing urbanisation, income growth, and changing consumer preferences. Not to mention the greatly expanded international linkages characteristic of the globalised value chains of today (Bijman, 2008). Agriculture has developed from what was once predominantly subsistence production to an increasingly commercialised market-oriented system. As a result, agriculture is increasingly characterised by higher levels of specialisation and coordination within value chains (Rehber, 2007).

With the increasingly consolidated and connected structure of modern agricultural value chains, there is a tendency towards greater vertical coordination (Bijman, 2008). CF is often understood as an instrument of vertical coordination. Where vertical coordination, broadly described, refers to the management of activities and relationships across different stages of production and marketing (Rehber, 2007). For this reason, CF plays an increasingly important role as a system through which to closely mediate the selective requirements of modern agricultural value chains (Bijman, 2008).

Firms use CFAs, particularly in cases where the parameters of quality, quantity, and timing of agricultural produce are important, and therefore necessitate a greater degree of control in the supply process. Such requirements are particularly applicable to exporting companies, supermarket suppliers, and agro-processing firms. For these types of buyers, there is a need for high levels of assurance regarding the supply and characteristics of commodities. Often premium prices are offered to suppliers to incentivise the quality and consistency of production (Bijman, 2008). The need for coordination is not only to address market demands. Operations in the processing industry are typically very capital-intensive. The steady supply of input materials is critical for operations' success. Especially as optimal levels of throughput and operational efficiency are required to cover high running and investment costs (Bijman, 2008; Stringfellow, 1996).

2.2 Contract Farming Participation and Smallholders

2.2.1 Background and Contract Farming Impacts

Interest in improving the performance of agriculture in Africa is not new. Neither are the questions of whether CF offers an effective institutional arrangement to mediate and assist in driving the development of agriculture in developing nations (Glover, 1990).

Much of the literature on CF deals with the motivations for CF participation and the impact of CF on farmers. Wang, Wang & Delgado (2014) provide a review of empirical literature related to the factors influencing the participation of farmers in CF, in addition to the impacts of CF on farmers' welfare and productivity. They emphasize that these aspects are still an active area of research, and a clear consensus has by no means been reached (Wang *et al.*, 2014).

Several factors are suggested as reasons why smallholder farmers want to participate in CF. The primary reasons typically suggested are to earn higher incomes and to mitigate production and market risks (Bijman, 2008). Despite the difficulty of determining clear causality in the impacts of CF on farmers, increasing evidence seems to indicate that CF participation improves the productivity and efficiency of farmers. The improvements in farmer productivity are ascribed to gains in scale arising from the coordinated consolidation of smallholder farmers and enabling the adoption of modern technologies and best practices (Wang *et al.*, 2014).

Additionally, the literature tends to find evidence that, on average, CFA participants earn higher incomes and may experience greater food security and lower income variability compared to non-participants (Bellemare & Bloem, 2018; Bellemare *et al.*, 2021; Bellemare & Lim, 2018; Bellemare & Novak, 2017; Meemken & Bellemare, 2020). Increased income is likely a function of higher prices offered for quality products and the consequences of greater output arising from gains in productivity (Bijman, 2008). These outcomes seem to support the notion that CF could be an important pathway to stimulate modernisation in smallholder agriculture (Wang *et al.*, 2014).

2.2.2 Participation and Exits in Contract Farming Arrangements

Despite the supposed benefits of CF participation, several studies note that CFAs often have high exit rates of smallholder farmers (Barrett *et al.*, 2012; Narayanan, 2013; Ruml & Qaim, 2021). Research into the dynamics of participant turnover and sustained participation in CFAs over time has not received as much attention in the academic literature (Barrett *et al.*, 2012; Bellemare & Bloem, 2018; Michelson, 2017; Narayanan, 2013).

Barrett *et al.* (2012) provide a framework which conceptualises some of the key stages and decisions of the CF participation process. Basically described, contracting firms determine locations which offer suitable production attributes. Contracts are then offered to eligible farmers who choose whether the contract terms are acceptable. Once entered into a contractual relationship, stakeholders then make decisions regarding their adherence to contract terms. At the current contract's conclusion, the cycle would start again. However, farmers and contracting firms now re-evaluate and adjust their expectations and beliefs regarding engagement based on the outcomes of past experience. As a result of this learning process, CF participation decisions are dynamic over time. Barrett *et al.* (2012) point out that this dynamism in smallholder CF participation is understudied.

Some of the gaps in knowledge surrounding smallholder CF participation over time include who enters and why? Who exits and why? What are the impacts of participation over time? Narayanan (2013) aimed to address the paucity of knowledge about smallholder participation in CFAs. Looking at five different CFAs in India, Narayanan (2013) investigated the extent and reasons behind farmer exits.

Narayanan (2013) states that exits across the five different CFAs were relatively widespread. Moreover, the reasons for exit stated by farmers revolved primarily around a divergence between expected outcomes versus actual experience. For instance, the profitability of CF being lower than expected was the most commonly cited reason for exit. Followed by higher than expected labour requirements. Narayanan (2013) posed the self-reported reasons for exit as an open question, after which a total of 19 overarching reasons emerged. Thus, while some reasons for exit were more prevalent than others, it is clear that the causes of farmers' exit from CFAs can be highly variable (Narayanan, 2013).

Glover (1990) raises a further important point when considering farmer CFA participation and exits, that being barriers to exit. When farmers have viable alternatives to CFA participation it improves their bargaining power with the contractor. Furthermore, should CFA participation not provide the expected utility for farmers, they can simply withdraw from participation and pursue more beneficial alternatives (Glover, 1990). However, in the case where profitable alternatives to CFA participation are limited, farmers would face a greater barrier to exiting and a loss in bargaining power within the contractual relationship. Hence, low exit rates of farmers may suggest a successful scheme and satisfied participants. Alternatively, a low exit rate could also be as a result of high barriers to exit. Similarly, a high turnover rate may be indicative of an underperforming CFA, or farmers with very low barriers to exit being highly opportunistic on reneging on contract terms with little to no consequences. Therefore, careful consideration must be given when assessing the participation outcomes of CFAs (Glover, 1990).

Studies analysing the impacts of CF participation often use cross-sectional data. The drawback of this is that the dynamic effects of participation cannot be appropriately investigated (Barrett *et al.*, 2012). Andersson, Chege, Rao, *et al.* (2015) sought to address this limitation by using panel data on smallholder vegetable farmers in Kenya, studying the dynamics of Kenyan smallholders participating in the supermarket channel. Similarly, Michelson (2017) investigated the CF participation dynamics in supermarket channels based on panel data from Nicaragua. Meanwhile, Granja and Wollni (2018) used time-series data combined with a household survey to analyse the participation dynamics of smallholder broccoli farmers involved in the export market in Ecuador. Therefore, to appropriately investigate the dynamics of CFA participation in Malawi, this study likewise uses panel data.

Wang *et al.* (2014) conducted an empirical review of CF impacts on smallholders and attempted to highlight some of the correlates of CF participation frequently found to be significant. Furthermore, they reviewed the experience of CF in China. Wang *et al.* (2014) highlight the existence of considerable heterogeneity in CF outcomes across different settings and arrangements. This heterogeneity is evident within the literature regarding factors driving farmers' decisions in contract participation. The direction and significance of factors influencing the participation decision in CF seem to vary across many studies. Thus, when conducting research in the area of CF, researchers must keep cognisant of the heterogeneous nature of the subject and how this will influence the implications drawn. It is emphasised that the relationship between the potential explanatory variables and CF participation is often largely dependent on the context (Wang *et al.*, 2014).

In the context of Malawi, CFAs have been used in various forms for the production of different crops for quite some time. Some major crops have included chillies, cotton, coffee, sugarcane, paprika, tea, and tobacco (Kumwenda & Madola, 2005). In the case of tobacco, the conventional form of marketing entails an auction-type system. However, in the early 2000s a notable shift occurred as tobacco companies began increasingly utilising CF to source tobacco leaf. Tobacco CF has now expanded to the point where over 70 per cent of Malawi’s burley tobacco production is sourced using CFAs (Prowse, 2022).

Malawi has expressed interest in stimulating greater commercialisation within the agricultural sector, with the promotion of CF being suggested as one of the important pathways

(MoAIWD, 2016, 2018; NPC, 2020). To the best of the researcher's knowledge, investigation into the dynamics of CF participation over time within the Malawian context is very limited. Given the observations of high farmer exit from CFAs in other contexts (Andersson *et al.*, 2015; Barrett *et al.*, 2012; Narayanan, 2013; Ruml & Qaim, 2021), and that the topic of sustained CF participation is understudied in general (Andersson *et al.*, 2015; Barrett *et al.*, 2012; Bellemare & Bloem, 2018; Granja & Wollni, 2018; Michelson, 2017; Narayanan, 2013), an investigation into the duration and dynamics of CF participation in Malawi could make a relevant contribution to the discussion surrounding this topic.

2.3 Conceptual Considerations in Participant Turnover

Research on employee turnover provides some important considerations applicable to participant turnover in CFAs. The drivers and impacts of employee turnover have been a major point of interest in human resource management research (Tziner & Birati, 1996). The number of individuals exiting, the duration that individuals are staying, and the functionality (performance quality) of leavers are important dimensions considered when analysing employee turnover (O'Connell & Kung, 2007).

Employee exits can result in several costs in terms of time and resources. Direct costs are incurred in dismissing current employees and recruiting, hiring, training, and integrating new employees. There can also be significant indirect costs in terms of disruptions to productivity and production (Tziner & Birati, 1996). It may take time to find suitable replacements, and these replacements may take some time before their productivity equals or surpasses that of their predecessors (O'Connell & Kung, 2007; Tziner & Birati, 1996). Furthermore, it is only once actual work starts that individuals and organisations can accurately gauge the engagement's suitability. As a result, relatively newer employees tend to have higher turnover probabilities than those engaged for longer (Tziner & Birati, 1996).

Moreover, a distinction is often made between turnover termed as 'functional' and 'dysfunctional'. The occurrence of employee turnover should not be considered categorically negative. Where poor performers leave an organisation, it may allow better-performing individuals to be hired. This type of turnover could be considered 'functional' since it would likely result in beneficial outcomes such as improved performance and productivity. Where well-performing individuals are exiting, turnover may be considered 'dysfunctional' given that replacements of these individuals will likely be more difficult and costly (Tziner & Birati, 1996).

This study applies these considerations to the analysis of CFA participation turnover. Looking at the extent of farmers exiting, how long farmers are staying, and where possible any inferences that can be made regarding the functionality of participant turnover.

Chapter 3: Methods and Data

3.1 Methods

3.1.1 Survival Analysis

Chapter 3 starts with an explanation of the survival analysis approach, and why it is particularly suited to address questions regarding the likelihood and timing of events. The decision-making involved in CFA participation is a dynamic process. As contract stakeholders engage, new information is gained based on observed outcomes and experiences. Over time prior beliefs and expectations are incrementally updated, further shaping and adjusting the participation decision (Barrett *et al.*, 2012).

Interest in the variable 'time to event' has been relevant to various research fields, from medicine and sociology, to engineering and economics (Emmert-Streib & Dehmer, 2019). Survival analysis, or duration analysis, refers to a group of statistical techniques employed to deal with questions related to the timing of events (Mills, 2011). Along with analysing the effects of explanatory variables on the likelihood of event occurrence in a given time period (Allison, 2014; Cox, 1972; Euler, Schwarze, Siregar, *et al.*, 2016). In economics, duration analysis has frequently been applied to study unemployment duration and technology adoption (e.g., time until employment or adoption) (Euler *et al.*, 2016; Singh & Dlamini, 2021).

Survival analysis methods have also been applied to topics and contexts related to those in this study. Lambrecht and Ragasa (2018) used duration analysis to investigate the factors, particularly the presence of development projects, which affect participant entry and exit in maize CFAs in Ghana. Khataza *et al.* (2018) employed a discrete-time duration analysis to assess factors influencing the timing of conservation agriculture adoption in Malawi. Euler *et al.* (2016) employed duration analysis to analyse participation determinants and dynamics in palm oil cultivation in Indonesia. In contrast, Granja and Wollni (2018) applied a duration model to examine factors influencing the time-to-withdrawal of smallholders in the broccoli export sector of Ecuador. Thus, it appears that a duration or survival analysis approach is appropriate for addressing the research questions of this study.

Event histories refer to data which records the sequential series of events associated with a given subject of study. Event histories are ideal for analysing the occurrence and timing of events. However, these types of records possess characteristics that pose significant obstacles to applying standard statistical methods. Censoring and time-varying covariates are factors that conventional statistical methods do not appropriately account for (Allison, 1982). Therefore, it is important to use methods, such as survival analysis models, to accommodate the unique qualities of survival time data (Jenkins, 2005).

In any analysis of event occurrence, there will be individuals who do not experience the event during the observation period. These individuals have event histories which are said to be 'censored'. For censored subjects, the researcher does not know if or when an individual will experience the event because it will occur at a time beyond the study period. One may be tempted to remove all censored cases from the analysis, but this leads to a loss of information and can result in the skewing of estimates. The survival analysis approach can avoid the loss of this information and appropriately incorporate the survival time information from censored data (Willett & Singer, 1993).

Survival analysis models are essentially regression models (Mills, 2011). The primary task is to develop and estimate a regression model for which the probability of an event occurring at a given time is conditional on several explanatory covariates. Hazard and survival functions are key components in modelling the risk of event occurrence (Allison, 2014). The hazard rate, which is the conditional probability of event occurrence in a given period t provided it has not occurred before time t, is given by the hazard function $h(t)$ (see Equation 1) (Emmert-Streib & Dehmer, 2019; Mills, 2011).

That is to say, the hazard probability indicates the risk of event occurrence within a specific time period. In contrast, the hazard function summarises the pattern of the hazard probabilities across the different time periods. Hazard probabilities are calculated for each given period until the event of interest occurs, or the case is censored. In this manner, survival analysis methods can incorporate both censored and non-censored cases within estimations, so that no data need to be excluded or arbitrarily aggregated (Willett & Singer, 1993).

$$\boldsymbol{h(t) = Pr(T = t | T \geq t)} \tag{1}$$

The probability of 'survival' beyond a specific time t, or alternatively described, the probability that an event has not occurred until time t is given by the survival function $S(t)$ shown in Equation 2 (Emmert-Streib & Dehmer, 2019; Mills, 2011).

$$\boldsymbol{S(t) = Pr(T > t | T \geq t) = 1 - h(t)} \tag{2}$$

In this study, the 'event' of interest is when a farmer exits from contract participation with the current CFA. The survival function represents the probability that a farmer participates (survives) in the CFA beyond a specific time t. While the hazard function gives the conditional probability that a farmer ceases participation in the CFA during a given time period t, on the condition that the farmer has not exited before the given period t.

With survival analyses, the risk of an event occurring at a given time can be modelled using either continuous or discrete-time models (Mills, 2011). The work by Cox (1972) was a seminal contribution to the statistical methods of survival analysis and the resultant development of the widely used continuous-time Cox proportional hazards model (CPHM).

The proportional hazards (PH) model is a semiparametric regression model. It allows for parametric estimation of the relationship between the hazard rate and covariates, while not making assumptions about the distribution of event occurrence. That is to say, the shape of the baseline hazard function is nonparametric (Allison, 2014; Jenkins, 2005). The semiparametric nature of the PH model is possible because of the assumption of proportional hazards (PH) (Jenkins, 2005). The assumption is that the effect of a given variable on the hazard rate is constant across time. In other words, the relative hazard rate is proportional over time (Allison, 2014; Cox, 1972).

The validity of the PH assumption is considered a limitation of the PH model (Allison, 2014). It is not uncommon to find that the PH assumption does not always hold in practice, and the effects of covariates on the hazard rate may vary over time (Euler *et al.*, 2016; Singer & Willett, 1993). Although, Allison (2014) suggests that the PH assumption is not highly restrictive, and in instances where it may be violated, the PH model still offers a competent approximation. It is advised that researchers should pay closer attention to issues of misspecification, measurement errors, and unobserved heterogeneity (Allison, 2014).

With continuous-time models, it is implicitly assumed that the precise instant of an event occurring is known. Hence the measurement of time on a continuous scale. However, in reality, event records are often measured in a more discrete fashion (Singer & Willett, 1993). For example, while events may occur at any time, the records of those events may only be taken at specific time intervals, such as once a day, month, quarter, or year. Therefore, the exact timing is unknown, except that the event occurred within a given interval. Another case may be that events occur at regular discrete time intervals, such as term limits within government election cycles (Allison, 1982).

Discrete-time models are used when it is known that an event occurred within a certain time interval, but the exact time of occurrence is not known. For example, the case where one knows an event occurred within a given year but not the exact day of the year (Mills, 2011; Singer & Willett, 1993). Therefore, discrete-time methods were considered the most appropriate for this study, given that the data on contracting farmers are recorded yearly. Additionally, changes in the CF participation status of farmers are only known with reference to the year within which contracting ceases.

The hazard function can be expanded so that the conditional probability of event occurrence in a given time interval includes the effects of covariates (Equation 3). Hence, the dependent variable modelled in discrete-time models is the probability of event occurrence, conditional on the event having not yet occurred before time t, and conditional on the vector of covariates x (Mills, 2011).

$$\boldsymbol{h(t) = Pr(T = t | T \geq t, x)} \quad (3)$$

The basic proportional hazards (PH) model of Cox (1972) can be expressed as:

$$\boldsymbol{h_i(t, X) = h_0(t)\{exp\,(\beta_1 X_{i1} + \ldots + \beta_k X_{ik})\}} \quad (4)$$

Equation 4 shows that the hazard of event occurrence in time t for individual i is a product of an unspecified baseline hazard function $h_0(t)$, and the vector of individual-specific explanatory variables X (Allison, 1982; Jenkins, 2005; Mills, 2011). The baseline hazard function is left unspecified; therefore, PH models do not have a term for the intercept. The baseline hazard represents the hazard for an individual when all other covariates assume values of zero (Mills, 2011).

Given that the baseline hazard $h_0(t)$ is only dependent on t and not covariates X, it is considered to reflect the duration dependence pattern shared across all individuals. The nature of duration dependence is an important consideration. It reflects the relationship between survival time and variations in the hazard rate. The set of individual-specific covariates X, are considered to explain the variations of individuals' hazard rate from the common baseline hazard (Jenkins, 2005).

