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# Preferences for tree fruit market attributes among smallholder farmers in Eastern Rwanda

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## Abstract

The increasing demand for high-value agricultural products such as fresh fruit presents opportunities for farmers in developing countries due to their higher market value compared with traditional staple crops. This study uses data on trust, risk, and time preferences obtained through behavioral experiments, combined with a discrete choice experiment to understand their effect on farmers' choices of marketing attributes, collecting data from 252 farmers from Eastern Rwanda. The results reveal that farmers, overall, have positive attitudes toward collective marketing channels with guaranteed immediate payments, written contracts, provision of inputs, credit, and training, a personal relationship with a buyer, and low investment costs. Additionally, farmers with lower levels of risk aversion were found to have a greater preference for immediate payment than farmers with higher levels of risk aversion. Farmers with higher future orientation are more likely to choose contracts that guarantee inputs and/or services and written contracts, and they attach lower relative importance to immediate payments than farmers with lower future orientation. Farmers with higher trust levels attach lower relative importance to immediate payments, written contracts, and a personal relationship with a buyer than farmers with lower trust levels.

## KEYWORDS

choice experiment, field experiments, marketing preferences, Rwanda, trust risk and time preferences

## JEL CLASSIFICATION

C93, D9, Q13

## 1 | INTRODUCTION

The demand for fresh fruit in sub-Saharan Africa is estimated to grow substantially due to economic and human population growth, rapidly accelerating urbanization rates, and shifts in dietary patterns toward healthier and more sustainable diets (James & Zikankuba, 2017; OECD/FAO, 2016; Ola & Menapace, 2020b; Omotayo

& Aremu, 2020). Fruit production offers considerable marketing and income opportunities, particularly for small-scale producers of fruit trees in developing countries (Dagar et al., 2020; Jamnadass et al., 2011; Kehlenbeck et al., 2013; Van Damme, 2018). Besides contributing to household income, the integration of fruit trees in agricultural lands is important for mitigating risks of land degradation and climate change (Elagib & Al-Saidi, 2020;

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Leakey, 2018). Thus, fruit trees are often part of large-scale agroforestry programs (Dave et al., 2019). Most agroforestry programs and projects focus primarily on planting trees rather than marketing the fruit itself, posing considerable risk for farmers as well as program sustainability (Russell & Franzel, 2004). To ensure that agroforestry programs deliver on the livelihood and environmental outcomes for which they are designed, it is essential that development professionals understand the marketing motivations and preferences of these smallholder farmers and include these in program design (Ola & Menapace, 2020a; Poku et al., 2018). This is of particular relevance, as some evidence suggests high dropout rates in contract farming schemes in developing countries (Barrett et al., 2012; Romero Granja & Wollni, 2018). As noted by Poku et al. (2018), poorly designed contracts can expose smallholder farmers to additional risks and exploitation of larger agricultural actors. By better addressing farmers' differing barriers, needs, and preferences when planning interventions, fruit production, and especially fruit marketing, can become more attractive to a greater number of farmers.

An emerging body of literature analyzes farmers' preferences for contract design, market characteristics, and characteristics of transaction partners. One strand of literature explores smallholder preferences for different contract attributes, generally concluding that smallholder farmers prefer contracts that include a guaranteed market for their products without subjective product rejections and buyers supplying agricultural inputs (Abebe et al., 2013; Blandon et al., 2009; Ochieng et al., 2017; Ruml & Qaim, 2020). However, there is some degree of heterogeneity regarding specific contract characteristics that has mostly been explained by various demographic and socioeconomic factors. A second strand of literature argues that trust and familiarity with buyers have an important influence on farmers' market preferences, which they assume is related to issues of trust and more in line with traditional markets (Gelaw et al., 2016; Schipmann & Qaim, 2011a).

Empirical evidence focusing on the role of behavioral characteristics in explaining differences in marketing choices and contract preferences remains thin, despite several studies demonstrating that risk preferences influence farmers' marketing channel choices (Kamoyo & Makochekanwa, 2018; Zheng et al., 2008). Clot and Stanton (2014) observed that present-biased farmers are more likely to participate in contracts than those with time-consistent or future-biased preferences. However, with the exception of a few studies (Fischer & Wollni, 2018; Vassalos et al., 2016), available research on contract and market choices examine behavioral preferences on the effects of risk aversion and trust on market preferences and choices without explicitly accounting for subjective attitudes (Gelaw et al., 2016; Ochieng et al., 2017; Schipmann & Qaim, 2011b;

Vassalos et al., 2016). Information regarding farmers' acceptance and perceived trade-offs between various marketing attributes in interaction with trust, risk, and time preferences is vital for designing better market participation options.

This study advances this evidence base by investigating how farmers' individual trust, risk, and time preferences affect the choice of fruit marketing attributes. More specifically, data on trust, risk, and time preferences is elicited through behavioral experiments, combined with a discrete choice experiment (DCE) to understand the effect on farmers' choice on six marketing attributes: sales mode, timing of payment, input/service provision, form of contract, relation to the buyer, and investment costs. We also estimate the willingness to pay (WTP) for each marketing attribute. Assessing WTP can help to better understand economic relevance and farmers' incentive structures and to quantify preference levels. Data used in this study is collected from 252 smallholder farmers in Eastern Rwanda.