A complementary log-log specification (cloglog) is the discrete-time alternative to the continuous-time PH model. As a result, the discrete-time PH model (DTPH) is often also referred to as the 'cloglog' model (Jenkins, 2005). The discrete-time hazard function can be written as shown in Equation 5. Where j now reflects the discrete-time interval, as opposed to a measurement of time t on a continuous scale. Thus, γ_j reflects the baseline hazard summarising the pattern of duration dependence within the discrete-time interval j (Jenkins, 2005).

$$\boldsymbol{h(j, X) = 1 - exp[-exp\,(\gamma_j + \beta' X)]} \quad (5)$$

The actual hazard rate may increase or decrease with survival durations. It is also possible that the shape of the hazard function exhibits a combination of these relationships. Thus, it may be preferable not to impose strong simplifying restrictions on the hazard rate by opting for a flexible nonparametric approach (Jenkins, 2005). This study opted to characterise the baseline hazard function using a piecewise approach to summarise duration dependence. Meaning dummy variables had to be created to represent each of the specific time intervals j ($\mathrm{D_1} \ldots \mathrm{D_j}$). These interval-specific dummy variables require that the intercept term be excluded from model estimation to avoid causing problems of collinearity (Jenkins, 2005). Equation 6 provides the resultant expression of the DTPH model's hazard function after incorporating the piecewise approach to characterising the baseline hazard function:

$$\boldsymbol{cloglog}[\boldsymbol{h}(\boldsymbol{j},\boldsymbol{X})] = \boldsymbol{\gamma_1 D_1} + \boldsymbol{\gamma_2 D_2} + \ldots + \boldsymbol{\gamma_j D_j} + \boldsymbol{\beta' X} \tag{6}$$

At this point, the model expressions assume that differences in hazard rates between individuals are fully explained by variations in the values of observable covariates contained within the vector X (Jenkins, 2005; Singer & Willett, 1993). However, there may be unobservable factors, whether they be omitted variables not contained within the study dataset, or inherently unobservable factors, which have important influences on the differences in hazard rate observed. These effects are often described as unobserved heterogeneity or frailty. If unobserved heterogeneity is present but unaccounted for, it can lead to overestimation or underestimation of the baseline hazard. Moreover, it can skew the proportionate response of the hazard rate to changes in covariates. Fortunately, the discrete-time cloglog model can be extended, as shown in Equation 7, to control for such unobserved heterogeneity (Jenkins, 2005).

$$\boldsymbol{cloglog}[\boldsymbol{h}(\boldsymbol{j},\boldsymbol{X}|\,\boldsymbol{u})] = \boldsymbol{\gamma_1 D_1} + \boldsymbol{\gamma_2 D_2} + \ldots + \boldsymbol{\gamma_j D_j} + \boldsymbol{\beta' X} + \boldsymbol{u} \tag{7}$$

The individual-specific error term u, is a random variable assumed to have finite variance, a mean of zero, and a distribution independent of the time j and covariates X (Jenkins, 1995, 2005). By incorporating the error term u, the impact of unobservable variables on the hazard rate can now be summarised within the model. The distribution of the random variable u is often specified with a Gamma distribution. Alternatively, an Inverse Gaussian distribution is also frequently used for the Normal heterogeneity model, where errors are assumed to be normally distributed (Jenkins, 2005).

The parameters of the complementary log-log model are estimated using a maximum likelihood estimation (MLE) method, and if the coefficients in Equation 7 are exponentiated, one can obtain hazard ratios (Allison, 2014). Hazard ratios indicate the proportional change in the hazard of event occurrence, for a one-unit change of a given covariate, *ceteris paribus* (Jenkins, 2005).

3.1.2 Discrete-time Model Implementation and Estimation Procedures

The procedures outlined by Jenkins (2005) were followed to operationalise and estimate the discrete-time survival models used in this analysis. The estimation of discrete-time models involves the application of conventional binary dependent variable regression models to a discrete-time structured dataset (Jenkins, 2005).

Discrete-time event history data must be organised into a format compatible with standard binary dependent variable regression analysis. Therefore, data must be structured in a person-period format similar to the example in Table 1 (Singer & Willett, 1993). The data is essentially arranged into an unbalanced panel data structure. Each individual has a row for every time interval that they are at risk of event occurrence (Jenkins, 2005). Each person receives a unique identifier variable (ID). A binary dependent variable is also created, indicating whether or not an event occurred for an individual in a specific time period. For example, the variable 'Event Indicator' reflects a value of 1 when an individual experiences the event of interest. While a value of 0 is shown for instances of censored events or event non-occurrence (Singer & Willett, 1993).

Consider the individual with the ID code 02 in Table 1. Looking at the 'Event Indicator' variable, it can be determined that the person identified by the code 02 experienced the event in their fourth year. By contrast, the individual identified by the code 01 survives beyond the five-year duration of study period before any event occurrence is observed. Although individual 01 is an example of a censored case, the event history of such an individual still conveys important information regarding survival over time. This example illustrates why survival analysis methods' ability to incorporate censored cases is valuable.

Time indicator variables (D_1 ... D_5) are a set of dummy variables which identify specific time periods for which individuals are at risk of experiencing the event of interest (Singer & Willett, 1993). As explained earlier, these time indicators are used to characterise the baseline hazard function to summarise the pattern of duration dependence. The dummy variables for each interval of time are created to estimate the interval-specific hazard rates. The baseline hazard rate is considered to vary between time intervals but be constant within time intervals (Jenkins, 2005).

To incorporate covariates, one needs to structure the data so that there are multiple records per individual, referred to as episode splitting. By splitting an individual's survival time into episodes, it allows for the values of each time-varying covariate to be constant within a respective subperiod (Jenkins, 2005). In this manner, the survival analysis approach can accommodate time-varying covariates. It can be seen that the covariate X_1 is time-varying. Annual income would be a good example of such a time-varying case. Across intervals, the values can change but they are constant within subperiods. At the same time, X_2 shows a case of a time-invariant predictor, where the characterisation remains the same across all time intervals for a given individual. Consider an example where X_2 indicates a value of 1 for males, and a value of 0 indicates females. It is still necessary that there is an interval-specific value for X_2, though it does not vary over time.

Table 1 Example of person-period data structure

ID	Event Indicator	D_1	D_2	D_3	D_4	D_5	X_1	X_2
01	0	1	0	0	0	0	7	1
01	0	0	1	0	0	0	12	1
01	0	0	0	1	0	0	17	1
01	0	0	0	0	1	0	4	1
01	0	0	0	0	0	1	20	1
02	0	1	0	0	0	0	3	0
02	0	0	1	0	0	0	14	0
02	0	0	0	1	0	0	18	0
02	1	0	0	0	1	0	10	0
03	0	1	0	0	0	0	2	1
03	1	0	1	0	0	0	20	1
04	0	1	0	0	0	0	3	0
04	0	0	1	0	0	0	15	0
04	1	0	0	1	0	0	2	0
05	1	1	0	0	0	0	9	1
06	0	1	0	0	0	0	2	1
06	1	0	1	0	0	0	4	1
07	0	1	0	0	0	0	10	1
07	0	0	1	0	0	0	11	1
07	1	0	0	1	0	0	17	1

Once the appropriate data structure has been set up, and the appropriate functional form has been selected, the next step is to estimate the binary dependent variable regression in a suitable statistical program. The Stata program is often used for survival analyses (Jenkins, 2005). Specifically, this study used the Stata 17 program (StataCorp, 2021a), to implement a complementary log-log specification.

Typically, model estimation starts with a simple baseline hazard model. This baseline model only considers the effects of time on the hazard of exit. By only considering the effects of time and no other covariates, this initial model provides the baseline hazard common to all individuals. One then builds on this baseline hazard in subsequent models. Adding covariates which characterise individuals and are expected to explain the differences in their respective hazards beyond the baseline effects of time (Singer & Willett, 1993).

In this study, the initial baseline hazards, and the subsequent full effects estimations, are estimated using complementary log-log models with, and without, unobserved heterogeneity effects. The Normal heterogeneity model can be estimated using Stata's 'xtcloglog' command. Meanwhile, the 'pgmhaz8' program can be installed in Stata and used to estimate the Gamma heterogeneity model. However, unobserved heterogeneity models can be challenging to fit, and models may not always reach convergence (Jenkins, 2005). This study primarily uses the Normal heterogeneity model due to the difficulties of model convergence experienced with the Gamma heterogeneity model. However, the Gamma heterogeneity model estimations converged for the full effects model.

3.2 Data and Data Source

This study aims to provide a more detailed understanding of the duration of farmer participation in CF. Statistically analysing the impact of observable factors on the likelihood and timing of farmer withdrawal from contracting. To accomplish these aims, this study used secondary panel data from the internal records of a burley tobacco contracting firm in Malawi.

A case study involving a Malawian burley tobacco CFA was deemed appropriate for the following reasons. First of all, tobacco is the most important export crop for Malawi, accounting for a major share of the country's total export earnings. The crop is of such significance to the nation, that Malawi is often described as having one of the most tobacco-dependent economies in the world (Mangani *et al.*, 2020; Moyer-Lee & Prowse, 2015). It is burley tobacco in particular which is responsible for most of the tobacco proceeds generated for Malawi (Mangani *et al.*, 2020). A salient fact to recognise, because burley in Malawi is primarily produced by smallholder farmers (Prowse & Moyer-Lee, 2014).

Another fact that makes a burley CFA case study highly relevant is the considerable rise in the proportion of burley tobacco produced under contract in Malawi (Prowse, 2022). Prowse (2022) estimates that burley production under contract has increased over the last two decades since the early 2000s, to where now approximately 70 per cent of Malawi's burley is currently produced using CFAs. Hence, analysing a case of burley tobacco is relevant, not only because of the national importance of the crop, but also because of the increasing application of CFAs to engage Malawian smallholders to supply the high-value tobacco market.

Moreover, the tobacco industry in Malawi is subject to many of the evolving demands and trends faced in supplying modern high-value markets. The tobacco industry operates in a rapidly evolving environment and receives an amount of scrutiny beyond that of most other crops. With mounting pressures related to health concerns from smoking, and given that the industry is strongly buyer-driven, Malawi's tobacco sector has seen a considerable shift towards high compliance and traceability requirements (Moyer-Lee & Prowse, 2015).

The importance of diversifying Malawi's economic reliance on tobacco is widely recognised (Mangani *et al.*, 2020; Wineman, Chilora & Jayne, 2022). However, it is argued that factors influencing the ability of Malawian smallholders to endure the stresses of supplying a modern high-value market, such as tobacco, are likely to be similar factors that Malawian farmers will face for other high-value market crops grown in Malawi. Suppose well-structured markets emerge for the production of alternative high-value crops in Malawi. In that case, these modern constraints will likely still play an important role in the challenges smallholders face to participate and sustain participation in such modern agricultural value chains. It is therefore believed that analysing a smallholder burley CFA provides an informative case with which to examine the CF participation dynamics of Malawian smallholders in modern agricultural value chains.

This study utilised data on all burley tobacco farmers who the participating firm contracted in the time period between 2018 to 2022. The data used covers several farm and farmer characteristics. In addition, the records provide information regarding historical farmer performance, when participants first start to contract with the firm, and the subsequent participation until disengagement. In addition to the primary contract crop of burley tobacco, there was also data on farmers' nontobacco farm enterprises. However, this study did not distinguish between nontobacco enterprises produced for subsistence or commercial purposes. For completeness, it was only possible to determine the number of different nontobacco enterprise types, not the volumes or values.

Some individuals were excluded from the analysis due to incomplete records. The final dataset contained the contracting records of 23,625 individuals across the five-year time period. Individuals contracting for longer than one season naturally have multiple records. Consequently, the total number of observations for time-at-risk across the sample of individuals totalled 49,911. In this analysis, the minimum survival time was one season, and the maximum possible survival time observed was five seasons. Further descriptive statistics are explored in Section 3.4. However, first, we turn to Section 3.3 to describe the explanatory variables and the respective expectations the literature informed for inclusion in this analysis.

3.3 Expectations and Key Variables

As previously mentioned, many factors are considered to have important influences on CF participation. The predominant rationale suggested for smallholder CF participation involves the purported opportunities for achieving higher incomes, greater productivity, and risk mitigation (Bellemare & Lim, 2018; Bijman, 2008; Wang *et al.*, 2014). Therefore, it would be important to examine the effects of income, variability, and productivity in relation to CF participation duration and exit. In addition to such motivations, certain characteristics may also play an important role in participation decisions (Lambrecht & Ragasa, 2018). Several technical, socioeconomic, and household characteristics are often considered as explanatory variables in CF participation (Euler *et al.*, 2016; Narayanan, 2013; Wang *et al.*, 2014). This study examines how the expectations regarding these factors and effects play out over time in the context of a Malawi CFA. Specifically, how such factors and effects impact the probability and timing of contract exit for smallholders engaged in burley CF in Malawi. Similar to the application of discrete-time methods by Khataza *et al.* (2018), examining the adoption of conservation agriculture by Malawian smallholders, this study uses relevant literature as the primary guide in selecting potential explanatory variables. Table 2 summarises the variables and variable descriptions used in this study.

3.3.1 Duration Dependence Effects

As outlined by Jenkins (2005) time indicator dummy variables for each interval of time are created to estimate the interval-specific hazard rates. With these dummy variables, one can examine the effects of time (duration dependence) on the hazard of exit. A dummy variable is created for each time interval present in the data for which individuals are at risk of experiencing the event of interest. With this nonparametric approach, the baseline hazard cannot be estimated for time-intervals in which no events occur. For intervals with no events, one either must redefine the interval or exclude that interval from the estimation. Therefore, this study only includes time indicator variables for periods in which events occur, such as the seasons 2018 through to 2021. The data cannot provide information on exits for 2022, since information on event occurrence for these individuals will only be known within the following year of 2023. Because the exits of farmers in the 2022 season are not known within the period of observation, they are cases of censored event occurrence. Nonetheless, these cases still provide important information with respect to survival over time. With a fully nonparametric estimation approach for the baseline hazard, no intercept is included in the model. Hence, one needs to select the 'noconstant' option in Stata (Jenkins, 2005).

3.3.2 Farmer and Household Characteristics

Age

Wang *et al.* (2014) found in a review of empirical studies, that the direction and significance of the effects of age associated with farmers' decisions to participate in CF, to be inconclusive. In some instances, the effect is positive, others negative, and others still find nonlinear effects. Tiller, Feleke and Starnes (2010) used age as an indicator for farming experience when explaining variations in USA burley farmer efficiency and their ability to adapt to changing institutional environments. Tiller *et al.* (2010) also pointed to the expectation that the effect of age would be nonlinear. Relatively younger farmers were expected to have less experience. Hence, they were expected to have a higher likelihood of exiting the burley tobacco industry in the USA. Relatively older farmers, on the other hand, may be too cautious in times when rapid adaption to a changing institutional environment would be imperative. Again, it was posited that this would raise the likelihood of older farmers exiting the tobacco industry. In turn, middle-aged farmers were expected to have a lower probability of exiting the tobacco industry compared to the formerly mentioned age groups (Tiller *et al.*, 2010).

Similarly, this study uses three age dummy variables (see Table 2) to examine the expected nonlinear relationship between age and the hazard of exiting. The expectation is that the relatively younger farmers (Age < 45 years) and the relatively older farmers (Age ≥ 65 years) will have higher hazards of exit relative to the reference category of middle-aged farmers (Age 45 ≤ & ≤ 64 years).

Gender

Several studies have found that female-headed households have low participation levels in CF schemes (see, for example, Prowse (2022), and Wang *et al.* (2014)). These low levels of participation may be due to challenges that women face regarding access and ownership of productive resources such as land. As a result, if women cannot provide assurances of access to the necessary productive resources, some contracting firms may be concerned about whether the farmer can provide a guaranteed supply. However, this is not to say that female-headed households participating in CF cannot perform well (Prowse, 2022). Rather the key point is that female-headed households may be less likely to participate in CF, given the higher barriers to entry that they may face (Prowse, 2022; Wang *et al.*, 2014).

Lambrecht and Ragasa (2018) found that female households had a higher likelihood of exiting CF. Similarly, Granja and Wollni (2018) found that female-headed households were more likely to exit broccoli export CF in Ecuador. However, after a negative external shock to the industry, female-headed households seemed to exit at a slower rate. The explanation suggested was that female-headed households were possibly more vulnerable to facing exit barriers in adverse times, and so stayed longer in the hope of recouping losses. Therefore, this study expects that male contract farmers will have a lower probability of exiting than female contract farmers.

Education

The conclusions of empirical studies concerning the influence of education level on CF participation also vary. It is again suggested that the effect may be nonlinear (Wang *et al.*, 2014). Lambrecht and Ragasa (2018) found that households without formal education were more likely to participate in CF. It was suggested that less educated households are less likely to have the same extent of alternative opportunities compared to better-educated individuals. Or perhaps less formally educated individuals are aware of such alternatives, but educational constraints limit their opportunities to engage in alternative activities (Lambrecht & Ragasa, 2018).

An individual's education level can be considered a proxy for human capital. It can represent the capacity of farmers to innovate and adapt. Consequently, greater education levels may enhance production efficiency due to greater awareness or openness to adopting new or innovative practices. Thus, improving the resilience of a farmer in sustaining operations over time (Tiller *et al.*, 2010). The findings of Tiller *et al.* (2010) suggest that better-educated farmers had a greater probability of exiting the burley tobacco industry in the USA. The rationale being that higher education levels improve an individual's productivity and increase off-farm opportunities. Andersson *et al.* (2015) found that education increased the probability of Kenyan farmers dropping out from supplying high-value markets. They also argue that more educated individuals would have higher opportunity costs for allocating their time (Andersson *et al.*, 2015). On the other hand, better-educated farmers may have improved information access and are possibly more adept at adjusting to new managerial requirements (Euler *et al.*, 2016). In the case of Indian CFAs, higher education levels lowered the probability of exit (Narayanan, 2013).