Rwanda is a particularly interesting case for examining farmers' preferences for market attributes that could promote sustained market participation. As one of the early adopters of landscape restoration, with the ambitious goal to restore 2 million hectares (ha) of land with trees, Rwanda is also strongly dependent on agriculture. Incentivizing farmers to integrate trees on their land, strengthening value chains, and developing markets for tree fruit are key to realizing this vision (Dave et al., 2019). With almost 75% of Rwanda's land under agricultural production, the sector accounts for 39% of GDP and nearly three quarters of employment, and is considered a key growth engine for economic development and poverty reduction (IFC, 2019).

The remainder of this article is organized into five sections. Section 2 introduces the conceptual framework of the study. Section 3 describes the study area and data collection process. Section 4 explains the design and application of the behavioral economic experiments, the DCE, mitigation measures against hypothetical bias (HB) in the DCE design, and the estimation approach. Section 5 outlines the results and discussion, and the conclusion is presented in Section 6.

## 2 | CONCEPTUAL FRAMEWORK

This section describes a framework for assessing how key attributes of fruit marketing affect the participation of smallholder farmers and how they relate to behavioral preferences. Table 1 presents an overview of our expectations regarding the relationships between different marketing profile attributes and trust, risk, and time preferences. Table A1 in the Supporting Information summarizes the underlying mechanisms by which the marketing

**TABLE 1** Expected relationships between behavioral preferences and preferences for marketing profile attributes

Attribute levels	Expected sign of preference coefficient	Risk preference ( $r_i$ )	Time orientation ( $\delta_i$ )	Trust ( $\theta_i$ )
Individual marketing	+			
Immediate payment	+	-	-	-
Inputs (seedlings, fertilizer) and access to credit and training	+	-	-	
Written contract	+		+	-
Buyer personally known	+			-
Investment costs	-			

profile attributes are expected to be related to different market outlets.<sup>1</sup>

**Sales mode:** This attribute refers to the way fruit products are marketed, which can either be individually or collectively through cooperatives. While collective marketing through cooperatives can help farmers commercialize their products, the literature suggests various reasons that may discourage farmers from collectively marketing products, including uncertainty about the performance of cooperatives (Blandon et al., 2009), free-riding behavior of other members (Blandon et al., 2009), and insufficient lucrative returns of cooperatives (Fischer & Qaim, 2014). Therefore, it is expected that farmers prefer selling individually rather than collectively.

**Timing payment:** This refers to the period between product delivery and payment. Immediate payment upon product delivery is the typical payment mode in traditional markets. With delayed payment, farmers receive payment at a specific time in the future following product delivery (Ola & Menapace, 2020b). As farmers usually have very low savings, the day-to-day consumption requirements of their families cause them to sell their products to buyers that pay immediately, even if that means inadequate prices. Delayed payment creates uncertainty on the part of farmers, particularly when the buyer is unknown (Blandon et al., 2009; Fischer & Qaim, 2014; Ochieng et al., 2017). Therefore, it is expected that farmers have a higher preference for immediate payment as opposed to delayed payment. Recent research suggests that risk and time preferences are related, and individuals who are, or can afford to be, more risk tolerant also display more patience (Clot et al., 2017). This allows drawing the reverse conclusion that impatient, risk-averse individuals may prefer immediate payment over delayed payment. Thus, we assume

that farmers with higher levels of trust attach less relative importance to immediate payment.

**Input/service provision:** This attribute refers to services provided by the buyer (i.e., tree seedlings, fertilizer, access to credit, and training), and we expect that farmers have positive preferences. Farmers are often constrained by low access to quality input, credit, and training, resulting in impediments to market participation (IFC, 2019; Mbitse-munda & Karangwa, 2017). Lack of credit access can lead to farmers' inability to invest in production inputs, such as fertilizer, seeds, and the agricultural technologies necessary to increase productivity and competitiveness. Thus, farmers are expected to consider the provision of inputs and/or services as an important mechanism for reducing production uncertainty. Accordingly, more risk-averse farmers are expected to attach higher importance to contracts that include these services.

**Form of contract:** Marketing contracts typically refer to oral or written agreements between a buyer and a seller that specify fixed prices, possible price adjustments, quality requirements, and a delivery schedule (Katchova & Miranda, 2004; Vassalos et al., 2016). In terms of the form of contract attribute, we expect farmers to have preferences for a written contract. While written contracts impose penalties for non-compliance in a formal and agreed way, oral contracts rest on reputation and repeated interactions. One of the most important reasons for contracts are secured markets and assurance of long-term future relationships with a buyer (Cook et al., 2001; Vassalos et al., 2016). High future orientation is expected to be positively related to the preference for written contracts. Oral contracts, in contrast, create uncertainty for the farmer and open the risk of opportunistic behavior on the part of the seller due to disaggregation of agreement, product delivery, and payment. Thus, farmers with higher levels of trust are expected to attach less relative importance to written contracts.

**Relation to the buyer:** This attribute refers to the strength of the relationship between the buyer and the producer and is specified as personally known; known by friends, relatives, or a cooperative; or not personally known.

<sup>1</sup> We summarized three different market outlets and briefly described the characteristics of these outlets. In the study area, small-scale fruit producers face different choices of market outlets such as buyers at local markets, intermediary traders/middlemen at the farm-gate, and cooperatives. Direct sales to exporters, processors, and supermarkets – often considered as the more modern market outlets – are still of minor importance for producers and are therefore not considered here.