In a similar vein to the work of Chirwa (2009), who looked at factors affecting Malawian smallholders' tobacco profitability, this study likewise uses four dummy variables to represent different levels of education. For this study, it is expected that farmers with higher levels of education will have lower hazards of exiting relative to farmers with no formal education.

Household Size

Chirwa (2009) found a positive relationship between household size and Malawian smallholders' tobacco profitability. Given the labour-intensive nature of burley tobacco production, increased household size would ease labour constraints and strengthen farm profitability.

Andersson *et al.* (2015) found that household size, as a proxy for available family labour, had a negative effect on the likelihood of smallholder farmers exiting the supply of high-value market channels in Kenya. It is proposed by Andersson *et al.* (2015) that supplying high-value markets, such as supermarkets, requires large commitments of time and effort. Therefore, with more household members, the opportunity costs of a household's labour time would likely be lower. Whereas, for smaller families, the opportunity cost of time may consequently be much higher. Narayanan (2013) found that, amongst other reasons, high labour requirements were reported as a reason behind some farmers' exit from CFAs in India. Similar to Hernández and Reardon (2012) this study considers the total number of adults within the household as an indicator of available household labour.

3.3.3 Farm Characteristics

Contracted Hectarage

In many studies, larger farms appear to show a higher propensity to participate in CF (Wang *et al.*, 2014). Euler *et al.* (2016) highlight that the land area under contract had a significant and positive effect on which smallholders could later expand their palm oil production. Contracting firms may prefer larger farms, given the associated reductions in transaction costs. However, contractors often will report that they value a farmer's willingness to learn and collaborate to be almost as, if not more important than the size of farms. Furthermore, firms may engage farmers with a mixed strategy concerning the size composition of their supplier base. Having a variety of supplier sizes can be important to avoid hold-up problems, which may arise if a firm is overly dependent on a few large suppliers (Swinnen & Maertens, 2007).

Nonetheless, Tiller *et al.* (2010) found that farm size had a negative and significant effect on the probability that USA burley farmers exit from the industry. Both medium and large-scale burley farms across all periods had a lower propensity to exit than small-scale producers. Moreover, large-scale farmers had a lower propensity to exit compared to medium-scale farmers. This negative relationship between farm size and exit likelihood could indicate scale economies which make larger farmers relatively more efficient than the operations of smaller farms. Suggesting the unit costs of tobacco production decrease with increased farm scale (Tiller *et al.*, 2010).

In Malawi, however, burley production is predominantly produced at a smallholder scale (Prowse & Moyer-Lee, 2014). Yet, the likelihood of burley tobacco CF participation is higher for Malawian smallholders with relatively larger farm sizes than non-CF participants (Shaba, Edriss, Mangisoni, *et al.*, 2017). The trends within Malawi's tobacco sector suggest shifts towards larger scales of production in terms of the hectarage individual farmers allocate to tobacco cultivation (Wineman *et al.*, 2022). Therefore, in this study, it is expected that smallholder farmers with relatively larger contracted areas are less likely to exit and, consequently, more likely to sustain participation.

Data on total farm sizes were unavailable; however, land area under contract was available at the club and farmer level. Therefore, it is assumed that the area under contract would exhibit similar effects to the total farm size variables used in other studies. This study uses farm size categories similar to the regional Malawian farm size categories presented in Muyanga, Nyirenda, Lifeyo, *et al.* (2020).

Nontobacco Crops and Livestock Enterprises

Tiller *et al.* (2010) examined whether tobacco farmers also engaged in nontobacco farm enterprises and found it to be an important consideration within burley farmer exits in the USA. A distinction was drawn between nontobacco crop production and livestock production. Tiller *et al.*

(2010) found that farmers who operate livestock enterprises in addition to tobacco production were more likely to exit the tobacco industry. Yet, farmers had a lower likelihood of exiting the tobacco industry if they grew other crops in conjunction with tobacco. Tiller *et al.* (2010) suggest that since there exists a greater potential for input sharing between tobacco and nontobacco crops, it may introduce cost saving benefits from economies of scope. While with livestock, the extent of a complementary relationship with tobacco is expected to be much lower.

In the Malawian context, Shaba *et al.* (2017) explain that contracted farmers at times may divert some of the inputs they receive for tobacco, such as fertiliser, to other crops. Such actions, however, are typically in breach of contractual agreements (Shaba *et al.*, 2017). Nonetheless, said actions may indicate the presence of a similarly important and complementary relationship between tobacco production and other crops in Malawi. Furthermore, Moyer-Lee and Prowse (2015) report that some tobacco contract packages enable farmers improved access to inputs and seed for other nontobacco crops. Therefore, it is expected that contracted smallholders who grow other crops in conjunction with tobacco, will have lower probabilities of exiting. At the same time, farmers with livestock enterprises in conjunction with tobacco are expected to show relatively higher hazards of exiting. Respectively, two variables are used in this study to characterise the number of nontobacco crops and livestock enterprises that contracted farmers produce in addition to burley tobacco.

Table 2 Description of covariates

Variable domain	Variable code	Variable description
	Period 1	dummy = 1 if 2018 otherwise 0
	Period 2	dummy = 1 if 2019 otherwise 0
Duration Dependence Effects	Period 3	dummy = 1 if 2020 otherwise 0
	Period 4	dummy = 1 if 2021 otherwise 0
	Period 5	dummy = 1 if 2022 otherwise 0
	Age < 45 years	dummy = 1 Age below 45 years old; otherwise = 0
Farmer Age	Age 45 ≤ & ≤ 64 years	dummy = 1 Age between 45 & 64 years old; otherwise = 0
	Age ≥ 65 years	dummy = 1 if Age equal to or greater than 65 years old; otherwise = 0
Farmer Gender	Gender	dummy = 1 if farmer gender is male; otherwise 0 for female
	No Education	dummy = 1 if no formal education
	Primary	dummy = 1 if primary school education
Education Level	Secondary	dummy = 1 if secondary school
	Post-secondary	dummy = 1 if post-secondary school education
Household Size	Total Adults	total number of household adults in a given time period.
	Hectares ≤ 1	dummy = 1 if average contracted area is less than or equal to 1 hectare
	Hectares 1 < & ≤ 2	dummy = 1 if average contracted area is greater than 1 hectare and less than or equal to 2 hectares
Farm Size	Hectares 2 < & ≤ 5	dummy = 1 if average contracted area is above 2 hectares or less than or equal to 5 hectares
	Hectares > 5	dummy = 1 if average contracted area more than 5 hectares
Nontobacco Farm Enterprises	Nontobacco Crops	average number of different nontobacco crops grown by a farmer
	Livestock	average number of different livestock types raised by a farmer
Social Capital and Network Effects	Club Members	average number of members within farmer's club

Table 2 Description of covariates *(continued)*

Variable domain	Variable code	Variable description
Productivity Effects	Yield per hectare	natural log of actual crop yield (kilograms sold) per hectare in a given season
	Yield Expectation	dummy = 1 if farmers yield is greater than or equal to expected yield
Income and Quality Effects	Profit per hectare	natural log of farmer's seasonal profitability per hectarage under contract
	Sales Expectation	dummy = 1 if farmers actual sales is greater or equal to expected sales at season start
	Quality	dummy = 1 if club average price is greater than overall seasons average price received in a given season
Contract Package Type	Finance Type	dummy = 1 if loan package is the comprehensive finance type
Loan Recovery	Repayment full	dummy =1 if loan was fully repaid
	Repayment none	dummy =1 if no loan repayment was made; otherwise 0 for partial or full repayment
	Repayment partial	dummy =1 if only partial loan repayment was made; otherwise 0
District Effects	Lilongwe	dummy = 1
	Mchinji	dummy = 1
	Dowa	dummy = 1
	Kasungu	dummy = 1
	Mzimba	dummy = 1
	Rumphi	dummy = 1

3.3.4 Contract Characteristics and Performance

The considerations around exiting CF are expected to potentially differ from the motivations and expectations for CF entry. The experience and outcomes of farmers in CF are likely to have a significant bearing on whether or when they choose to exit. The net benefits or costs of participation realised will probably be the most informative to the decision-making process (Barrett *et al.*, 2012). The differences between expected versus experienced outcomes can only be determined by farmers' and other stakeholders' ex-post (Lambrecht & Ragasa, 2018). Narayanan (2013) found that farmers in India assess their CF experience relative to available alternatives. It is also important to remember that contracting firms are looking for consistent supply and quality to satisfy the downstream market requirements. If a farmer cannot meet expectations they stand a high chance of being dropped by the contracting firm (Barrett *et al.*, 2012; Moyer-Lee & Prowse, 2015; Narayanan, 2013; Prowse, 2012). Therefore, several of the following variables aim to engage with this interplay between expected versus realised outcomes, particularly as they pertain to expectations regarding yield and income.

Productivity effects

Efficiency is considered one of the major factors influencing the survival of organisations (Tiller *et al.*, 2010). Dong, Hennessy, Jensen, *et al.* (2016) found that more technically efficient dairy farms were less likely to exit and more likely to expand their scale of production. Crop yield can be used as an indicator of productivity and technology use. Yield can therefore be reflective of the technical efficiency of a farmer. Where higher yields suggest greater efficiency (Tiller *et al.*, 2010). Chirwa (2009) measured the burley production efficiency of Malawian smallholders as the ratio of tobacco produced per unit of land area under cultivation. Chirwa (2009) found that farmer efficiency in burley production was positively related to profitability. This study calculated yield in terms of the marketed crop quantity per hectare. This variable was transformed into a logarithmic form to examine changes in the hazard of exit for proportional changes in farmers' productivity (Gujarati & Porter, 2010).

A further consideration included in this study relates to productivity expectations. At the start of Malawi's tobacco season, farmer clubs are registered with the Tobacco Control Commission (TCC) and receive a tobacco production quota appropriate for the season's expected production (Prowse & Moyer-Lee, 2014). This study takes this preseason contracted volume and divides it by the contracted area to derive a proxy for expected yield. Taking this expected productivity and comparing it to the actual productivity (actual crop volume sold per contract hectarage), is believed to provide an indicator of whether yield expectations are met. It is supposed that a farmer has a lower likelihood of exit if the actual productivity is greater or equal to the expected productivity.

Income and Quality Effects

Price premiums are often considered to be a major incentive motivating farmers to participate in CF (Lambrecht & Ragasa, 2018). In Malawi, the literature suggests that tobacco CF participants receive higher prices than non-participants since contracted tobacco is usually of higher quality (Prowse & Moyer-Lee, 2014; Shaba *et al.*, 2017). Narayanan (2013) found that lower-than-expected income and low crop prices were among the reasons of exit from CFAs reported by Indian smallholders.

Given the suggested importance of income effects on CF participation decision-making (Bellemare & Lim, 2018; Bijman, 2008; Wang *et al.*, 2014), a variable representing a farmer's profitability per hectare for a given season is included. Where profitability is calculated as tobacco sales, less marketing, input, and loan costs (assuming full repayment). This variable was also transformed into logarithmic form to assess the effect on the hazard of exit for proportional changes in farmers' profitability (Gujarati & Porter, 2010).

In addition, this study compares farmers actual sales revenue to the expected sales revenue (contracted volume*previous year's average price), to gauge whether sales expectations are met and whether this impacts the likelihood of exit. It is presumed that there is a lower hazard of exit if the actual sales revenue is greater or equal to the pre-season expected sales revenue.

As highlighted earlier, downstream buyers and modern value chains seek consistent volume and quality from suppliers. Tobacco leaf prices are set according to specific grades of quality. Thus, the grade quality of tobacco brought to market is a major determinant for the price that will be paid. Tobacco CF is expected to improve crop quality and, as a result, entail higher prices and incomes for contracted farmers. Therefore, in this analysis the average price received is considered to be an indicator of crop quality. A dummy variable indicates whether the quality (average price received by club members) is greater than the quality across all farmers (average price received across all farmers in a given season). The expectation is that farmers who receive prices above the season's average are less likely to exit since they produce a quality crop which is highly desirable to buyers. Meanwhile, producing a quality crop is desirable to farmers due to the associated price premiums they would receive (Moyer-Lee & Prowse, 2015).

Club Membership

In addition to the importance of physical capital, Andersson *et al.* (2015) found that social capital plays an important role in influencing the participation dynamics of Kenyan smallholder farmers in high-value markets. Farming club membership can strengthen social capital, especially for information sharing between individuals (Chirwa, 2009).

Farming clubs are often used within Malawi's burley production; such groups of farmers typically take on a collective loan with which inputs can be acquired. Members are jointly responsible for debt repayment at the end of the marketing season. Clubs can prove beneficial to farmers in that they provide a mechanism through which Malawian smallholders can gain access to credit, inputs, and extension services. Furthermore, the aggregation that comes from collective production can yield several benefits. For example, clubs may be able to obtain discounted input prices due to larger bulk purchases. Clubs can also act as a support network for farmers by promoting the exchange and diffusion of useful information. Support may also be available in the form of assistance from fellow members in particularly labour-constrained times. There is evidence that burley club members in Malawi achieved higher levels of productivity and improved sales relative to non-club members (Negri & Porto, 2008).

In Malawi, contracting firms often use farming clubs, where the club serves as the basis upon which credit and extension services are coordinated. Since farm club members frequently live in the same community or area, they experience similar climatic conditions and receive similar technical advice. As a result, there is a tendency for members' outcomes to be correlated to club outcomes (Prowse, 2022). Given the benefits of social capital and network effects, it is expected that the more club members there are, the greater the support network and, therefore, the less likely a farmer will be to exit.

Finance Type

In surveying the primary motivations of participation in burley CF in Malawi, Shaba *et al.* (2017) found that access to inputs was one of the most frequently cited reasons. Followed by having a guaranteed market, higher prices, and then access to a loan. Reducing production costs and extension services were also mentioned, but not to the same degree as the abovementioned reasons. The loan packages offered by contracting firms often make provisions for allowances during 'lean periods' of food and income availability. These allowances can help farmers weather such times. From the firm's perspective, these allowances ideally reduce the risks of farmer contract breach. In the sense that those farmers with access to allowances are not put in a position where, out of desperate need for income or food, they side-sell some of the contracted crop. As a result, farmers have a feasible alternative to cope with lean periods without breaching contract (Shaba *et al.*, 2017).

The food security component of CF is also supported by Bellemare and Novak (2017), who found that households participating in CF are more likely to exit their hungry season at any given time compared to nonparticipants. Contracted farmers also appear to report shorter durations of these lean periods (Bellemare & Novak, 2017). Therefore, it seems reasonable to expect that there are important food security motivations to CF participation in the context of Malawi as well. A further point for consideration is that credit may relax farmers' liquidity constraints, which supports their ability to access the inputs required to boost productivity. However, loan repayments can hurt profitability (Chirwa, 2009). Consequently, there is likely an incentive to gain and maintain access to contract packages that offer credit allowances. Particularly, when they can help households cope with lean periods and improve farmers' capacity to access key inputs.

The data provided for this study allows for a distinction to be drawn between two types of loan packages offered by the contracting firm. The first package is a more comprehensive loan covering all key inputs with additional allowances. In contrast, the second package is more reduced in scope and is typically only used to cover certain inputs such as seed. Therefore, entailing a lower level of credit. Farmers with the second type of package tend to pay for their inputs using sources of income other than a complete loan from the contracting company. It is expected that farmers who produce with comprehensive loan packages are less likely to exit.

Loan Recovery

Loans allocated to farmers based on club membership typically entail that all members are collectively liable and responsible for repayment (Prowse, 2022). It goes almost without saying that loan recovery is an important factor in the success of a contractual relationship. Failure to repay debts would logically increase the likelihood of farmers being dropped from further contracting.

3.3.5 District Effects

Tiller *et al.* (2010) found significantly different exit hazards for burley farmers across different American states. Likewise, Chirwa (2009) found that Northern region tobacco farmers seemed to have higher gross profit levels compared to that of farmers in the Central and Southern regions of Malawi. Possibly suggesting the presence of regional differences in the costs or climatic conduciveness of production. Therefore, district dummy variables are included for the six different districts present in the data to control for any regional differences that may be present.

3.4 Descriptive Statistics

In Section 3.3 the motivations and expectations relevant to the covariates of interest in this analysis were laid out. We now focus on the descriptive statistics in Table 3, to get a preliminary grip on the dynamics of CF participation present within the burley CFA case studied. The descriptive statistics reflect the relative proportions and the average values of farmer characteristics. Statistics are displayed for the total sample, observed exit cases, and for different survival times. The values for binary variables indicate the relative distribution of characteristics in percentages. While for the continuous variables, the values shown reflect the calculated means.

Age

The bulk of contracted farmers in this study are aged below 45 years old (43.7%), or between 45 and 64 years old (48.9%). Only a very small proportion of all farmers fall within the age group of 65 years and above (7.4%). The individuals aged between 45 and 64 years, account for the largest proportion of farmers in the total sample. By contrast, within cases of observed exit, the relatively younger farmers aged below 45 make up the largest proportion at 47.4 per cent. Which is slightly higher than that of the middle-aged category (45.3%). The proportion of farmers aged 65 years or above remains relatively similar within the total sample and within observed exits. Looking at different durations of participation, the share of middle-aged and relatively older farmers increases with longer durations. While for the age group below 45 years old, the proportion falls with increased participation lengths. Therefore, at this stage, farmers in the middle-aged and relatively older age categories are associated with longer survival times. Middle-aged farmers account for over half of farmers who sustain participation for three years or more.

Gender

Almost all of the contracted farmers analysed within this study are male (90%), which is not an uncommon finding within CF (Prowse, 2022; Wang *et al.*, 2014). However, the proportion of male farmers who are observed to exit is slightly lower (87.3%). Thus, although females only account for about 10 per cent of the total sample, they account for a slightly larger share within cases of observed exits (12.7%). This supposition is supported by the fact that the share of male farmers increases with greater participation durations. 86.4 per cent of farmers who participate for one year are male, however male farmers make up over 90 per cent of the farmers who survive for four seasons or more. In contrast, the proportion of female farmers decreases over greater participation durations. Consider the share of females who participate for one season (13.6%), versus participation spanning four (7.3%) or five seasons (6.0%).