Selling products to an unknown buyer is typical for spot marketing, wherein the relationship is more flexible and based on random, short-term encounters. A stronger relationship is assumed to increase the probability of regular transactions, and farmers are expected to prefer a relationship in which the buyer is personally known or known by friends, relatives, or a cooperative rather than an unknown buyer. Previous studies highlighted the importance of long-standing or personal relationships for smallholder producers (Mujawamariya et al., 2013; Schipmann & Qaim, 2011a), explained by a higher degree of trustworthiness (Gelaw et al., 2016). Farmers with lower levels of trust are expected to attach more importance to a personal relationship with a buyer.

*Investment costs:* Smallholder farmers often face multiple barriers to market participation, such as high investment or entry costs. Entry costs are associated with the capacity to invest in specific assets (e.g., high quality seedlings, irrigation equipment, and storage facilities). Investment costs also include transaction costs, such as the time and effort to learn about a new crop or a new farming technique or to interact with a new value chain (Jagwe et al., 2010). Aggregating smallholder farmers into cooperatives is a common approach for distributing and lowering transaction costs for individual farmers, while also linking them to markets (Gramzow et al., 2018). Cooperative membership fees are often required, particularly at start-up, and are considered investment costs (Blandon et al., 2009; Verhofstadt & Maertens, 2014). Concerning the investment costs attribute, farmers are expected to prefer low barriers to entry, including little or no up-front investment.

### 3 | DATA AND BACKGROUND

#### 3.1 | Study area

This study was conducted in the Bugesera district located in the Eastern Province of Rwanda, part of the Kagera River Basin, a social-ecological hotspot in Eastern Africa (Khan et al., 2019). Increasing population pressure, highly variable rainfall, prolonged droughts, and loss of water catchment areas due to deforestation has caused rain-fed agriculture to become an extremely risky occupation (Khan et al., 2019; UNEP, 2011). The majority of farms are small, with less than 1 ha of land, and grow a variety of food crops (Iiyama et al., 2018; NISR, 2019). Bugesera is one of the main fruit producing regions in the country, cultivating avocados, mangoes, apples, papayas, oranges, lemons, guava, and mulberries (NISR, 2019); however, productivity and quality remain low, and most of the fruit is used for domestic consumption (Clay & Turatsinze, 2014; NISR, 2012). Fruit producers predominantly sell their products to

middlemen, who then sell them at markets in and around the Bugesera district. Due to increasing population growth, the demand for fruit is projected to increase from 520,000 tons in 2016 and 2017 to 620,000 tons in 2023 and 2024 (GoR, 2018), implying excellent potential for intensification and marketing (Dijkxhoorn et al., 2016). However, a lack of planting material availability, either in the form of grafting material or germplasm, in addition to high input prices and inadequate access to fertilizer and pesticides, constitute major constraints to fruit production. Moreover, fruit tree cultivation is aggravated by a lack of extension services and storage facilities (IFC, 2019).

#### 3.2 | Data collection

The data used in this study were obtained from five different data collection segments conducted among smallholder farmers in Bugesera district in March 2020, including a household survey, an experiment on risk preferences, an experiment on time preferences, a trust game, and a DCE (see Section 4). The survey gathered information on farmers' socioeconomic characteristics, farm characteristics, and fruit marketing strategies.

A multi-stage sampling approach was used to form our survey sample. During the first stage, we purposely selected three sectors:<sup>2</sup> Juru, Nyamata, and Rweru across Bugesera district. Farmers in these three sectors commonly grow fruit trees and they are among the major fruit producing regions in the district for domestic and traditional markets (NISR, 2019). During the second stage, we randomly selected cells: Mugarore, Murama, Nemba, and Rwinume, then randomly selected 12 villages and 20 households within each village referencing updated, village-level household lists. The households were contacted and mobilized by local extension officers and village chairpersons. A total of 252 households were interviewed.

All selected households were visited at home to conduct a 2-h, face-to-face interview and experiments. A team of 10 local enumerators were carefully selected, trained, and supervised by the researchers and conducted all the interviews and experiments. To ensure that respondents were able to comprehend the survey questions and experimental choices presented to them, all tools were translated into the official language, *Kinyarwanda*. All respondents provided consent to participate in the study. Data were collected electronically using tablets based on the Open Data Kit platform and uploaded to an online server by the enumerators on a daily basis.

<sup>2</sup> The administrative structure of Rwanda is organized into provinces, districts, sectors, cells, and villages.



TABLE 2 Design of risk preference experiment

Lottery (50/50)	Low payoff	High payoff	Expected value	Standard deviation	Implied CRRA <sup>†</sup> range	Risk category <sup>‡</sup>
1	2800	2800	2800	0	$3.46 < r$	RA
2	2400	3600	3000	600	$1.16 < r < 3.46$	RA
3	2000	4400	3200	1200	$.71 < r < 1.16$	RA
4	1600	5200	3400	1800	$.50 < r < .71$	RA
5	1200	6000	3600	2400	$0 < r < .50$	RN
6	200	7000	3600	3400	$r < 0$	RS

Notes: Payoffs are displayed in Rwandan Franc (RWF). Exchange rate: 1 USD = 920 RWF (March 2020).

<sup>†</sup>Co-efficient of relative risk aversion.

<sup>‡</sup>Risk category RA = risk-averse, RN = risk-neutral, and RS = risk-seeking.

## 4 | METHODS

### 4.1 | Behavioral economic experiments

A series of incentivized experiments were used to elicit behavioral characteristics related to trust, risk, and time preferences. The order of the experiments was held constant.<sup>3</sup> At the end of the survey, one of the three experiments was randomly selected to be paid out to the participant. Average payoffs per person were 2460 RWF (US\$ 2.60).

The experimental game eliciting risk preferences was designed following Eckel and Grossman (2002, 2008) and Dave et al. (2010). The game was designed in a simple manner and elicited risk preferences that allow enough heterogeneity in choices for the estimation of utility parameters. Participants were presented with an array of six lotteries and asked to choose one. Each of the lotteries (listed in Table 2) involved a 50% chance of receiving a low payoff and a 50% chance of a high payoff; one of the lotteries was a sure alternative. Participants' choice was based on a picture card illustrating the different lotteries (see Figure A1 in the Supporting Information). Based on their choices, participants were classified into different risk groups: Lotteries 1–4 were classified as risk-averse, and Lottery 5 and Lottery 6 were classified as risk-neutral and risk-seeking, respectively (Dave et al., 2010). For the econometric analysis, a continuous variable  $r_i$  was generated, taking values from 1 to 6. A low value indicates strong risk aversion, whereas a high value represents risk-seeking behavior.

Time preferences were elicited with a simple money allocation task following Angerer et al. (2015). In this experiment, participants were endowed with 1000 RWF (US\$ 1.10) and asked to allocate any round amount of money in 100 RWF (US\$ .10) denominations between

2 days in the future—tomorrow and in 4 weeks. The money allocated to in 4 weeks was doubled and to be paid out 4 weeks after the experiment; money allocated to tomorrow was paid out the following day (see Figure A2 in the Supporting Information).<sup>4</sup> An option for an immediate payout was not included, to correct for present bias.<sup>5</sup> The amount of money, that is, allocated to the later date is a simple measure of farmers' future orientation and a reflection of their patience. A variable  $\delta_i$  was generated, taking values from 0 (i.e., 0 RWF) to 10 (i.e., 1000 RWF), reflecting the amount of money that was allocated to the future.

We also conducted a two-person binary trust game (Berg et al., 1995; Clot & Stanton, 2014; Fischer & Wollni, 2018). According to this game, random pairs of participants were formed and assigned the role of sender and receiver. In our case, the sender received 1000 RWF (US\$ 1.10) and chose whether to send any round amount between 0 RWF and 1000 RWF (US\$ 1.10) to the receiver or to keep the money. The money sent was then tripled by the team members assigned to conduct the experiment with the supervision of the PI. Accordingly, the receivers were asked to decide whether, in the event that the sender sent some money, they would keep the money or split it evenly between themselves and the sender. This procedure is graphically illustrated in Figure A3 in the Supporting Information. Based on the participants' choices, a dummy variable  $\theta_i$

<sup>4</sup>To strengthen the trust in receiving the money in the future (Harrison et al., 2005), participants received a credit voucher indicating the amount of money they would receive and the date of payment. The credit voucher was issued by team members assigned to conduct the experiment with the supervision of the Principal Investigator (PI). For both choices, the money was sent to the participant's number via a mobile money transfer by a finance officer of our institution exactly on the date of payment, as indicated on a credit voucher. These considerations are important in a field context, particularly in less developed countries.

<sup>5</sup>Most decision makers have a high present bias, meaning that they have a high preference for an immediate payout in comparison to a delayed payout, resulting in extremely high discount rates due to quasi-hyperbolic discounting (Frederick et al., 2002).

<sup>3</sup>See Supporting Information for more information on the experimental design.

**TABLE 3** Overview of attributes and levels used in the discrete choice experiment

Attributes	Definition	Attribute levels
Sales mode	Refers to the mode of selling and payment system	1. Individual marketing (payment for the quantity produced) 2. Collective marketing (payment as share of total revenue)
Timing of payment	Farmers can be paid cash on delivery or payment can be delayed	1. Immediate payment (at delivery) 2. Delayed payment (4 weeks after purchase)
Input/service provision	Refers to input and/or service provision to alleviate the operating capital constraints often faced by farmers	1. Inputs (seedlings, fertilizer) 2. Inputs (seedlings, fertilizer), and access to credit 3. Inputs (seedlings, fertilizer) and access to credit and training 4. None
Form of contract	Refers to the contract/agreement form	1. No written contract 2. Written contract
Relation to the buyer	Refers to the relationship with the buyer	1. Buyer personally known 2. Buyer known by friends, relatives, or a cooperative 3. Buyer not known at all
Investment costs	Corresponds to membership fees to become a cooperative member or entry costs	1. None 2. 10,000 RWF 3. 20,000 RWF 4. 30,000 RWF

was generated to reflect trust and coded 1 for “money sent” and 0 for “money not sent.”

## 4.2 | Discrete choice experiment

A DCE was used to elicit farmers’ preferences for different features of fruit marketing profiles. For more detailed information on DCE, readers are referred to Hensher et al. (2015). The levels used to describe each attribute of the DCE were determined following thorough discussion and consultation with scientists, community leaders, and agricultural extension officers. Additionally, four focus group discussions were conducted in different villages to further examine how farmers would understand the levels of the marketing profiles considered in our DCE. Based on their feedback, six attributes that were deemed important in fruit marketing, with two to four levels, were selected (Table 3).