Education

Primary education accounts for 62.9 per cent of the total sample's highest level of education. Followed by secondary education, which accounts for the second largest proportion (31.8%). The shares of farmers with no formal education (2.3%), or post-secondary education (3.0%), are significantly lower within the total sample. The relative distribution of education levels across exiting farmers, and across different lengths of participation appears to be relatively similar to that observed within the total sample's distribution. There is only a marginal increase in the proportion of farmers with primary education levels corresponding to longer spells of contracting. While for the remaining education levels, there appear to be marginal decreases in their shares with respect to greater survival times.

Table 3 Mean statistics and relative distribution of farmer characteristics

				Number of Seasons				
	Units	**Total**	**Exits**	**1**	**2**	**3**	**4**	**5**
Age < 45 years	%	43.7	47.4	53.3	47.3	40.4	40.1	36.0
Age 45≤ & ≤ 64 years	%	48.9	45.3	40.9	46.3	51.3	52.1	55.3
Age ≥ 65 years	%	7.4	7.3	5.7	6.5	8.3	7.8	8.6
Male	%	90.0	87.3	86.4	89.2	89.4	92.7	94.0
Female	%	10.0	12.7	13.6	10.8	10.6	7.3	6.0
No Education	%	2.3	2.5	2.7	2.2	2.2	2.7	2.0
Primary	%	62.9	62.9	61.4	60.9	63.2	66.8	64.5
Secondary	%	31.8	31.5	32.1	33.4	32.1	28.5	30.7
Post-secondary	%	3.0	3.1	3.8	3.5	2.5	2.1	2.8
Total Adults	Number	2.76	2.39	2.49	2.80	2.72	2.62	3.06
Hectares ≤ 1	%	44.9	61.4	70.9	52.6	40.6	33.4	21.6
Hectares 1 < & ≤ 2	%	42.6	29.5	21.0	34.9	46.6	55.6	61.7
Hectares 2 < & ≤ 5	%	11.4	8.2	7.0	11.3	11.8	10.0	15.5
Hectares > 5	%	1.1	0.8	1.0	1.1	1.0	1.0	1.2
Nontobacco Crops	Number	2.04	1.70	1.85	1.95	1.91	2.23	2.40
Livestock	Number	1.22	1.09	1.03	1.14	1.24	1.34	1.40
Club Members	Number	2.44	2.59	2.30	2.23	2.67	2.50	2.50
Yield per hectare	Log	7.35	7.33	7.29	7.33	7.40	7.37	7.38
Yield Expectation	%	49.3	41.7	49.7	49.8	50.6	44.5	49.1
Quality	%	56.4	45.8	51.3	53.8	53.7	60.3	65.5
Profit per hectare	Log	7.17	7.06	7.28	7.14	7.08	7.10	7.22
Sales Expectation	%	39.3	29.3	39.1	40.2	31.1	40.8	47.1
Finance Comprehensive	%	77.9	75.6	69.3	75.8	85.0	79.8	79.2
Finance Noncomprehensive	%	22.1	24.4	30.7	24.2	15.0	20.2	20.8
Repayment full	%	87.4	86.6	81.9	85.8	90.8	90.6	89.1
Repayment none	%	1.2	2.1	2.3	1.5	0.7	0.7	0.4
Repayment partial	%	11.6	11.8	16.6	12.9	8.4	8.6	10.5
Lilongwe	%	25.2	23.9	24.0	20.9	22.2	28.1	33.3
Mchinji	%	10.8	10.0	10.2	9.9	7.9	11.4	15.5
Dowa	%	18.5	15.5	15.8	15.6	15.0	26.5	24.9
Kasungu	%	13.6	10.8	15.9	18.3	12.6	10.5	8.7
Mzimba	%	25.4	29.8	27.1	29.4	31.2	20.7	14.9
Rumphi	%	6.5	10.1	7.1	6.0	11.1	2.8	2.7

Household Size

The average number of adults within a farmer's household for the total sample is 2.76, which is slightly higher than the mean of 2.39 found for exit cases. Table 3 also shows that with increased participation duration, the average number of adults tends to be higher.

Contracted Hectarage

For the total sample, the largest proportion of farmers operate within the contract size categories of one hectare or less (44.9%), or between one and two hectares (42.6%). Which is followed by operations between two and five hectares (11.4%) and areas over five hectares (1.1%). Farmers operating contracted areas over two hectares are evidently less prevalent. Almost two-thirds (61.4%) of the farmers observed to exit, correspond to farmers growing on contracted areas less than or equal to one hectare. Followed by farmers growing on contracted areas between one and two hectares (29.5%). The share of farmers producing within a scale of one hectare or less shows a marked decline with increased participation durations. At the same time, the proportion of farmers producing between one and two hectares is considerably greater for longer survival times. The share of operations between two and five hectares also tends to be greater for longer contracted durations. Though for the largest hectarage group (above five hectares) the share appears stable across survival times. As a result, it would appear that increased contracted areas are correlated with increased participation durations. Additionally, the largest variations associated with participation length appear to occur amongst the one hectare or less, and one-to-two-hectare categories.

Nontobacco Crops and Livestock Enterprises

Overall, farmers produce an average of 2.04 different types of nontobacco crops and raise an average of 1.22 different types of livestock. Which is higher than an average of 1.70 different nontobacco crops, and an average number of 1.09 different types of livestock observed within cases of exit. Longer survival times appear to be associated with farmers with higher averages for the number of different nontobacco crops and livestock they produce. Farmers surviving for at least four seasons or more, reflect average values above those found for the overall sample of farmers. In particular, the average number of nontobacco crops seems to show relatively large increases associated with longer survival times. For instance, consider the average of 1.85 nontobacco crops for one-season farmers versus 2.40 for five-season farmers.

Club Members

The mean number of club members for the whole sample is 2.44. Interestingly the mean number of club members is slightly higher for observed exits (2.59). Yet the average club membership size tends to be higher with longer participation durations. Farmers participating for three or more years are associated with club membership sizes above the total sample average of 2.44.

Productivity

Regarding productivity, it can be observed that the average yield per hectare in the case of exits (7.33), is slightly lower than that of the overall sample (7.35). Moreover, generally larger yields per hectare are associated with longer survival times. Survival times of three or more seasons indicate average yield values greater than that of the overall sample.

Regarding productivity expectations, just under half (49.3%) of farmers seem to achieve final yields equal to or above the pre-season yield expectation. Of the exiting farmers, only 41.7% appear to meet productivity expectations. Farmers who contract for three seasons have the highest percentage (50.6%) in meeting productivity expectations. Except for four seasons of participation (44.5%), the proportion of farmers that meet or exceed productivity expectations remains very similar to that observed for the total sample.

Income and Quality

Regarding quality, 56.4 per cent of farmers in the total sample receive prices greater than the season's average, which contrasts with the 45.8 per cent observed for farmers in the exit cases. There is a clear rise in the percentage of farmers exceeding the season's average price within the longer survival durations. Over 60 per cent of the farmers who survive four seasons or more appear to achieve crop quality above the seasonal average.

In terms of profitability, the average profit per hectare for the overall sample (7.17) is greater than that found within the observed exit sample (7.06). For survival durations of one season and five seasons, the average profitability is higher than that of the total sample. While for the remaining durations of two, three, and four seasons the average profitability is slightly lower than the average of the overall sample. This result seems to imply that at this stage there is no obvious linear trend associated with farmers' relative profitability and participation duration.

Only 39.3 per cent of the farmers in the total sample appear to meet or surpass preseason sales expectations, which is even lower within the observed exit cases (29.3%). The proportion of farmers able to meet sales expectations does increase with longer survival durations. Farmers participating for five seasons have the highest percentage of meeting sales expectations at 47.1 per cent.

Contract Package Type

It is evident that the large majority of contracted farmers, over 70 per cent, opt for the more comprehensive contract package option. Compared to the overall sample (77.9%), there is a slightly lower proportion of farmers selecting the comprehensive finance package in the exit cases (75.6%). Though it remains a strong majority. Longer participation durations also have correspondingly higher proportions of farmers selecting to contract under more comprehensive finance packages.

Loan Recovery

The proportions seen within the loan recovery rows show that only a small share of farmers completely default on their loans (1.2%) in the overall sample. The share of farmers who partially repay their seasonal loan (11.6%) is also relatively low compared to the share of farmers who repay their loans fully (87.4%). It is worth noting that the partial loan repayment category does not differentiate between the varying degrees of partial repayment. Hence, many farmers grouped in the partial repayment category may have paid back the majority of their loans with only a small outstanding amount that will carry over to the next season. Assuming that participation continues. These distributions seem to hold across survival times, with slight increases in the share of full loan recovery amongst longer survival times. Meanwhile, the shares of partial or no loan recovery decrease with increased survival durations.

Districts

At the district level we can observe that the Mzimba (25.4%), Lilongwe (25.2%), and Dowa (18.5%) districts account for the largest shares of farmers overall. While the remaining share of farmers are found distributed across the Kasungu (13.6%), Mchinji (10.8%), and Rumphi (6.5%) districts. This relative distribution is largely maintained within the cases of farmer exits. Table 3 indicates that the proportion of farmers located within the districts of Lilongwe, Mchinji, and Dowa rises with longer participation spells. While for Kasungu, Mzimba, and Rumphi the proportions are observed to decline.

These descriptive statistics have offered a precursory glance into the patterns and dynamics of contract farmers' characteristics. Specifically, as they relate to the total sample of farmers, in addition to the sub-samples of farmers observed to exit, and across different participation durations. The descriptive statistics have served as a useful point of departure, thus far contextualising the expectations related to the respective covariates. However, more robust analysis is necessary to address this study's research questions. Therefore, we now proceed to Chapter 4.

Chapter 4: Results and Discussion

Chapter 4 begins with a nonparametric estimation of the contracted farmers' survival and failure functions using Kaplan-Meier estimators. The results from the Kaplan-Meier estimates enable an assessment of the probabilities of participant survival or failure over time. The conversation then turns from the univariate Kaplan-Meier estimates to the multivariate discrete-time hazard model.

Discussing the results of the discrete-time hazard model starts with model evaluation statistics. These results provide guidance in establishing which of the models demonstrates the best fit. A brief explanation is then provided for how the discrete-time model's estimated hazard ratios should be interpreted. The hazard ratios are then presented in Table 7 and interpreted.

The hazard ratios, descriptive statistics and Kaplan-Meier results are incorporated into the discussion to consolidate the overall findings. The various results within the analysis are integrated so that the findings can be coherently linked to addressing the research questions posed.

4.1 Nonparametric Survival Results

Like most survival analyses, we start with Kaplan-Meier estimates. Kaplan-Meier survival and failure estimates offer a useful nonparametric method to examine the relationship between exits and the effects of time. With these estimates, it is possible to derive a survival function and plot a survival curve for the contract farmers in this case study (Jenkins, 2005; Kaplan & Meier, 1958; Mills, 2011).

Figure 1 presents the survival curve, plotted from the Kaplan-Meier survival estimates, for farmers' contracting duration. The Kaplan-Meier survival estimates can be interpreted as the probability that farmers sustain participation beyond a specific duration of time. Alternatively, the estimates reflect the proportion of individuals expected to survive beyond a given duration of time (Mills, 2011).

It is clear from the Kaplan-Meier survival curve that the probabilities of sustaining participation generally decrease over time. Approximately 69 per cent of farmers are estimated to survive beyond one contract season. Over half of the farmers (51%) are expected to sustain participation for at least two seasons. It is estimated that 24 per cent of farmers sustain participation for at least three seasons, and only 19 per cent of farmers are estimated to survive at least four seasons or more. The graph suggests that the largest changes in the survival rate of farmers occur across the durations of one, two, and three years.

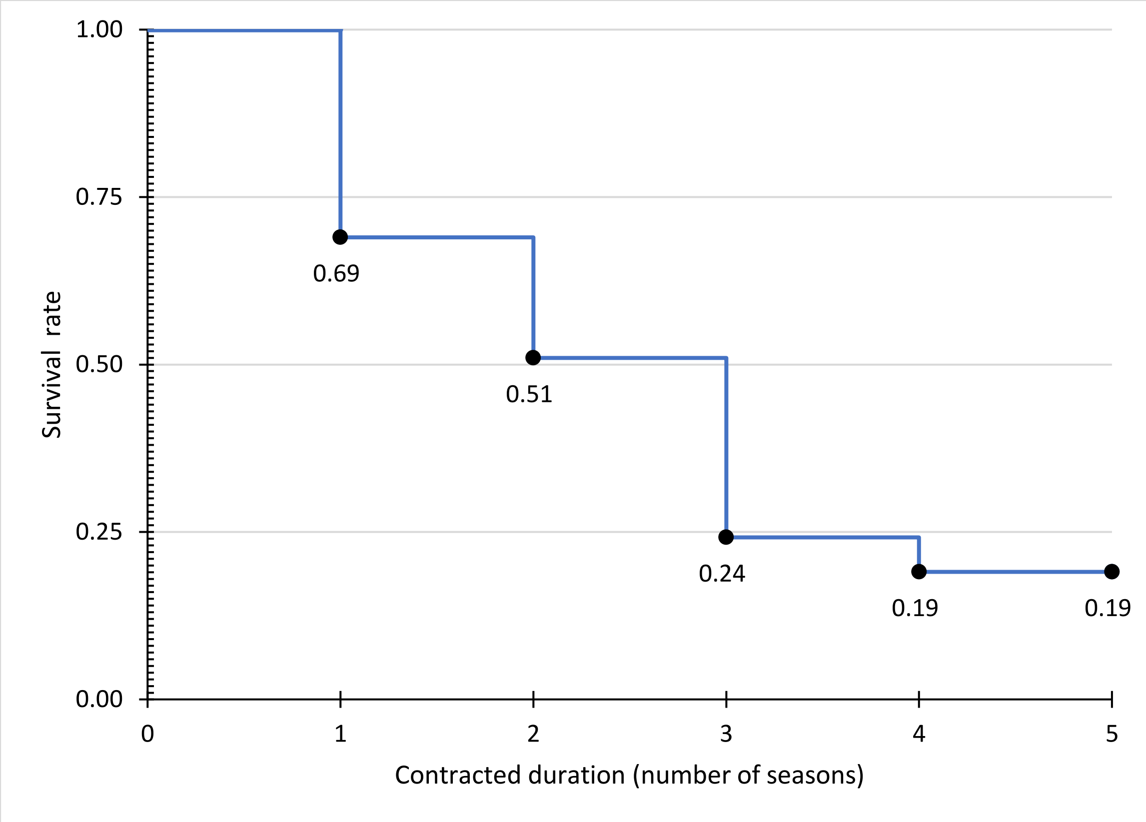

Figure 1 Kaplan-Meier survival curve for farmers' contracting duration

Table 4 Panel A demonstrates that for the total sample of individuals examined, approximately 65.3 per cent are observed to exit at some point within the five years of analysis. Looking at Panel C in Table 4, farmers survive on average for 2.11 seasons, with a median participation duration of two seasons. The maximum participation duration observed within the study period was five seasons. Although, as highlighted by the survival function (Panel B), the probability of farmers within the sample reaching a duration beyond four seasons is about 19 per cent.

While the Kaplan-Meier survival estimates are obtained from the survival function, one minus the survival function produces the failure function. Since the failure function is simply the reverse of the survivor function, it can be interpreted as the probability that a farmer will exit before or at a specific time period (Mills, 2011). Therefore, about 81 per cent of farmers are expected to exit before or upon reaching a duration of four seasons. Moreover, the failure function demonstrates that the cumulative probability of exiting increases over longer participation durations. While there is a 31 per cent likelihood that farmers will exit after one year of contracting, the likelihood of exiting increases for durations of two seasons (49%), three seasons (75.8 %) and four seasons (81%) (Table 4 Panel B).

Table 4 Kaplan-Meier survival and failure summary statistics

Panel A	Number of Observations	23 625		
	Number of Exits	15 428	65.3%	
Panel B	Time	Survivor Function	Failure Function	
	1	69.0%	31.0%	
	2	51.0%	49.0%	
	3	24.2%	75.8%	
	4	19.0%	81.0%	
	5	19.0%	81.0%	
Panel C	Mean	Min	Median	Max
	2.113	1	2	5

The Kaplan-Meier estimates provide a useful starting point for the survival analysis of contracted farmers' participation through the computation of the survival and failure functions. However, they cannot inform us about the effects of multiple covariates on the probabilities of survival or failure (Jenkins, 2005). Therefore, we proceed to Section 4.2 to examine the results from the discrete-time hazard model which is able to incorporate the effects of multiple covariates. However, it is necessary to first review the discrete-time hazard model's overall goodness of fit before proceeding to the interpretation of the hazard model estimates.

4.2 Discrete-time Hazard Model Results

4.2.1 Hazard Model Diagnostics and Evaluation

Mills (2011) suggests that one should compare alternative model specifications to assess which model best fits the data. The following section describes the tests and indicators used in this study for model evaluation (see Table 5). Log-likelihood (LL), standard errors, and Wald chi-square tests are some of the conventional statistics often used to assess overall model fit.

The Wald chi-square test assesses whether at least one of the explanatory variable estimates differs from zero. A significant Wald test suggests rejection of the null hypothesis, concluding that at least one of the explanatory variables does explain some of the dependent variable's response (Mills, 2011). In Table 5 it is clear that the Wald chi-square tests are significant across all the models, suggesting that the null hypothesis can be rejected for all the models estimated.

The -2LL statistics can be informative for model fit when comparing alternative models, and a decrease in -2LL statistic suggests improved model fit (Mills, 2011). Based on the -2LL statistics, the models that account for frailty have consistently lower -2LL values than the models with no unobserved heterogeneity effects. Furthermore, the models that include the full set of variables show the lowest -2LL statistics—indicating that these full models fit the data best.

One of the most frequently used statistics to assess overall model fit involves information criterion tests. The Akaike information criterion (AIC) and Bayesian information criterion (BIC) are useful indicators for model parsimony. These information criteria assess model precision relative to the number of parameters. They are a useful guide to deriving the simplest model with high predictive power. Thus, avoiding issues of over parametrisation. Lower AIC and BIC values indicate better model fit (Mills, 2011). A similar conclusion is reached when looking at the AIC and BIC values across the different models. Frailty models have better overall goodness of fit relative to models not accounting for unobserved heterogeneity.