The six attributes and differing levels imply a full factorial design with 384 ( $4^2 \times 3^1 \times 2^3$ ) combinations. Theoretically, each unique combination of attribute levels represents a specific marketing profile. To produce a more manageable experiment, a D-optimal design<sup>6</sup> was used to generate a subset of marketing profiles to cover the range

of variability between all possible combinations. In total, 32 choice sets were included in our design. The choice sets were subdivided into four subsets containing eight choice sets each. To reduce the response burden and to avoid fatigue, participants were randomly assigned one of these four subsets, with an even number of households allocated to each of the subsets. A choice set consisted of two alternative marketing profiles (A and B) and a status-quo (“none of the market profiles”) option.

## 4.3 | Mitigation measures against hypothetical bias in the DCE design

Hypothetical bias is one of the ubiquitous issues in relation to the use of DCE that elicit WTP measures. This is due to the hypothetical nature and inherent lack of realism of the choice questions asked that may lead to respondents overstating their WTP since their responses have no real consequences in terms of commitment for the payment of the service in question (Bello & Abdulai, 2016; De-Magistris et al., 2013; Fang et al., 2021). There are several approaches that can be employed to mitigate the HB. The available HB mitigation measures can be broadly categorized into ex-ante and ex-post methods. The most common ex-ante methods include cheap talk (Cummings & Taylor, 1999), honesty priming (De-Magistris et al., 2013), real talk, consequentiality scripts, solemn oath scripts, opt-out reminders (Alemu & Olsen, 2018; Ladenburg & Olsen, 2014), and more recently the use of virtual reality (Fang et al., 2021) and 3D videos (Rid et al., 2018). Ex-post methods such as the certainty calibration scales are based

<sup>6</sup>There are several approaches to reducing the number of alternatives, including orthogonal fractional and D-optimal designs. The decision between these approaches represents a trade-off between statistical efficiency (D-optimal design) and non-correlation between attributes (orthogonal design) (Hensher et al., 2015). We consider statistical efficiency to be more important; therefore, we used the D-optimal design, considering the possibility that attributes might be correlated.

on follow-up questions that measure respondent certainty about their choices or stated WTP values on a numerical scale (Loomis et al., 2014). It is important to note that there are several factors that are likely to influence HB and no single mitigation method can be regarded as the “magic bullet” (Fang et al., 2021; Moser et al., 2014; Murphy et al., 2005) and hence the use of a combination of both ex-post and ex-ante as complements, depending on context is usually recommended (Whitehead & Cherry, 2007).

Following Alemu and Olsen (2018), this study incorporated a repeated opt-out reminder (ROOR) as a mitigation strategy against HB that emanates from the hypothetical nature of our DCE marketing profiles.<sup>7</sup> The DCE design included a status-quo or opt-out option (“none of the market profiles”) in anticipation that a participant might not prefer either of the two marketing profiles listed. The status-quo option captures unobserved factors over and beyond the variations of attitude levels of the choice sets included in the DCE. Inclusion of this alternative allows participants to choose another alternative rather than the two market profiles presented in the DCE. The status-quo option also reflects farmers’ preference toward no change to the current situation with respect to all given attributes. The ROOR is placed repeatedly before each choice set as an explicit reminder to participants of the opt-out alternative so as to avoid a forced choice setting, thus assisting them to stay on the “true” preference path (Hensher, 2010; Ladenburg & Olsen, 2014). Evidence from Alemu and Olsen (2018) empirically demonstrated that the ROOR completely eliminated or mitigated the HB in WTP for attributes of novel food products.

#### 4.4 | Estimation approach

To demonstrate the effects of trust, risk, and time preferences on farmers’ marketing choices, data from both the experimental games and the DCE were used. The econometric analysis is based on mixed logit models that are estimated using maximum simulated likelihood (Train, 2009). Our models include an alternative specific constant (ASC) to account for the fact that the choice sets include a status-quo (“none of the market profiles”) option. The ASC is a dummy variable, coded 1 and 0 for the status-quo alternative and marketing profile alternatives, respectively. All attribute variables were effect coded instead of dummy

coded to avoid correlation of the attribute estimates with the ASC (Bech & Gyrd-Hansen, 2005; Holmes & Adamowicz, 2003). The investment costs attribute was specified as continuous in all models. Furthermore, all attribute variables and the ASC were specified as having a random component, except for the investment costs, specified as fixed in all models since we assume that farmers have a homogeneous preference for low costs. All model coefficients were assumed to be normally distributed.

We ran different model specifications.<sup>8</sup> In model (1), we analyze the relative importance of different marketing profile characteristics for farmers’ marketing choice. The base specification includes only the ASC and attribute levels as explanatory variables. In simplified terms, it can be expressed as:

$$Y_{ijk} = \beta_0 ASC + \beta_1 S_{ijk} + \beta_2 P_{ijk} + \beta_3 I_{ijk} + \beta_4 C_{ijk} + \beta_5 R_{ijk} + \beta_6 IC_{ijk} + e_{ijk} \quad (1)$$

where  $Y$  denotes the binary decision made by farmer  $i$  for alternative  $j$  and choice set  $k$ ;  $S$ ,  $P$ ,  $I$ ,  $C$ ,  $R$ , and  $IC$  are the marketing profile attributes sales mode, timing of payment, input/service provision, form of contract, relation to the buyer, and investment costs, respectively, and  $e$  represents a random error term.