Moreover, the lowest AIC and BIC values are observed for the full effects frailty models. However, the Normal frailty model has slightly higher AIC and BIC values than the Gamma frailty model. Although the full effects models include a larger number of parameters, the information criterion tests indicate that they remain parsimonious and offer improved model fit over the other models.

The Hausman specification test can also be used to compare the specification of different panel data models through comparison of the model coefficients. The null hypothesis of the Hausman specification test is that a consistent and asymptotically efficient estimator, will have a zero covariance in its difference with a consistent but asymptotically inefficient estimator (Hausman, 1978). Alternatively put, the Hausman specification test compares two estimators that are known to be consistent and assesses the validity of the assumption that the reference estimator is an efficient estimator of the true parameters. For this to be valid there should be no systematic difference between the two estimators (StataCorp, 2021b).

The post-estimation command 'hausman' can be used in Stata to perform the cross-model Hausman specification test. In Stata, the null hypothesis of the Hausman test is that the difference in coefficients between two model specifications is not systematic. If systematic differences in the estimates are present, then the assumption of efficiency under the reference estimator would be questionable. While a rejection of the null hypothesis would suggest that the reference model specification is preferable in modelling the underlying effects (StataCorp, 2021b). The Hausman specification test statistics in Table 5 compare the full Normal frailty model, as the reference model, to the full no frailty model. The significant p-value suggests a rejection of the null hypothesis, implying that the Normal frailty model is more efficient in estimating the underlying effects within this study.

Table 5 Model fit statistics

	Baseline Hazard Models		**DTPH Models (no district effects)**		**DTPH Models (full effects)**		
	No Frailty	Normal Frailty	No Frailty	Normal Frailty	No Frailty	Normal Frailty	Gamma Frailty
N	49 911	49 911	49 911	49 911	49 911	49 911	49 911
df	4	5	25	26	30	31	31
AIC	68 914	59 665	43 710	43 482	43 510	43 285	43 254
BIC	68 949	59 709	43 929	43 709	43 772	43 556	43 525
LL	-34 453	-29 827	-21 830	-21 715	-21 725	-21 611	-21 596
-2LL	68 906	59 655	43 660	43 430	43 450	43 223	43 192
Wald Chi^2	9 998	4 936	12 399	8 768	12 481	8 714	.
Prob > Chi^2	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	.
Hausman Chi^2						146.96	
Prob > Chi^2						0.000***	

Significance level: *(10%), **(5%), ***(1%)

Thus far the model evaluation statistics have demonstrated that models controlling for unobserved heterogeneity appear to show the best overall fit. Having earlier established the importance of accounting for unobserved heterogeneity or 'frailty' effects, it is necessary to finally assess whether the effects of unobserved heterogeneity are statistically significant in this study. This is done using a likelihood ratio (LR) test to compare a reference model, without frailty, to a model which accounts for frailty. The null hypothesis tests whether the variance of the unobserved heterogeneity estimate is equal to zero. Low unobserved heterogeneity variances and a non-significant p-value of the LR test would suggest that the effects of unobserved heterogeneity are unimportant, and therefore the reference model, which does not account for unobserved heterogeneity, would be preferred (Jenkins, 2005).

Table 6 shows that unobserved heterogeneity effects are statistically significant in this study. Confirming that the models which control for the effects of unobserved heterogeneity are preferred over those that do not.

Table 6 Unobserved heterogeneity effects: likelihood ratio test statistics

	Baseline Hazard Models	DTPH Models (no district effects)	DTPH Models (full effects)		
	Normal Frailty	Normal Frailty	Normal Frailty	Gamma Frailty	
	Coeff(b)	**Coeff(b)**	**Coeff(b)**		**Coeff(b)**
rho	0.895 (0.003)	0.206 (0.016)	0.208 (0.016)	Gamma Var.	0.378 (0.029)
LR test rho=0	9 251.05	230.54	227.26	LR test Gamma var =0	257.84
Prob>=Chibar2	0.000***	0.000***	0.000***	Prob.>=Chibar2	0.000***

Significance level: *(10%), **(5%), ***(1%)

Based on the model evaluation statistics, the frailty models achieve the best fit. It should be noted that models with lower standard errors are preferable over models with comparatively higher standard errors (Mills, 2011). Given that the standard errors for the full Normal frailty model are slightly lower than the full Gamma frailty model, the results presented in Sections 4.3 and 4.4 concentrates on the Normal frailty model estimates. Refer to Appendix A for the results of all the baseline and general hazard models estimated in this study.

4.2.2 Interpreting the Discrete-time Hazard Estimates

By exponentiating the parameter coefficients, the reported results in Table 7 reflect hazard ratios. Recall that hazard ratios indicate the proportional change in the risk of event occurrence for a one-unit change in a particular covariate, *ceteris paribus* (Jenkins, 2005). For continuous variables, subtracting one from the hazard ratio produces the percentage change in the hazard for a one-unit change in the relevant covariate (Allison, 2014).

Hazard ratios greater than one imply that an increase in the respective explanatory variable leads to an increase in the likelihood of exit. While hazard ratios smaller than one indicate a negative effect, which means that an increase in the relevant covariate corresponds to a decrease in the risk of event occurrence. Hazard ratios equal to one suggest there is neither a positive nor negative impact on the hazard of event occurrence for changes in the relevant covariate (Allison, 2014; Euler *et al.*, 2016; Khataza *et al.*, 2018).

It is also worth bearing in mind that the parameter estimates of multiple-category dummy variables, reflects the predicted hazard of a specific dummy variable, relative to the reference category of that variable (Allison, 2014; Tiller *et al.*, 2010). Put another way, the comparative difference in exit hazard between a particular category and the reference category. The reference category is the variable category excluded from the parameter estimation (Tiller *et al.*, 2010). The general rule is to include one less than the total number of category indicator variables ($m - 1$). Substantial collinearity issues arise if one does not do this (Gujarati & Porter, 2010).

Table 7 presents the hazard ratio estimates for the baseline and general discrete-time hazard models. In Sections 4.3 and 4.4, which follow next, the results from Table 7 will be interpreted. In addition, the findings from the respective descriptive statistics and Kaplan-Meier estimates will be integrated with the hazard model results, to inform the discussion pertaining to the research questions of this study.

Table 7 Normal frailty discrete-time hazard model estimates

	Baseline Hazard Model		**Discrete-time Model (no district effects)**		**Full Discrete-time Model**	
Variable	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**
Period 1	0.062***	0.003	141.914***	34.421	142.304***	35.169
Period 2	0.290***	0.011	130.248***	31.747	132.561***	32.914
Period 3	5.867***	0.261	522.783***	127.665	534.918***	133.066
Period 4	3.637***	0.203	216.419***	52.725	229.725***	57.076
Age < 45 years			1.162***	0.027	1.187***	0.028
Age ≥ 65 years			0.989	0.042	0.979	0.042
Gender			0.816***	0.027	0.850***	0.029
Primary			0.724***	0.050	0.711***	0.049
Secondary			0.735***	0.052	0.688***	0.049
Post-secondary			0.891	0.082	0.833**	0.077
Total Adults			0.806***	0.006	0.810***	0.006
Hectares 1 < & ≤ 2			0.325***	0.010	0.327***	0.010
Hectares 2 < & ≤ 5			0.349***	0.015	0.352***	0.015
Hectares > 5			0.389***	0.045	0.407***	0.047
Nontobacco Crops			0.709***	0.009	0.719***	0.009
Livestock			1.046***	0.015	1.056***	0.016
Club Members			0.982**	0.008	0.985*	0.009
Yield per hectare			0.885**	0.046	0.849***	0.044
Yield Expectation			1.008	0.029	1.005	0.029
Quality			0.846***	0.021	0.853***	0.021
Profit per hectare			0.779***	0.023	0.794***	0.024
Sales Expectation			0.991	0.026	0.971	0.026
Finance Type			0.660***	0.022	0.643***	0.022
Repayment full			0.389***	0.077	0.410***	0.082
Repayment partial			0.444***	0.090	0.469***	0.096
Mchinji					1.130***	0.046
Dowa					0.869***	0.031
Kasungu					1.001	0.041
Mzimba					1.091***	0.035
Rumphi					1.666***	0.075

Significance level: *(10%), **(5%), ***(1%)

4.3 Extent and Timing of Exit

The hazard ratio estimates in Table 7 for the variables Period 1 to Period 4, reflect the conditional probabilities of farmers' exit within each respective time interval (Tiller *et al.*, 2010). Looking at the baseline hazard estimates it can be observed that the hazard ratios rise across the time intervals. An increase in the hazard over time indicates a positive duration dependence (Jenkins, 2005). That is to say that the risk of exiting is observed to increase over time.

The baseline hazard model implicitly assumes a homogenous population given that no other covariates are included that would distinguish individuals. Thus, for a homogenous population the interval-specific hazard rates are particularly high within the later time intervals of Period 3 (5.867) and Period 4 (3.637). While the earlier time intervals, Period 1 (0.062) and Period 2 (0.290) have considerably lower interval-specific hazards. All of the time interval variables are statistically significant, indicating that time has an important effect on the conditional probability of farmer exit.

It is noted that the pattern of duration dependence differs slightly within the estimates of the full effects Normal frailty model. After incorporating the effects of all the covariates of interest, the overall pattern of duration dependence is still positive. The overall hazard of exit rises over time. Yet now the interval-specific hazard for the first time period (142.30) is slightly higher than that of the second time period (132.56). The highest interval-specific hazards are still in the third (534.92) and fourth (229.73) time periods. The time indicator variables all remain statistically significant.

Regarding the first research question, what then can be said about the extent and nature of smallholder participation and exits within this Malawian burley CFA? Firstly, the Kaplan-Meier survival estimates from Table 4 indicated that participation is quite dynamic within the burley CFA analysed, since over the five-year period of analysis around 65 per cent of the farmers were observed to exit at some point before the end of the study. This result is similar to the findings that over half of analysed participants supplying Kenyan supermarkets exited after four years (Andersson *et al.*, 2015), and over half of the studied contracted broccoli farmers in Ecuador exited within the first five years (Granja & Wollni, 2018).

These results support the observation made by Barrett *et al.* (2012) that considerable dynamism exists within the decision-making of CF participation. Therefore, it should be emphasized that smallholder participation in CFAs, and by implication modern agricultural value chains, should not be viewed as a static outcome. Meaning, that while an increased number of smallholder farmers entering the supply of modernised high-value markets may be considered a successful outcome, the decision to enter participation is really only the beginning. Not all farmers who start contracting will participate for extended periods. It must be recognised that the outcomes from participation will be shaped by the dynamic decision-making and the consequently variable duration of participation after entry. Moreover, the implications of participation and the subsequent cessation thereof, will be best informed by the intentions or causes behind farmers' exit. Farmers exiting because they are unable to continue participation has different implications to farmers who could sustain participation but choose not to. In the latter case, a high exit rate is not necessarily a negative outcome if farmers are exiting to pursue more beneficial alternatives to CF participation (Narayanan, 2013).

Concerning the duration and timing of farmer exits, farmers survive on average for 2.11 seasons. This finding is comparable to average participation durations of two years found within maize CFAs in Ghana (Lambrecht & Ragasa, 2018). Furthermore, a median of two indicated that half of the farmers analysed in this study sustained participation for at least two seasons. Almost a quarter of the farmers were found to sustain participation for a least three seasons. While nearly 20 per cent of the participants were found to contract for at least four seasons. Within this last group, some of the farmers reached the five-season maximum participation time. The exits of these farmers are censored. Hence, all that can be concluded is that there are some farmers who were able to sustain participation for at least five seasons without exiting. It is possible that some of these farmers may continue to participate beyond this duration. In any case, the central point is that some farmers demonstrate durability in their CFA participation.

The exact proportion and the final participation duration of the censored farmers cannot be determined within the confines of this analysis. However, finding a positive duration dependence within the study offers some insight. With an overall positive duration dependence, the conditional probability of exiting is found to increase over time. Therefore, the proportion of farmers who are able to sustain participation beyond five seasons is expected to keep declining with each consecutive year. Data covering a longer time period would be required in order to confirm this.

Trends within the tobacco sector offer some explanation for the observation that there is an increasing hazard of exit over time. Wineman *et al.* (2022) found that the number of farmers who produced tobacco in Malawi fell sharply between 2004 and 2019—suggesting that the pressures on the tobacco industry, and the reductions in global demand for tobacco, have had major effects on the tobacco sector in Malawi. This would logically translate to higher risks of exit over time as the pressures on the tobacco industry continue to mount and demand continues to decline.

The Kaplan-Meier estimates indicated that the largest changes in the survival rate of farmers occur within the first three years. Particularly for survival lengths of one and three seasons. So, while the positive duration dependence reflects that the conditional risk of exit generally increases over time, the Kaplan-Meier estimates would further indicate that the risk increases at a decreasing rate. Note that the difference in survival rate between three seasons (24%) and four seasons (19%) is not as great as the differences in survival rate between one (69%), two (51%), and three (24%) seasons.

Additionally, the interval-specific hazards for the full effects discrete-time model showed that the first year had a relatively higher associated hazard of exit compared to the second year. While the third time interval had the highest interval-specific hazard. Thus, when incorporating the effects of other covariates, farmers showed a higher risk of exiting in the first-year interval relative to the second-year interval. Nonetheless, the highest risk of farmer exit was associated with the later time intervals three and four. It should be recognised that time interval three corresponds to the year 2020 and interval four the year 2021. Needless to say, these time periods are associated with the first two years of the global Covid-19 pandemic. This external shock may in part be a contributing factor to why the hazard ratios for Period 3 and Period 4 are observed to be particularly high.

A relatively larger hazard of exit after one season of participation compared to two seasons, may reflect the reality that only upon actual engagement are individuals able to accurately gauge the suitability of the arrangement (Barrett *et al.*, 2012; Lambrecht & Ragasa, 2018; Tziner & Birati, 1996). Hence, it would appear that the first year of contracting plays a major role in informing further participation. However, the overall findings suggest that the timing of farmers exit is most likely to occur after the first two seasons.

4.4 Effects of Observable Covariates

In trying to further understand the dynamics and durability of CFA participation, the discussion now pivots to the line of inquiry posed through the second research question. What do the results suggest concerning the impact of various covariates on the conditional probability of exit?

4.4.1 Farmer and Household Characteristics

Age

From Table 7 we observe that relative to the reference category of middle-aged farmers (age between 45 and 64 years old), the statistically significant hazard ratio of 1.187 suggests that the relatively younger farmers have a higher propensity to exit. That is to say, farmers younger than 45 years old have an 18.7 per cent higher hazard of exit relative to the middle-aged farmer group. Unexpectedly, the older farmers aged 65 years or more, had a lower relative risk of exiting (0.979) compared to the middle-aged farmers. Which translates to a 2.1 per cent lower hazard of exit. However, this finding was not statistically significant, and the magnitude of the effect appears marginal.

It was expected that middle-aged farmers would have a lower risk of exit than the other age categories. This result would have suggested that farmer age would show nonlinearity within its effects on the hazard of exit. The hazard model results show that relatively younger farmers, had a higher propensity to exit relative to the older age categories. However, in contrast to the expectations, the farmers in the oldest age category had a slightly lower exit hazard than the middle-aged category. Therefore, to some extent, there is more of a linear effect associated with age, where the risk of exit decreases with increases in farmer age.

The descriptive statistics from Table 3 of farmers' distributions within these age categories provide some added clarity. The vast majority of farmers within the sample were found within the relatively younger and middle-aged categories. Only around 7.4 per cent of farmers in the total sample could be classified into the oldest age group. This result could explain why the hazard ratio difference observed for the older age category was marginal. Interestingly, across longer participation durations it was clear from the descriptive statistics that the proportion of relatively younger farmers steadily declines, while for the older age groups, they rise. This would support the conclusion that, generally speaking, older farmers have lower propensities to exit, and therefore are more likely to sustain CFA participation.

Suppose the age of a farmer is reflective of experience as suggested by Tiller *et al.* (2010). In that case, these findings indicate that experience plays a rather important role in the durability of farmer CFA participation. Furthermore, in Malawi older farmers tend to have greater access to productive assets such as land (Lindsjö, Mulwafu, Djurfeldt, *et al.*, 2021; Muyanga *et al.*, 2020). However, Malawi has been experiencing high population growth, and as a result the nation's youth and young adults account for a large share of the population (Muyanga *et al.*, 2020). Therefore, beyond the experience brought on by age, there may also be important generational effects related to resource accessibility at play, compounded by a growing and predominantly youthful Malawian population.

Gender

As expected, male farmers were found to have a lower propensity for exiting relative to female farmers, and the hazard ratio of 0.850 is statistically significant. Therefore, male farmers have about a 15 per cent lower hazard of exiting relative to female farmers.

The descriptive statistics show that the proportion of female contracted farmers within the sample is very low. Which the literature suggests is often the case found in CFAs across many parts of the world (Prowse, 2022; Wang *et al.*, 2014). So, while recognising that the number of female farmers contracting in this sample is low overall, male farmers do appear to be more likely to sustain participation, supporting the findings of Lambrecht and Ragasa (2018).

Education

The relative risk of exit characterised by education level is compared to the reference category of no formal education. Across the different formal education categories, the risk of exit is significantly lower relative to farmers with no formal education. Farmers with secondary education have the lowest relative hazard of exiting with a hazard ratio of 0.688. Interestingly, farmers with only primary education have a lower hazard ratio (0.711) than those with post-secondary education (0.833).

Meanwhile, from the descriptive statistics it was noted that, over 60 per cent of farmers in the analysis had primary education as their highest level of education. In contrast, about 30 per cent of the contracted farmers had obtained an education at the secondary level. As a result, the proportion of participating farmers who have no formal education, or those who have post-secondary education is considerably less prevalent. The descriptive statistics would support the findings of Muyanga *et al.* (2020), that education beyond the primary level in Malawi is generally more limited.

Lambrecht and Ragasa (2018) similarly found that formally educated farmers were more likely to participate in CF. Although most contracted farmers in this case only have primary education, it is those with secondary education who demonstrate the lowest propensity to exit, and therefore are more likely to sustain participation. Implying that the level of education has an important influence on the hazards of exit but not necessarily in a perfectly linear manner. It could be inferred that increases in education correspond to decreases in the hazard of exit, but beyond the level of secondary education the effect appears to wane. The proposition that more educated farmers possess a greater capacity to innovate and adapt, which improves their resilience in sustaining participation (Euler *et al.*, 2016; Tiller *et al.*, 2010), could explain these findings. Yet there is some evidence that beyond secondary education, the opportunity costs for highly educated individuals may be causing a diminished effect on lowering the hazard of exit (Andersson *et al.*, 2015).

Household Size

The total number of adults within a household, taken as an indicator of household labour availability, was found to have a sizeable effect on lowering the hazard of farmer exit. The statistically significant hazard ratio of 0.810 implies that for a unit increase in the total number of household adults, there is a 19 per cent lower conditional probability of exit for farmers. This result would be in line with the expectations that availability of labour is quite an important factor for the success of a labour-intensive crop such as burley (Chirwa, 2009). Moreover, the intensity of time and effort involved in supplying modern high-value markets is generally quite high (Andersson *et al.*, 2015). In fact, high labour requirements were reported as one of the reasons behind some farmers exiting from

CFAs in India (Narayanan, 2013). The findings would suggest that requirements of a similar nature play a major role in the success and durability of CFA participation in the burley case studied.

4.4.2 Farm Characteristics

Contracted Hectarage

Contracted hectarage, as a proxy for farm size, exhibited hazard ratios which were lower than any other variable within the analysis. Relative to the smallest category of one hectare or less, the remaining larger average contracted area categories have significantly lower associated hazards of exit. Operations between one and two hectares had the lowest hazard ratio (0.327), followed by those between two and five hectares (0.352). It is interesting to observe that the largest size category, over five hectares, had a slightly higher hazard ratio of 0.407. Respectively the size categories of between one and two hectares, between two and five hectares, and over five hectares, showed hazards of exit which were 67.3 per cent, 64.8 per cent, and 59.3 per cent lower than farmers operating at a scale of one hectare or less. These results are similar to the findings of Tiller *et al.* (2010) that farm size had a negative and significant effect on burley farmers' probability of exiting the USA tobacco industry.

The descriptive statistics indicated that over 80 per cent of the farmers in the total sample operate contracted areas of two hectares or less. This result means that contracted areas of one hectare or less, and between one and two hectares, together constitute the predominant scale of operations for most of the contract farmers in this particular CFA. Only a small proportion of the farmers operated contracted areas between two and five hectares (11.4%), and areas greater than five hectares (1.1%).

Furthermore, the largest variations in farmer proportions associated with participation length, were found amongst the two smallest hectarage categories. A distinct decline was observed in the proportion of farmers operating contracted areas which are less than or equal to one hectare across longer participation durations. In contrast, the proportion of farmers producing between one and two hectares shows a pronounced increase associated with longer participation times. The share of operations contracting between two and five hectares also tends to be greater for longer contracted durations. However, the share of operations over five hectares appears to be stable across longer survival times.

These findings reinforce that burley production in Malawi is largely produced at a smallholder scale, even within a CFA context (Prowse & Moyer-Lee, 2014). Wineman *et al.*, 2022 find evidence which supports that there are shifts towards larger scales of production in terms of farm areas under tobacco cultivation in Malawi. However, in the findings of this study, the shift to larger areas under cultivation with increased participation times is still mostly confined to the smallholder scale. The proportion of farmers producing burley at a medium scale, which can be defined as production between five and 50 hectares (Anseeuw, Jayne, Kachule, *et al.*, 2016), is very low. Keep in mind that the scale discussed in this study refers to the average hectarage under contract. Saying that the proportion of farmers producing contracted burley at a medium scale is low, does not imply that the contracted farmers are not medium-scale producers at the total farm size level. Only that the hectarage contracted at the medium scale is not as widespread as contract cultivation at the small scale.

This study contends that the scale under contract offers a useful proxy for the effects of farm size. The findings demonstrate that increased production scale significantly lowers the hazard of exit. Which implies that farmers with larger areas under contract tend to have much higher propensities to sustain CFA participation. However, this finding does present a dilemma since Malawi is a land scarce nation. A rapidly growing population, combined with the fact that little land remains which is unutilised, means that the scarcity of land in Malawi continues to increase. The constraints on land is further emphasised by the fact that majority of smallholders in Malawi presently operate farms which are less than a hectare (Muyanga *et al.*, 2020). Suggesting that land scarcity poses a significant challenge to overcome, should Malawian farmers aim to expand their scale of production to improve their propensity to sustain participation in modern high-value markets.

Nontobacco Crops and Livestock Enterprises

Tiller *et al.* (2010) found that farmers who produced nontobacco crops in addition to tobacco production were less likely to exit. In contrast farmers who raised livestock in addition to producing tobacco showed higher probabilities of exiting. As can be seen from the hazard ratios, this analysis found similar effects on the hazard of exit and the production of nontobacco crops and livestock. With a statistically significant hazard ratio of 0.719, increases in the number of nontobacco crops grown by a farmer corresponded to a 28.1 per cent lower conditional probability of exiting. While the hazard ratio of 1.056 for the average number of livestock types raised by a farmer, reflects that an increase in the number of livestock types raised corresponds to a 5.6 per cent higher exit risk.

Tiller *et al.* (2010) suggest that the difference in effects between nontobacco crops and livestock is related to the degree that nontobacco enterprises are complementary to tobacco production. It is posited that a greater potential for input sharing exists between tobacco and nontobacco crops, which may induce cost savings due to economies of scope. Conversely, livestock is argued to be more limited in the potential for input sharing (Tiller *et al.*, 2010). However, it could be reasoned that the 5.6 per cent higher hazard of exit resulting from increased livestock tending is a relatively marginal effect.

Diversification away from tobacco has become a major policy objective for Malawi (Mangani *et al.*, 2020; MoAIWD, 2018; NPC, 2020; Wineman *et al.*, 2022). Malawi's economy relies heavily on the export proceeds from tobacco as a source of foreign exchange (Mangani *et al.*, 2020; Moyer-Lee & Prowse, 2015; Wineman *et al.*, 2022). Declines in global demand for tobacco has raised concerns regarding the sustainability of tobacco as the mainstay of Malawi's export earnings and the resultant consequences for tobacco farmer livelihoods. These concerns have in part provided the impetus for agricultural transformation within Malawi, as it seeks to shift away from tobacco towards alternative crops for farmers and for export (Wineman *et al.*, 2022).

The descriptive statistics indicate that the contracted farmers analysed produced on average 2.04 different types of nontobacco crops and raised about 1.22 different types of livestock. This result raises an important point when talking about diversification in the context of tobacco in Malawi. Of course, at the national level it is clear that a reduction in the tobacco reliance of Malawi's economy is important. However, a distinction should be made when framing diversification in the context of tobacco farmers. It is evident from the findings that it would be incorrect to view tobacco farmers as solely producing tobacco. The descriptive statistics indicate that tobacco farmers showcase diversification in the respect that they also produce different nontobacco crops and raise livestock. Therefore, it would be more accurate to frame the diversification of tobacco farmers in Malawi in terms of profitable alternatives. So as to reduce farmer reliance on tobacco as a major source of income.

It is quite encouraging that the cultivation of other crops in conjunction to tobacco appears to have a synergistic relationship. Particularly as it appears to improve the likelihood for sustained CFA participation. Moyer-Lee and Prowse (2015) suggest that given the extensive experience of firms contracting tobacco in Malawi, it may prove beneficial to leverage this experience to other crops. The tobacco CFAs have the ability to produce quality products with a high level of traceability. They demonstrate the means to satisfy the strict requirements associated with supplying high-value markets, which suggests that they have the potential to apply this capability to the production of other high-value crops. Especially as Malawi aims to diversify its economy beyond a primary reliance on tobacco exports (Moyer-Lee & Prowse, 2015).

However, bear in mind that this analysis looked at the number of different types of nontobacco crops and livestock. Complete data on the quantities and values of nontobacco enterprises was not available. Information on the respective volumes and values of the nontobacco enterprises would provide important insights to moderate the inferences made thus far. Particularly, concerning the relative importance of nontobacco enterprises in terms of total farm income and the allocation of farm resources.

4.4.3 Contract Characteristics and Performance

Club Membership

It was expected that club membership size would reflect important social capital and network effects within the durability of CFA participation. There was a tendency for larger club membership sizes to correlate with longer participation durations. Since an increase in the average number of club members was found to marginally lower the propensity of farmers to exit by 1.5 per cent. However, the hazard ratio of 0.985 is only statistically significant at the 10 per cent level. Therefore, while social capital was found to have an important influence on the participation decisions of smallholders in high-value markets in other studies (Andersson *et al.*, 2015; Michelson, 2017), the effects are not as clear within the findings of this analysis. This result could indicate the need to examine alternative variables that better capture social capital's effects.

Contract Package Type

Over 70 per cent of the farmers in this analysis contracted under the more comprehensive finance package. Furthermore, farmers opting for the more comprehensive finance package demonstrated considerably lower propensities for exiting relative to farmers who did not. Farmers who engage in the more comprehensive contract packages show hazards of exiting which are 35.7 per cent lower relative to farmers who do not use these comprehensive packages. The associated hazard ratio of 0.643 was found to be statistically significant. The finding supports that input access is likely a major motivating factor for farmers participation in burley CF (Shaba *et al.*, 2017). Which is understandable given that tobacco yields are strongly influenced by the appropriate use of inputs such as fertiliser (Moyer-Lee & Prowse, 2015).

The results of this investigation would then support that CF participation can serve as an institutional option through which some smallholders try to cope with certain input risks and market failures (Bellemare & Lim, 2018). Moreover, it highlights that the allowance provisions, from the more expansive finance package, are plausibly playing an influential role in the participation decisions of contracted farmers (Shaba *et al.*, 2017).

From a different perspective, there is an argument to be made that contractors prefer farmers to produce their crop with more comprehensive finance packages. The reason being that such packages are well provisioned and entail a greater degree of involvement by the contractors. Therefore, with considerable provisions and support, quality and productivity are expected to be boosted under more comprehensive packages. Such packages also provide greater assurances regarding the traceability and transparency of production (Moyer-Lee & Prowse, 2015). Since these packages are associated with greater supervision and support, there is more certainty to whether best practices were adhered to, and that the quality of inputs used complies with market standards.

Productivity, Income, and Quality Effects

As described earlier, contracting firms typically seek consistency concerning the parameters of quality, quantity, and the timing of agricultural production to satisfy downstream market requirements. Price premiums are often used as an incentive to foster these outcomes of consistency and quality (Bijman, 2008). At the same time higher incomes, improved productivity, and mitigation of production and market risks are commonly cited motivations for smallholder participation in CF (Bijman, 2008; Wang *et al.*, 2014). The results of this analysis show that important productivity, income, and quality effects influence farmers' propensity to sustain CFA participation.

From the estimates in Table 7, it is observed that a one per cent increase in the yield per hectare, lowers the risk of exiting by 15.1 per cent (hazard ratio 0.849). The effect of higher productivity on the hazard of exit was found to be statistically significant. However, the hazard ratio of 1.005 indicates that farmers who surpass preseason yield expectations have almost no difference in the hazard of exit relative to farmers who do not exceed expectations. The effect of expected productivity was also not statistically significant. The effect of increased productivity on lowering the risk of farmers exiting, indicates that the productive efficiency of farmers has an important influence on the likelihood of sustained participation. A finding similar to that of Tiller *et al.* (2010) concerning burley farmer exits in the USA. Moreover, Wineman *et al.* (2022) observed that less productive farmers have been exiting the tobacco industry in Malawi over the past two decades. The issue of productivity is not only relevant to this specific CFA. Low on-farm productivity is reported to be a persistent problem facing many of Malawi’s farmers overall (Muyanga *et al.*, 2020).

Higher profitability per hectare was observed to have a statistically significant hazard ratio of 0.794. Thus, for a one per cent increase in farmers’ profitability, there is a corresponding 20.6 per cent decrease in the hazard of exiting. This result supports that income effects are a key motivating factor behind CF participation (Lambrecht & Ragasa, 2018). Achieving sales greater than the preseason expectation showed to lower the hazard of farmers exiting, relative to the farmers who did not, with a hazard ratio of 0.971. However, this was not found to be statistically significant.

Farmers who achieved above-average crop quality also demonstrated lower risks of exiting. The ‘Quality’ variable proves to be statistically significant and results in a hazard ratio of 0.853. Thus, farmers who are able to achieve above-average levels of crop quality have about a 14.7 per cent lower conditional probability of exiting. The importance of crop quality regarding the hazard of exit makes sense, given that crop quality forms the primary basis upon which tobacco prices are determined

(Moyer-Lee & Prowse, 2015). The literature suggests that tobacco CF participants receive relatively higher prices compared to non-participants since contracted tobacco is usually of higher quality (Prowse & Moyer-Lee, 2014; Shaba *et al.*, 2017). The improved crop quality, assumed to result from CF production, is suggested to be a key driver behind the increasing prevalence of firms producing tobacco under CFAs (Prowse & Moyer-Lee, 2014). The findings of this study would support that quality is also an important factor sought after by the contractors in this case. It would logically follow that the associated price premiums likely incentivise farmers who are actually able to produce a high-quality crop to continue CFA participation. While contractors would probably encourage the sustained participation of farmers who are able to produce high-quality crops.

Loan Recovery

The final aspect of performance considers the extent of loan recovery by farmers. The extent of loan repayments demonstrated considerable impacts on the hazard of exit. Relative to farmers who totally default on repaying their seasonal loans, those who make at least partial repayments (0.469) and full repayments (0.410) correspond to exit risks which are lower by 53.1 per cent, and 59 per cent respectively. Furthermore, these findings were found to be statistically significant.

The fact that partial loan recovery was also associated with a particularly lower hazard ratio suggests the strong aversion to outright loan defaults. Which is reinforced by the fact that in the descriptive statistics, the proportion of farmers who were found to completely default on repayments was very low (1.2%). The vast majority of farmers in the sample did manage to fully repay their loans. Recall that the partial loan repayment category does not differentiate between the varying degrees of partial repayment. Many farmers in the partial repayment category may have paid back the majority of their loan with only a small amount outstanding that will carry over to the next season, if participation continues. The results would imply that in some cases, perhaps where only a small amount of credit is outstanding, contractors give some tolerance concerning loan recovery. Assuming that such repayments will be recovered in the following season. Nonetheless, it is farmers who are able to fully repay their loans that have the lowest relative hazard of exiting.

The results clearly show that actual performance, as it relates to productivity, profitability, quality, and loan recovery, has an important influence on the likelihood of sustained CFA participation in this case. Which confirms that CFA participants who are unable to meet performance expectations have higher likelihoods of exiting from contracting (Barrett *et al.*, 2012; Moyer-Lee & Prowse, 2015; Narayanan, 2013; Prowse, 2012).

4.4.4 District Effects

Similar to Tiller *et al.* (2010), this study found that there are underlying regional effects which influence the conditional probability of farmer exit. Farmers in the districts of Rumphi (1.666), Mchinji (1.130), and Mzimba (1.091) had higher hazards of exit relative to those in Lilongwe. In contrast, farmers in the Dowa district (0.869) had a lower associated risk of exit relative to Lilongwe farmers. Kasungu district (1.001) showed no real difference in farmers' hazard of exit relative to Lilongwe, and the hazard ratio for Kasungu was the only district for which the hazard estimate was not statistically significant.

Recall that the descriptive statistics showed the largest proportion of farmers in the sample to be located within the Dowa, Lilongwe, and Mzimba districts. The relative distributions across districts were found to remain relatively constant. However, there were some decreases in the share of farmers located in Kasungu, Mzimba, and Rumphi districts corresponding to longer participation spells. Wineman *et al.* (2022) observed that farmers who have remained in tobacco production are increasingly clustered in Dowa, Kasungu, and Lilongwe districts, which would explain some of the results observed within this study. A fuller understanding of what particular components within these underlying district effects are driving the observed trends is, unfortunately, beyond this study's scope.

Chapter 5: Conclusion

5.1 Summary

This study had two research questions: One, what is the extent and nature of participant turnover within a smallholder contract farming arrangement (CFA) in Malawi? Two, how do observable factors and farm characteristics impact the likelihood and timing of smallholder exits in a Malawi CFA? This study used a discrete-time proportional hazards model and a series of descriptive statistics to address these questions.

The analysis focused on the case of a large burley CFA in Malawi. Studying such a case was deemed relevant since burley production in Malawi is predominantly produced by smallholder farmers (Prowse & Moyer-Lee, 2014). Furthermore, there has been considerable expansion in using CFAs to engage Malawian smallholders in burley production. As a result, most Malawian burley is currently produced under contract (Prowse, 2022). The increased application of CFAs is largely because the tobacco industry operates in a strongly buyer-driven market and faces considerable scrutiny from health concerns related to smoking. These factors have led to increased demands for compliance and traceability within Malawi's tobacco sector (Moyer-Lee & Prowse, 2015). Hence, the tobacco industry in Malawi can be considered at the forefront of the evolving demands and trends faced in supplying modern high-value markets. Thus, smallholder burley production through CFAs provides an informative case to examine the CF participation dynamics of Malawian smallholders in modern value chains.

Regarding the extent of participant turnover, approximately 65 per cent of the individuals analysed were observed to cease participating at some point before the end of the five-year study period. The durations for which farmers sustained participation in the CFA showed considerable variation. Participation durations ranged from a minimum of one season, all the way up to five seasons. However, farmers tended to sustain participation for a median of two seasons.

Moreover, it was found that the conditional probability of exiting increases over time, implying that the likelihood of continued participation tends to decline with longer survival times. However, there was evidence in the results to suggest that the risk of exit may increase at a decreasing rate. Lastly, the interval-specific hazards for the full effects discrete-time model showed that farmers had a higher risk of exiting in the first-year relative to the second year of participation. However, the highest risk of farmer exit corresponded with the durations of three and four seasons.