Models (2)–(4) include interaction terms between marketing attributes and behavioral preferences to assess the effects hypothesized in the conceptual framework in Section 2. As described previously,  $r_i$  and  $\delta_i$  are continuous variables, and  $\theta_i$  is a dummy variable that measures risk aversion, time preference, and trust, respectively. In model (2), we explore the relationship between risk preference and timing of payment and input/service provision and add the respective interaction terms (*Immediate payment* × *risk*) and (*No input provision* × *risk*). In model (3), we test the relationship between time preference and the timing of payment (*Immediate payment* × *time*), input/service provision (*Input and credit provision* × *time*), and the form of contract (*Written* × *time*), respectively. In model (4), we explore the relationship between trust and the timing of payment, the form of contract, and the relation to the buyer. We add interaction terms (*Immediate payment* × *trust*), (*Written contract* × *trust*), and (*Buyer known personally* × *trust*).

$$Y_{ijk} = \beta_0 ASC + \beta_1 S_{ijk} + \beta_2 P_{ijk} + \beta_3 I_{ijk} + \beta_4 C_{ijk} + \beta_5 R_{ijk} + \beta_6 IC_{ijk} + \gamma_1 (I_{ijk} \times r_i) + e_{ijk} \quad (2)$$

<sup>7</sup> The ROOR was operationalized by informing participants that the drawings used hypothetical marketing profiles rather than real ones (see Figure A4 in the Supporting Information). Figure 5A in the Supporting Information shows the actual choice set presented to participants, with the two marketing profiles choices and an opt-out alternative. Each choice set was repeatedly accompanied by the ROOR instruction.

<sup>8</sup> The models are estimated by maximum simulated likelihood using 500 Halton draws (Hole, 2007).



$$Y_{ijk} = \beta_0 ASC + \beta_1 S_{ijk} + \beta_2 P_{ijk} + \beta_3 I_{ijk} + \beta_4 C_{ijk} + \beta_5 R_{ijk} + \beta_6 IC_{ijk} + \gamma_1 (P_{ijk} \times \delta_i) + e_{ijk} \quad (3)$$

$$Y_{ijk} = \beta_0 ASC + \beta_1 S_{ijk} + \beta_2 P_{ijk} + \beta_3 I_{ijk} + \beta_4 C_{ijk} + \beta_5 R_{ijk} + \beta_6 IC_{ijk} + \gamma_1 (P_{ijk} \times \theta_i) + \gamma_2 (C_{ijk} \times \theta_i) + \gamma_3 (R_{ijk} \times \theta_i) + e_{ijk} \quad (4)$$

The coefficient estimates of model (1) are used to calculate farmers' WTP for the different marketing profile attributes as follows:

$$WTP_{attribute} = \frac{\beta_{attribute}}{-\beta_{costs}} \quad (5)$$

where  $\beta$  represents the coefficient of the cost attribute and of the attribute for which the WTP is calculated.

## 5 | RESULTS AND DISCUSSION

### 5.1 | Summary statistics of the sample

About 35% of our respondents were female, the mean age was 48 years, and the number of years spent in school was four for men and three women. From the sample, 58% of the respondents accommodate five or more family members in their household. A respondent's household has a 40% likelihood of living at or below the poverty line of US\$ 1.90 per day. Although most households own only a small area of land, at an average of .6 ha and a standard deviation of .7 ha, the majority rely on agricultural activities, either solely on crop farming or in combination with livestock farming. Income from non-agricultural business was excluded. While 89% of farmers sampled growing fruit trees on their farms, only 32% reported selling their fruit.<sup>9</sup> About half of the farmers who do not market their fruit indicated using the fruit they produce for personal consumption. On average, farmers had 17 fruit trees on their farms. There was a high variation in types of fruit trees across the sample; however, the diversity at an individual farm level was low, averaging only two fruit tree species managed. Most of the fruit was sold at the farm gate (58%) and the local market (42%), whereas selling directly to supermarkets, institutions, or middlemen was not common. Farmers sell their produce individually, and none of the farmers indicated being involved in collective marketing. Contracts between sellers and buyers are uncommon. Of five sellers with a buyers' con-

tract, only one seller had a written contract, whereas four had oral contracts. Farmers decide to sell fruit on the basis of various conditions, including timely payment (54%), good price offers (49%), and personally knowing the buyer (20%).

About 34% of our sample farmers are members of a cooperative. On average, farmers were members for about 8 years and paid 18,000 RWF (US\$ 19.00) in cooperative membership fees. Cooperatives support members by providing saving schemes, access to credit, and farm inputs, including planting material and mineral fertilizer. About half of the respondents indicated receiving extension service/technical advice on production techniques, pest management, and post-harvest product handling. Reasons cited for not choosing cooperative membership include high associated membership entry costs and lacking knowledge of the cooperatives' existence. About 17% of non-members were not interested in becoming members, assuming that cooperatives do not confer benefits to farmers. The results further suggest that cooperatives are considered somewhat exclusive, since remoteness and lack of capacity to fulfill membership criteria further prevent farmers' joining. See Tables A2, A3, and A4 in the Supporting Information for more detailed summary characteristics and an overview of farmers' fruit production and cooperative membership.