In terms of farmer and household characteristics, it was found that with increased farmer age, the hazard of exit tended to decrease, indicating that relatively younger farmers had a higher hazard of exiting. Relative to middle-aged farmers, individuals younger than 45 years old had an 18.7

per cent higher risk of exit. Farmers aged 65 years or older had a 2.1 per cent lower risk of exiting relative to middle-aged farmers. Male farmers were found to have about a 15 per cent lower conditional probability to exit relative to females. Meanwhile, higher levels of education led to reductions in the risk of exit relative to farmers with no formal education. Respectively, farmers with primary, secondary, and post-secondary education had exit risks which were 28.9 per cent, 31.2 per cent, and 16.7 per cent lower than farmers with no formal education. Most farmers had education at the primary level. However, farmers with secondary education exhibited the lowest relative hazard of exiting. A higher number of total adults within a farmer's household demonstrated important labour-availability effects in reducing the likelihood of exit. A unit increase in the total number of adults in a household translated to a 19 per cent lower conditional probability of exit.

Farm characteristics also substantially affected the likelihood of sustained CFA participation. Farm size, represented by hectarage under contract, was negatively correlated with the probability of exit. Respectively, the size categories of between one and two hectares, between two and five hectares, and over five hectares, showed exit risks which were 67.3 per cent, 64.8 per cent, and 59.3 per cent lower than farmers operating at a scale of one hectare or less. Furthermore, producing a number of nontobacco crops in conjunction with tobacco cultivation was associated with a reduced exit hazard. In fact, producing two crops in addition to tobacco versus one, reduced the exit probability by 28.1 per cent. In contrast, a unit increase in the number of livestock types raised the risk of exit by 5.6 per cent.

Regarding contract characteristics, club membership size was not found to have a particularly large effect on the exit hazard. A unit increase in the average number of club members only lowered the propensity of farmers’ exit by 1.5 per cent. However, farmers who engaged in the more comprehensive contract packages showed conditional exit probabilities which were 35.7 per cent lower than farmers who did not produce under the comprehensive packages. Lastly, increases in performance-related factors such as productivity, profitability, crop quality, and loan recovery also translated into reductions in the conditional probabilities of farmer exit. A one per cent increase in a farmers’ yield per hectare lowered the risk of exiting by 15.1 per cent, while a one per cent increase in farmers’ profit per hectare corresponded to a 20.6 per cent decrease in the risk of exit. Furthermore, farmers who achieved above-average levels of crop quality (receiving prices greater than the season's average), had a 14.7 per cent lower conditional probability of exiting. Lastly, concerning loan recovery, farmers demonstrating partial, or full loan recovery, showed exit risks which were respectively 53.1 per cent and 59 per cent lower than farmers who totally defaulted on repaying their seasonal loans.

In terms of magnitude, the largest effects on lowering the hazard of farmers' exit from this burley CFA were associated with larger contracted hectarage, high loan recovery, and comprehensive contract financing. Additionally, higher levels of education, simultaneous cultivation of nontobacco crops, higher profitability, larger numbers of household adults, higher productivity, and higher crop quality were among the factors which had the largest impact on lowering the hazard of exit.

Evidently, productive resources and farmer performance are particularly influential in improving the likelihood that farmers sustain participation in this burley CFA. It suggests that quality and quantity parameters are essential for a modern high-value market like tobacco – to satisfy these key market parameters appears to entail relatively labour, resource, and capital-intensive production. Consequently, it is argued that the factors influencing the ability of Malawian smallholders to endure the stresses of supplying a modern high-value market, such as tobacco, are likely to be similar factors that Malawian farmers will face in producing other high-value market crops.

There is increasing empirical evidence which suggests that, on average, CFA participants earn higher incomes, and may experience greater food security and lower-income variability than non-participants (Bellemare & Bloem, 2018; Bellemare, Lee & Novak, 2021; Bellemare & Lim, 2018; Bellemare & Novak, 2017; Meemken & Bellemare, 2020).

However, despite the apparent benefits of CF participation, high rates of smallholder exits are often observed within CFAs (Barrett *et al.*, 2012; Narayanan, 2013; Ruml & Qaim, 2021). Studies across different contexts, such as Kenya (Andersson *et al.*, 2015), Ecuador (Granja & Wollni, 2018), Ghana (Lambrecht & Ragasa, 2018), Nicaragua (Michelson, 2017), and India (Narayanan, 2013) have confirmed high rates of farmer turnover within CFAs. To the best of the researcher's knowledge, work of a similar nature has not been conducted within the Malawian context. Hence, this analysis contributes to the literature by investigating participant turnover within a CFA in Malawi. Similar to the literature mentioned above, a high rate of farmer turnover was observed within the CFA analysed.

This investigation found that around 65 per cent of farmers were observed to exit at some point within the five-year study period. This result is similar to Andersson *et al.* (2015), finding that over 50 per cent of participants dropped out after four years of supplying Kenyan supermarkets. Furthermore, Granja and Wollni (2018) observed that over half of the contracted broccoli farmers in Ecuador exited within the first five years.

Consequently, the discussion surrounding CFA participation dynamics becomes focused on the contrast between evidence for the benefits associated with CF participation, and the growing literature on high participant turnover within CFAs. If participation in CFAs is not durable, it may considerably diminish the efficacy and extent to which CFAs can truly be an avenue for agricultural development and poverty reduction. At first glance, the evidence may appear contradictory, but it advances the debate, recognising that distinguishing between the types of farmers' exit is essential for better understanding the dynamics and implications of farmer turnover (Narayanan, 2013).

The literature proposes that farmers' exits need to be differentiated according to whether they are involuntary, as a result of farmers' inability to meet contract requirements, or if exits are voluntary as an intentional pursuit of alternative opportunities thought to be more beneficial than further CF participation (Granja & Wollni, 2018; Lambrecht & Ragasa, 2018; Michelson, 2017; Narayanan, 2013; Ruml & Qaim, 2021).

Therefore, while CFA participation may serve to assist smallholder farmers in overcoming constraints related to inputs and market access initially (Barrett *et al.*, 2012; Bellemare & Lim, 2018; Bijman, 2008), the high rates of exit which follow may suggest that the benefits associated with CF diminish with longer participation. Alternatively, with the initial support from CF participation, alternative possibilities eventually become available for accessing inputs and markets without requiring further CF support, making farmers less inclined to continue participation (Lambrecht & Ragasa, 2018).

In the Kenyan case analysed by Andersson *et al.* (2015), sustained contracting with supermarkets corresponded to superior economic returns relative to the outcomes of farmers who dropped out. Implying that farmers' exits were not driven by more advantageous options outside of CF participation. In contrast, Granja and Wollni (2018) did not find significant income effects associated with CF participation over the long term, concluding that exiting farmers likely had profitable alternatives outside CF participation.

The results of this study suggested that productive resources and farmer performance were particularly influential in improving the likelihood that farmers sustain participation in this burley CFA. Hence, farmers with less productive resources and who are not high-performing tend to be the most likely to exit. As a result, the inference drawn is that the exits in this case are not reflective of farmers with the capacity for sustained CF participation, who choose to dropout to pursue more beneficial alternatives. Rather, it is indicative of limitations to farmers' capacity to keep up with CF requirements.

Thus, this investigation's results for the case of burley CF in Malawi are similar to those of Andersson et al. (2015) concerning Kenyan supermarkets. Therefore, it is likewise suggested that farmer exits do not appear to be driven by lucrative alternatives outside of CF. This finding could imply that there may be a lack of beneficial alternatives to burley CF in Malawi. Alternatively, it may suggest that continued burley CF participation is associated with greater benefits relative to available alternatives. However, farmers find it difficult to maintain participation over time. It should be noted that these are indirect inferences drawn from the results of this investigation since the types of exits are not explicitly known within the confines of this analysis. Therefore, this study cannot make strong conclusions concerning the prevailing type of exit found within participant turnover in this CFA; this limitation is discussed further in Section 5.4.

5.2 CFA Management Implications

The results of this study provide the following implications for CFA management. Firstly, it was found that farmers become increasingly more likely to exit the longer they contract. Where should CFA managers focus on dealing with the increasing exit risk? A helpful starting point is suggested by the finding that, on average, farmers sustain participation for two seasons, and most exits are expected to occur after a duration of two seasons. Thus, it is recommended that efforts to deal with the increasing risk of exit would be most impactful if directed towards promoting the participation of second-year farmers beyond the apparent two-season threshold.

Reflecting on the functionality (performance quality) of exiting farmers, the results imply that the farmer turnover in this particular CFA is functional. Meaning, that farmers characterised by greater endowments of productive resources (land, labour, education) and high performance (higher: yield per hectare, loan recovery, crop quality) tend to demonstrate greater propensities to sustain participation. The exit of less productive and under-performing farmers can be considered functional because it allows better-performing individuals to be contracted (Tziner & Birati, 1996). However, the firm should consider whether the turnover of farmers is sustainable. Around 65 per cent of farmers in the sample were found to exit at some point within the five-year study period. Are there enough high-performing farmers available to replace exiting farmers? If so, then it could be argued that farmer turnover in this CFA does not present an eroding impediment to operations. However, if finding suitable replacements for exiting farmers is increasingly difficult, then farmer retention should become of greater concern to management.

Where farmer retention is a priority, the following is suggested. Finding that the interval-specific exit hazard for the first season of participation, was higher than that of two seasons, suggests that the first contract year plays a key role in informing the suitability of further engagement. Therefore, during new farmer selection, advanced consideration of particular risk factors could help manage the inherent propensity of farmers' exit before engagement. In this way farmers predisposed towards shorter participation durations can be avoided.

Assuming that these criteria are not already considered during farmer recruitment, this study would suggest that contractors seek out farmers characterised by larger farm sizes, who grow additional nontobacco crops, and are more highly educated. The extent to which pre-emptive measures can work is caveated by the fact that some uncertainty will persist surrounding farmer suitability until actual engagement occurs.

Beyond farmer selection, close coordination and support stemming from the use of comprehensive contract packages improved the likelihood of sustained participation. The comprehensive contract packages are expected to support farmers' access to key inputs, in addition to contract allowances assisting farmers in coping with 'lean periods' (Shaba *et al.*, 2017). It could be further argued that close contractor support has beneficial knock-on effects, which can enhance performance-related factors that similarly affect lowering the exit hazard.

For example, contract packages which enable access to key inputs and greater support services, are suggested to facilitate improvements in productivity and crop quality (Chirwa, 2009; Moyer-Lee & Prowse, 2015). Improved yields and crop quality would be expected to bolster farmer profitability, and higher profitability would strengthen farmers' ability to repay loans. Therefore, it is contended that comprehensive contract support can be an important instrument with which to promote farmers' performance and consequently support farmer retention.

Labour availability, in terms of the number of household adults, was also found to lower the exit hazard. Therefore, to the extent that innovative labour-saving solutions could be found and applied to the production of the contract crop, the overall stability of farmers' participation in the CFA could be improved.

The production of nontobacco crops in conjunction with the contract crop led to lower hazards of farmer exit; this implies that should tobacco CFAs expand their portfolio of contract crops, or if contracted farmers are supported in producing other crops in addition to tobacco, it would complement the probability that farmers sustain CFA participation for longer.

Lastly, an exit interview policy for contracted farmers could offer considerable insight to understanding the motivations behind the exit of high-performing farmers. Such a practice would assist management in determining what could be done, if anything, to encourage farmers to stay, in the cases where retention of particular farmers is necessitated. Assuming such a practice is not already in effect.

5.3 Policy Implications

Malawi has expressed interest in transforming its agricultural sector, with increased smallholder commercialisation within its agriculture being among the objectives. CFAs are one of the possible institutional strategies that could facilitate pursuing these goals (MoAIWD, 2016, 2018; NPC, 2020). Therefore, policymakers should consider the following from the analysis results.

CF requires farmers to produce consistent quality and volume crops (Bijman, 2008). The farmers who were found to sustain participation in this CFA appear to reflect their capacity to meet these criteria. If Malawi aims to transform its agriculture and expand smallholder participation in modern high-value markets, particularly as it seeks to reduce its reliance on tobacco and find other sources for export earnings (Mangani *et al.*, 2020; Moyer-Lee & Prowse, 2015; Wineman *et al.*, 2022), then it is likely going to require farmers who have the capacity, motivations, and resources necessary for effective participation in those high-value modern markets.

The challenge for Malawian policymakers is that relatively wealthier smallholders will tend to be the ones who have the resources and capacity to produce the required crop volumes in a requisite manner (Moyer-Lee & Prowse, 2015). Furthermore, as mentioned within the discussion, there are several key challenges facing Malawi's agriculture outlined by Muyanga *et al.* (2020), which are at odds with the factors found to improve the durability of CFA participation in this analysis.

First, land is increasingly scarce and continues to fragment into smaller holding sizes within Malawi. At the same time, on-farm productivity remains frustratingly low for many of Malawi's farmers (Muyanga *et al.*, 2020). Furthermore, with rapid population growth experienced in Malawi, a large proportion of the population comprises of youth and relatively young adults (Muyanga *et al.*, 2020). Yet, in Malawi older farmers tend to have greater access to productive assets such as land (Lindsjö *et al.*, 2021; Muyanga *et al.*, 2020). Therefore, given the land constraints, it is expected that the individuals currently engaged in farming will most likely be the ones who will remain in farming in the near term. Hence, many youths and young adults will likely have to exit farming in Malawi (Muyanga *et al.*, 2020).

Furthermore, it appears that education beyond primary school is generally limited in Malawi (Muyanga *et al.*, 2020). The findings of this study would support this. The largest proportion of contracted farmers only had primary education. Yet secondary-level education was associated with the lowest relative hazard of exit. It is suggested that higher levels of education are important not only for improving the capacity of farmers to innovate and adopt modern technology (Euler *et al.*, 2016; Muyanga *et al.*, 2020; Tiller *et al.*, 2010), but also further education is vital for off-farm livelihood opportunities. Non-farm employment will need to absorb many of Malawi's youthful and resource-constrained individuals in the near future (Muyanga *et al.*, 2020).

Given the present challenges facing Malawian agriculture, policymakers should be realistic about what can be expected from CFAs as an institutional strategy for sustained smallholder participation in modern high-value markets. Farmers participate for durations of varying lengths; not all will sustain participation for extended periods. Consequently, farmers likely to stay and maintain CFA participation will need policy responses different to those with a high risk of exit, who will most likely need support outside agriculture.

By the findings of this analysis, individuals who are relatively younger, less educated, and have less land and productive resources are considerably less likely to sustain CFA participation. Constraints such as land are difficult to relax in a land-scarce nation such as Malawi, which means alternative resources must be developed and utilised. Investment supporting the nation's education would seem to yield dividends by boosting farmers' resilience and innovation capacity and promoting skills needed for greater non-farm livelihood opportunities. Developing the nation’s nonphysical resources, such as education, would be essential to reducing its reliance on physical resources.

A proportion of contracted farmers successfully demonstrated the ability to participate within the analysed CFA over several years, suggesting that there are Malawian farmers who possess the attributes and capabilities necessary to sustain participation in modern high-value markets. However, the proportion of contracted farmers expected to survive participation over several years was comparatively low, hinting that the proportion of farmers who possess the attributes and capabilities necessary for sustained participation may also be relatively low. Hence, if Malawi aims to successfully increase the number of farmers supplying modern high-value markets through CFAs, it will need to first focus on improving the capacities of its farmer population. It is suggested that particular attention be paid to the factors found to raise the propensity for sustained participation in this study. It is argued that doing so would support the efficacy of using CFAs as an institutional strategy to improve smallholder commercialisation through more durable modern-market participation.

Finally, given that there are farmers who currently demonstrate the capacity to sustain participation in tobacco CFAs. Leveraging the experience and framework of CFAs producing tobacco in Malawi may be valuable for promoting the successful participation of capable Malawian smallholders in producing alternative high-value crops for modern markets. Such farmers could be key in reducing Malawi’s reliance on tobacco export proceeds, especially since they are most likely capable of successful and durable participation in supplying alternative high-value crop markets. An expanded portfolio of high-value crops would offer a wider set of foreign exchange sources to diversify the burden on tobacco exports. Where possible, efforts should be undertaken to improve Malawian CFAs’ competitiveness within the production and marketing of alternative high-value crops. Public sector engagement with investors and CFA management could facilitate the identification of policy barriers impeding CFAs’ expansion and competitiveness within alternative high-value crops. Good faith discussions could guide practical steps for the Government of Malawi to take, to support the ability of tobacco CFAs to diversify their contract farmers’ crop portfolio.

5.4 Limitations and Further Research

This study has several limitations which should be recognised. CF participation dynamics is still a relatively understudied topic (Andersson *et al.*, 2015; Barrett *et al.*, 2012; Bellemare & Bloem, 2018; Granja & Wollni, 2018; Michelson, 2017; Narayanan, 2013), and whilst this study added to the existing literature, one should proceed cautiously when generalising the results since they could be location, firm, and crop specific.

In this investigation, the duration of smallholder participation in this particular CFA was measured as the length of time between when a farmer first appears in the contracting firm's records up until their last appearance. This approach assumes that exit from participating in the CFA is a single-episode event; individuals are assumed to only experience the event once (i.e., farmers are assumed to only enter and exit once) (Willett & Singer, 1993). However, there is evidence that farmers' participation in CF can be episodic, meaning some farmers enter and exit multiple times (Granja & Wollni, 2018; Narayanan, 2013). Therefore, participation may be intermittently reoccurring over time.

Additionally, no specific distinction was made between the types and destinations of farmer exits. Consider the following hypothetical cases. A farmer who ceases to participate in this specific CFA but goes on to contract with a competing CFA. The farmer who ceases participation and goes on to exit farming outright. Alternatively, the farmer who discontinues CF but continues production independently. Being able to differentiate between the destination of exit provides critical insight regarding the implications of farmer exits (Narayanan, 2013), and this differentiation is something which is lacking in this study. It is suggested that further research incorporating the types and destinations of farmer exits, would be highly beneficial to the body of knowledge surrounding the dynamics of CF participation, especially in the context of Malawi. There are advanced survival analysis methods, such as competing risk models, which can accommodate the hazards of multiple destinations and repeat occurrence events (Allison, 1982; Jenkins, 2005; Mills, 2011; Willett & Singer, 1993).