### 5.2 | Trust, risk, and time preferences

Table 4 presents the results of the behavioral economic experiments on trust, risk, and time preferences (see Figure A6 in the Supporting Information for a graphical representation). Results of the risk preference experiment reveal that about 69% of the sampled farmers were risk-averse, confirming the results obtained by other studies conducted in developing countries (Charness & Viceisza, 2016; Fischer & Wolni, 2018; Liebenheim & Waibel, 2014; Senapati, 2020; Ward & Singh, 2015). About 27% of the sampled farmers can be considered risk-seeking, and about 3% were found to be risk-neutral. In the time preference experiment, participants allocated about twice as much money to the later date than to the sooner date. This indicates that the sampled farmers are relatively patient. Based on the findings of several studies, we expected that people living in poor environments would prefer smaller immediate rewards over larger deferred rewards and are generally impatient (Anderson et al., 2004; Liebenheim & Waibel, 2014; Tanaka et al., 2010). Results of the trust game indicate that most participants, irrespective of assigned role as either sender or receiver, sent money to a stranger. The average amount sent by farmers is about 436 RWF (US\$ .50), representing 44% of the initial endowment. Our

<sup>9</sup> Farmers who produced and sold fruit in the last 12 months.

**TABLE 4** Results of risk, time, and trust experiments (n = 252)

	Mean	Standard deviation
Risk preference		
Risk-averse (%)	69.44	
Risk-neutral (%)	3.17	
Risk-seeking (%)	27.38	
Time preference		
Amount of money allocated to “tomorrow” (RWF)	315.48	392.48
Amount of money allocated to “in four weeks” (RWF)	648.52	392.91
Trust		
Sender <sup>†</sup>		
Sent money to stranger (%)	80.47	
Amount of money sent to stranger (RWF)	435.94	307.58
Receiver <sup>‡</sup>		
Sent money back to sender (%)	81.45	

Notes: Exchange rate: 1 USD = 920 RWF (March 2020).

<sup>†</sup>n<sub>Sender</sub> = 128.

<sup>‡</sup>n<sub>Receiver</sub> = 124.

result is similar to those found in other studies (Berg et al., 1995; Nguyen et al., 2016).

### 5.3 | General preferences for marketing attributes

The results of the mixed model are summarized in Table 5. Positive coefficients in the model indicate a positive preference (utility), and negative coefficients indicate a negative preference (disutility) for a specific attribute level compared with the reference category. Non-significant attribute levels indicate respondents' indifference to the choices given. In the following, we discuss the results of the entire sample (Table 5, column 1) first before analyzing how farmers' attitude toward risk, time, and trust influence their choices (Table 5, columns 2–4). The ASC has a negative and significant coefficient, indicating that farmers strongly prefer the marketing profile alternatives over maintaining the status quo. This result is remarkable, given that most of the sampled farmers did not sell fruit, suggesting a huge demand for marketing strategies.

Farmers did prefer immediate to delayed payments. This was expected and in line with previous studies (Blandon et al., 2009; Gelaw et al., 2016; Ochieng, 2020; Schipmann & Qaim, 2011b). In Malawi, Ochieng (2020) reported a positive attitude toward contracts offering immediate payments and farm inputs to cushion against farm-level risks. As the majority of smallholders are resource-constrained, liquidity is often limited, and they prefer immediate payments, despite delayed payments offering higher payouts (Fischer & Qaim, 2014). In Ghana, Poku et al. (2018) found

that out-grower schemes were more successful when paying instant cash and providing input.

We also observe a positive preference for input provision, particularly when combined with additional credit and training. Low input use is considered a major factor hampering agricultural productivity in Rwanda, further aggravated by insufficient extension service provision (Nahayo et al., 2017). For example, only 55% of farmers apply organic fertilizer, and approximately one-fourth use inorganic fertilizer. The use of improved seeds and pesticides is even smaller, with 17% and 16%, respectively (NISR, 2019). Use of inorganic fertilizer, pesticides, irrigation practices, and improved seedlings is more common for large-scale farmers, who have better access and more financial opportunities to cover the costs of inputs than smallholder farmers (NISR, 2019). Supporting smallholder farmers through access to quality inputs, credit, training, and extension services can improve both quality and productivity, preconditions for farmers' participation in the market. As expected, the coefficient for no input provision is negative and significant.

Consistent with the literature, our results show that farmers generally prefer written contracts to oral or no contracts. Ola and Menapace (2020b) identified a higher preference of farmers for formal relationships than informal or spot relationships, indicating a willingness to enter written contracts. They concluded that farmers prefer written to oral contracts as these explicitly specify expectations of both transaction partners and provide output market security. Since farmers bear the most risks, such as non-payment if products do not meet the agreed standard or crop failure, farmers prefer written contracts that