Certain limitations were also present concerning data availability. This investigation made use of data from a single burley CFA in Malawi. Because the investigation was focused on a single case and a single contract crop, it remains a question whether these findings carry over in other CFAs and for other contract crops in Malawi. Consequently, if several different CFAs contracting different crops could be analysed, it would contribute to cross-validating the conclusions drawn from this study.

While the panel data from the contracting firm contained a variety of useful indicators, there were also several constraints. When examining phenomena over time is always desirable to have information covering the longest period possible. While this study had access to the data from five seasons, to the extent it is feasible, it would be helpful if CF participation dynamics could be examined over a longer period. To ascertain whether the effects observed in this analysis hold across a time horizon longer than five years. In this way, the effects of external shocks can also be better controlled for and analysed.

In addition, the available data was restricted to the parameters the contracting firm undertook to record. Understandably, there are several observable and unobservable factors with major influences on CF participation decision-making not present in company records. Some examples would include data on off-farm income, total farm size, risk preferences, and personal aspirations. Self-reported reasons for exit or continued participation by farmers would also provide valuable insight into further illuminating the dynamics of CFA participation in Malawi.

Hopefully, this investigation will promote further discussion of smallholder CF participation more broadly, and within Malawi more specifically. Serving as a point of departure for further work to support Malawi and its farmers in successfully achieving their goals. Further research addressing this study's shortcomings would add considerable depth to understanding smallholder CF participation dynamics in Malawi. It would also offer a more holistic and refined basis for guiding policy responses that are better targeted and more effective.

Reference List

Allison, P.D. 2014. *Event History and Survival Analysis*. 2nd Edition. Thousand Oaks, California: SAGE Publications Inc.

Allison, P.D. 1982. Discrete-Time Methods for the Analysis of Event Histories. *Sociological Methodology*, 13:61–98.

Andersson, C.I.M., Chege, C.G.K., Rao, E.J.O. & Qaim, M. 2015. Following up on Smallholder Farmers and Supermarkets in Kenya. *American Journal of Agricultural Economics*, 97(4):1247–1266.

Anseeuw, W., Jayne, T., Kachule, R. & Kotsopoulos, J. 2016. The Quiet Rise of Medium-Scale Farms in Malawi. *Land*, 5(3):1-22.

Barrett, C.B., Bachke, M.E., Bellemare, M.F., Michelson, H.C., Narayanan, S. & Walker, T.F. 2012. Smallholder participation in contract farming: Comparative evidence from five countries. *World Development*, 40(4):715–730.

Bellemare, M.F. 2012. As You Sow, So Shall You Reap: The Welfare Impacts of Contract Farming. *World Development*, 40(7):1418–1434.

Bellemare, M.F. & Bloem, J.R. 2018. Does contract farming improve welfare? A review. *World Development*, 112:259–271.

Bellemare, M.F. & Lim, S. 2018. In all shapes and colors: Varieties of contract farming. *Applied Economic Perspectives and Policy*, 40(3):379–401.

Bellemare, M.F. & Novak, L. 2017. Contract farming and food security. *American Journal of Agricultural Economics*, 99(2):357–378.

Bellemare, M.F., Lee, Y.N. & Novak, L. 2021. Contract farming as partial insurance. *World Development*, 140:105274.

Bijman, J. 2008. Contract farming in developing countries: an overview. Working Paper. Unpublished manuscript. Wageningen: Wageningen University.

Chirwa, E. 2009. *Farmer Organisations and Profitability in Smallholder Tobacco in Malawi*. Working Paper No. 2009/04. Zomba: University of Malawi Chancellor College.

Collier, P. & Dercon, S. 2014. African Agriculture in 50 Years: Smallholders in a Rapidly Changing World? *World Development*, 63(2014):92–101.

Cox, D.R. 1972. Regression Models and Life-Tables. *Journal of the Royal Statistical Society: Series B (Methodological)*, 34(2):187–202.

De Cleyn, S.H., Meysman, J. & Braet, J. 2015. A Critical Assessment of the Non-Disclosure Agreement in the Framework of the Technology Transfer Process: A Longitudinal Study. *Journal of Private Equity*, 18(2):39–51.

Dong, F., Hennessy, D.A., Jensen, H.H. & Volpe, R.J. 2016. Technical efficiency, herd size, and exit intentions in U.S. dairy farms. *Agricultural Economics*, 47(5):533–545.

Eaton, C. & Shepherd, A.W. 2001. *Contract Farming: Partnerships for Growth. A Guide*. Agricultural Services Bulletin No. 145. Rome: Food and Agricultural Organisation of the United Nations.

Emmert-Streib, F. & Dehmer, M. 2019. Introduction to Survival Analysis in Practice. *Machine Learning and Knowledge Extraction*, 1(3):1013–1038.

Euler, M., Schwarze, S., Siregar, H. & Qaim, M. 2016. Oil Palm Expansion among Smallholder Farmers in Sumatra, Indonesia. *Journal of Agricultural Economics*, 67(3):658–676.

Glover, D. 1990. Contract Farming and Outgrower Schemes in East and Southern Africa. *Journal of Agricultural Economics*, 41(3):303–315.

Granja, C.R. & Wollni, M. 2018. Dynamics of smallholder participation in horticultural export chains: evidence from Ecuador. *Agricultural Economics*, 49(2):225–235.

Gujarati, D. & Porter, D. 2010. *Essentials of Econometrics*. 4th Edition. Singapore: McGraw Hill Education.

Hausman, J.A. 1978. Specification Tests in Econometrics. *Econometrica*, 46(6):1251–1271.

Hernández, R. & Reardon, T. 2012. *Duration Analysis of Farmer Adoption of New Technologies and Markets in Nicaragua: Quality-Niche versus Commodity Vegetables*. Managua, Nicaragua: Assets and Market Access Collaborative Research Support Program.

Jenkins, S.P. 1995. Easy Estimation Methods for Discrete-Time Duration Models. *Oxford Bulletin of Economics and Statistics*, 57(1):129–136.

Jenkins, S.P. 2005. Survival analysis. Unpublished manuscript. Colchester: University of Essex.

Kaplan, E.L. & Meier, P. 1958. Nonparametric Estimation from Incomplete Observations. *American Statistical Association*, 53(282):457–481.

Khataza, R.R.B., Doole, G.J., Kragt, M.E. & Hailu, A. 2018. Information acquisition, learning and the adoption of conservation agriculture in Malawi: A discrete-time duration analysis. *Technological Forecasting and Social Change*, 132(2018):299–307.

Kumwenda, I. & Madola, M. 2005. The Status of Contract Farming in Malawi. Pretoria: Food, Agriculture and Natural Resources Policy Analysis Network.

Lambrecht, I.B. & Ragasa, C. 2018. Do development projects crowd-out private sector activities? Evidence from contract farming participation in Northern Ghana. *Food Policy*, 74(2018):9–22.

Lindsjö, K., Mulwafu, W., Djurfeldt, A.A. & Joshua, M.K. 2021. Generational dynamics of agricultural intensification in Malawi: challenges for the youth and elderly smallholder farmers. *International Journal of Agricultural Sustainability*, 19(5–6):423–436.

Ma, M. & Sexton, R.J. 2021. Modern agricultural value chains and the future of smallholder farming systems. *Agricultural Economics*, 52(4):591–606.

Mangani, R., Jayne, T.S., Hazell, P., Muyanga, M., Chimatiro, S., Burke, W.J. & Johnson, M. 2020. *Agricultural Transformation in Malawi: Call to Action*. MwAPATA Institute Working Paper No. 20/01. Lilongwe: MwAPATA Institute.

Meemken, E.M. & Bellemare, M.F. 2020. Smallholder farmers and contract farming in developing countries. *Proceedings of the National Academy of Sciences of the United States of America*, 117(1):259–264.

Michelson, H.C. 2017. Influence of Neighbor Experience and Exit on Small Farmer Market Participation. *American Journal of Agricultural Economics*, 99(4):952–970.

Milgrom, P. & Roberts, J. 1992. *Economics, organization and management*. J. Roberts (ed.). Upper Saddle River, New Jersey: Prentice-Hall.

Mills, M. 2011. *Introducing Survival and Event History Analysis*. London: SAGE Publications Ltd.

MoAIWD. 2016. *Contract Farming Strategy*. Lilongwe: Ministry of Agriculture, Irrigation, and Water Development.

MoAIWD. 2018. *National Agricultural Investment Plan*. Lilongwe: Ministry of Agriculture, Irrigation, and Water Development.

Moyer-Lee, J. & Prowse, M. 2015. How Traceability is Restructuring Malawi's Tobacco Industry. *Development Policy Review*, 33(2):159–174.

Muyanga, M., Nyirenda, Z., Lifeyo, Y. & Burke, W.J. 2020. *The Future of Smallholder Farming in Malawi The Future of Smallholder Farming in Malawi*. MwAPATA Institute Working Paper No. 20/03. Lilongwe: MwAPATA Institute.

Narayanan, S. 2013. Smallholder attrition in contract farming schemes in India: extent, causes, and concerns. *Food Chain*, 3(3):155–170.

Negri, M. & Porto, G.G. 2008. *Burley Tobacco Clubs in Malawi: Nonmarket Institutions for Exports. Policy Research Working Paper 4561*. Washington DC: World Bank Group.

NPC. 2020. *Malawi Vision 2063 An Inclusively Wealthy and Self-reliant Nation*. Lilongwe: National Planning Commission.

O'Connell, M. & Kung, M. 2007. The Cost of Employee Turnover. *Industrial Management*, 49(1):14–19.

Prowse, M. 2012. *Contract farming in developing countries - A Review*. A Savoir Collection No. 12. Paris: Agence Française de Développement.

Prowse, M. 2022. Tobacco Contract Farming, Crop Diversification and Household Relations in the Central Region of Malawi. *Journal of Southern African Studies*, 48(2):355–374.

Prowse, M. & Moyer-Lee, J. 2014. A Comparative Value Chain Analysis of Smallholder Burley Tobacco

Production in Malawi - 2003/4 and 2009/10. *Journal of Agrarian Change*, 14(3):323–346.

Rehber, E. 2007. *Contract Farming: Theory and Practice*. Hyderabad: The ICFAI University Press.

Ruml, A. & Qaim, M. 2021. Smallholder Farmers' Dissatisfaction with Contract Schemes in Spite of Economic Benefits: Issues of Mistrust and Lack of Transparency. *Journal of Development Studies*, 57(7):1106–1119.

Saunders, M., Lewis, P. & Thornhill, A. 2016. *Research Methods For Business Students*. 7th Edition. Essex: Pearson Education Limited.

Shaba, A.K., Edriss, A., Mangisoni, J.H. & Phiri, M.A.R. 2017. *Tobacco Contractual Arrangements in Malawi and Their Impact on Smallholder Farmers: Evidence from Burley Tobacco Contracts*. MaSSP Working Paper No. 18. Lilongwe: International Food Policy Research Institute.

Singer, J.D. & Willett, J.B. 1993. It's about Time: Using Discrete-Time Survival Analysis to Study Duration. *Journal of Educational Statistics*, 18(2):155–195.

Singh, A.S. & Dlamini, S. 2021. Analytical Models of Survival Analysis: Concepts and Their Applications. *International Journal of Science and Research Methodology*, 19(2):150–169.

StataCorp. 2021a. *Stata Statistical Software* (Release 17). College Station, Texas: StataCorp LLC.

StataCorp. 2021b. *Stata 17 Base Reference Manual*. College Station, Texas: Stata Press

Stringfellow, R. 1996. *An investigation of the organisational features, commodities, and situations associated with contract farming and outgrower schemes in Sub-Saharan Africa and of the factors which are critical to their successful operation*. Project A0439. Chatham: National Research Institute ODA Crop Post-Harvest Programme.

Swinnen, J.F.M. & Maertens, M. 2007. Globalization, privatization, and vertical coordination in food value chains in developing and transition countries. *Agricultural Economics*, 37(1):89–102.

Tiller, K.J., Feleke, S.T. & Starnes, J.H. 2010. A discrete-time hazard analysis of the exit of burley tobacco growers in Tennessee, North Carolina, and Virginia. *Agricultural Economics*, 41(5):397–408.

Tziner, A. & Birati, A. 1996. Assessing Employee Turnover Costs: A Revised Approach. *Human Resource Management Review*, 6(2):113–122.

Verma, S. 2002. Legal Protection of Trade Secretes and Confidential Information. *Journal of the Indian Law Institute*, 44(3):336–353.

Wang, H.H., Wang, Y. & Delgado, M.S. 2014. The Transition to Modern Agriculture: Contract Farming in Developing Economies. *American Journal of Agricultural Economics*, 96(5):1257–1271.

Willett, J.B. & Singer, J.D. 1993. Investigating Onset, Cessation, Relapse, and Recovery: Why You Should, and How You Can, Use Discrete-Time Survival Analysis to Examine Event Occurrence. *Journal of Consulting and Clinical Psychology*, 61(6):952–965.

Wineman, A., Chilora, L. & Jayne, T.S. 2022. Trends in Tobacco Production and Prices in Malawi. *Nicotine & Tobacco Research*, 24(2):227–232.

World Bank. 2023. *Data*. [Online]. Available: https://data.worldbank.org/country/malawi [2023, February 03].

Zikmund, W.G., Babin, B.J., Carr, J.C. & Griffin, M. 2013. *Business Research Methods*. 9th Edition. M. Roche, E. Lowry, & J. Rich (eds.). Boston: Cengage.

Appendix A: Discrete-time model estimate results

Significance level: *(10%), **(5%), ***(1%)	Baseline Hazard Models				DTPH Models (no district effects)			
	No Frailty		Normal Frailty		No Frailty		Normal Frailty	
Event1exit	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**
Period 1	0.379 ***	0.006	0.062 ***	0.003	113.158 ***	23.214	141.914 ***	34.421
Period 2	0.344 ***	0.006	0.290 ***	0.011	92.549 ***	19.040	130.248 ***	31.747
Period 3	0.889 ***	0.012	5.867 ***	0.261	290.922 ***	59.187	522.783 ***	127.665
Period 4	0.379 ***	0.008	3.637 ***	0.203	135.698 ***	27.742	216.419 ***	52.725
Age < 45 years					1.138 ***	0.022	1.162 ***	0.027
Age ≥ 65 years					0.975	0.035	0.989	0.042
Gender					0.848 ***	0.023	0.816 ***	0.027
Primary					0.753 ***	0.042	0.724 ***	0.050
Secondary					0.760 ***	0.043	0.735 ***	0.052
Post-secondary					0.915	0.069	0.891	0.082
Total Adults					0.825 ***	0.006	0.806 ***	0.006
Hectares 1 < & ≤ 2					0.399 ***	0.008	0.325 ***	0.010
Hectares 2 < & ≤ 5					0.420 ***	0.015	0.349 ***	0.015
Hectares > 5					0.454 ***	0.044	0.389 ***	0.045
Nontobacco Crops					0.729 ***	0.008	0.709 ***	0.009
Livestock					1.043 ***	0.013	1.046 ***	0.015
Club Members					0.974 ***	0.007	0.982 **	0.008
Yield per hectare					0.851 ***	0.037	0.885 **	0.046
Yield Expectation					1.019	0.027	1.008	0.029
Quality					0.853 ***	0.018	0.846 ***	0.021
Profit per hectare					0.811 ***	0.020	0.779 ***	0.023
Sales Expectation					1.008	0.024	0.991	0.026
Finance Type					0.730 ***	0.020	0.660 ***	0.022
Repayment full					0.406 ***	0.063	0.389 ***	0.077
Repayment partial					0.463 ***	0.074	0.444 ***	0.090

Discrete-time model estimate results (*continued*)

Significance level: *(10%), **(5%), ***(1%)	DTPH Models (full effects)					
	No Frailty		Normal Frailty		Gamma Frailty	
Event1exit	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**	**exp(b)**	**Std. err.**
Period 1	113.517***	23.541	142.304***	35.169	150.941***	38.541
Period 2	94.062***	19.554	132.561***	32.914	139.703***	35.805
Period 3	296.212***	60.890	534.918***	133.066	577.342***	148.188
Period 4	141.322***	29.205	229.725***	57.076	246.381***	63.160
Age < 45 years	1.157***	0.022	1.187***	0.028	1.190***	0.028
Age ≥ 65 years	0.966	0.034	0.979	0.042	0.983	0.043
Gender	0.880***	0.024	0.850***	0.029	0.849***	0.029
Primary	0.740***	0.041	0.711***	0.049	0.712***	0.050
Secondary	0.719***	0.041	0.688***	0.049	0.689***	0.050
Post-secondary	0.864*	0.065	0.833**	0.077	0.830**	0.078
Total Adults	0.828***	0.006	0.810***	0.006	0.810***	0.006
Hectares 1 < & ≤ 2	0.402***	0.008	0.327***	0.010	0.322***	0.009
Hectares 2 < & ≤ 5	0.423***	0.015	0.352***	0.015	0.346***	0.015
Hectares > 5	0.473***	0.046	0.407***	0.047	0.401***	0.046
Nontobacco Crops	0.740***	0.008	0.719***	0.009	0.720***	0.009
Livestock	1.047***	0.013	1.056***	0.016	1.057***	0.016
Club Members	0.977***	0.007	0.985*	0.009	0.986	0.009
Yield per hectare	0.816***	0.036	0.849***	0.044	0.866***	0.046
Yield Expectation	1.014	0.026	1.005	0.029	1.007	0.029
Quality	0.863***	0.019	0.853***	0.021	0.855***	0.021
Profit per hectare	0.829***	0.021	0.794***	0.024	0.789***	0.024
Sales Expectation	0.989	0.024	0.971	0.026	0.971	0.026
Finance Type	0.715***	0.020	0.643***	0.022	0.633***	0.022
Repayment full	0.425***	0.066	0.410***	0.082	0.422***	0.087
Repayment partial	0.486***	0.078	0.469***	0.096	0.481***	0.102
Mchinji	1.087**	0.036	1.130***	0.046	1.143***	0.047
Dowa	0.890***	0.026	0.869***	0.031	0.871***	0.032
Kasungu	1.070**	0.036	1.001	0.041	0.998	0.041
Mzimba	1.072***	0.028	1.091***	0.035	1.102***	0.035
Rumphi	1.533***	0.055	1.666***	0.075	1.659***	0.075

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