TABLE 5 Mixed logit model estimates

Variables	(1) Basic	(2) Risk	(3) Time	(4) Trust
<i>Mean parameters</i>				
ASC <sup>†</sup>	-12.16* (2.48)	-12.21* (2.47)	-11.72* (2.52)	-12.30* (2.52)
Investment costs	-.00* (.00)	-.00* (.00)	-.00* (.00)	-.00* (.00)
Individual marketing <sup>‡</sup>	-.12* (.04)	-.12* (.04)	-.12* (.04)	-.12* (.04)
Immediate payment <sup>§</sup>	.36* (.04)	.24* (.08)	.53* (.09)	.42* (.10)
No input provision <sup>#</sup>	-.92* (.09)	-1.05* (.15)	-.89* (.09)	-.92* (.09)
Input and credit provision <sup>#</sup>	.29* (.07)	.29* (.07)	.10 (.12)	.29* (.07)
Input and training provision <sup>#</sup>	.71* (.08)	.71* (.08)	.70* (.08)	.71* (.08)
Written contract <sup>§</sup>	.30* (.04)	.30* (.04)	.16* (.07)	.40* (.09)
Buyer known personally <sup>&amp;</sup>	.16* (.06)	.16* (.06)	.15* (.06)	.27* (.12)
Buyer not known at all <sup>&amp;</sup>	-.21* (.06)	-.21* (.06)	-.21* (.05)	-.21* (.06)
<i>Interactions</i>				
Immediate payment × risk		.04* (.02)		
No input provision × risk		.04 (.03)		
Immediate payment × time			-.03* (.01)	
Input and credit provision × time			.03* (.01)	
Written contract × time			.02* (.01)	
Immediate payment × trust				-.07* (.10)
Written contract × trust				-.11* (.10)
Buyer known personally × trust				-.14* (.13)
Input and training provision × marketing				
Buyer known personally × marketing				
<i>SD parameters</i>				
ASC	5.22* (1.06)	5.26* (1.08)	4.96* (1.06)	5.30* (1.09)
Individual marketing	.47* (.06)	.47* (.06)	.46* (.06)	.47* (.06)
Immediate payment	.41* (.06)	.40* (.06)	.38* (.06)	.41* (.06)
No input provision	.47* (.11)	.46* (.11)	.44* (.12)	.48* (.11)
Input and credit provision	.02 (.31)	.01 (.30)	.06 (.37)	.02 (.29)
Input and training provision	.42* (.12)	.42* (.12)	-.42* (.12)	.42* (.12)
Written contract	.23* (.07)	.24* (.07)	.22* (.08)	.23* (.07)
Buyer known personally	-.21* (.12)	-.21* (.12)	-.20 (.13)	-.20* (.12)
Buyer not known at all	.24* (.11)	.24* (.12)	.19 (.13)	.24* (.11)
Log likelihood	-1189.87	-1187.42	-1182.86	-1188.48
Chi squared	187.68*	187.14*	183.66*	188.72*
Observations	6048	6048	6048	6048

Notes: Standard errors in parentheses. The number of observations is  $n = 8 * 3 * 252 = 6,048$ .

<sup>†</sup> Alternative specific constant.

<sup>‡</sup> Reference category is collective marketing.

<sup>§</sup> Reference category is delayed marketing.

<sup>#</sup> Reference category is input provision (seedlings, fertilizer).

<sup>§</sup> Reference category is no written contract.

<sup>&</sup> Reference category is buyer known by friends, relatives, or a cooperative.

\* $p < .1$ ; \*\* $p < .05$ ; \*\*\* $p < .01$ .

can potentially mitigate such risks (Barrett, 2008). Furthermore, in case of violation or non-compliance, written contracts allow farmers to hold their contract partners accountable and seek legal compensation (Mugwagwa et al., 2020). Our results illustrate that farmers' preferences

for written contracts contrasts with the actual situation, as written contracts are rare. This illuminates the need to consider farmers' preferences for contract design and policy interventions to successfully integrate smallholders into markets.

As expected, the coefficient for a buyer who is not known is negative and significant, revealing that farmers prefer to personally know the buyer. Since markets are often characterized by limited information, farmers may rely on personal judgment and experience to assess buyers' trustworthiness in terms of market information, measuring the quality and quantity, keeping promises, and complying with contracts as noted by Gelaw et al. (2016).

In contrast to our expectations and the literature (Blandon et al., 2009; Fischer & Qaim, 2014), farmers prefer collective marketing to individual marketing. Again, this finding starkly contradicts farmers' current mode of sales, taking place exclusively on individual bases. This suggests that farmers are unsatisfied with the current sales mode and have high expectations of collective marketing. Another possible explanation is that farmers may be aware of the benefits of collective marketing, while not being able or willing to access such opportunities. The negative coefficient of the attribute investment costs further suggests that farmers want to minimize their transaction costs. Several studies have shown that collective marketing through farmer groups can reduce transaction costs, improve marketing coordination, access to market information, and bargaining power, as well as increasing producer prices (Chiputwa et al., 2015; Hagos et al., 2019; Mutonyi, 2019; Verhofstadt & Maertens, 2014). Such collective marketing can be an important strategy for smallholder farmers to be competitive in rapidly changing markets (Fischer & Qaim, 2012) and to increase farm income (Verhofstadt & Maertens, 2014). At the same time, Lutz and Tadesse (2017) found that free riding is a major challenge for agricultural cooperatives with relatively open membership because cooperatives require significant investment and commitment from members to develop a competitive position in the market. It is also important to stress that during the interviews, farmers mentioned that high membership fees were one of the entry barriers for joining existing cooperatives (i.e., high investment costs). In line with previous studies (Tefera & Bijman, 2019; Wossen et al., 2017), our results stress the importance of governmental interventions to aggregate farmers to ensure that resource-poor communities can be connected with existing markets.

The attribute investment costs captures fees to become a cooperative member, market entry costs, and strategic resources, certification, and management costs (van Rijbergen et al., 2016). The negative and significant coefficient of this attribute indicates that farmers prefer selling to markets that do not require significant up-front costs. It is well established that smallholder farmers are resource-constrained with limited access to capital markets (Collier & Dercon, 2014; Lutz & Tadesse, 2017). This is supported by our descriptive results demonstrating high membership

entry fees as a core barrier to cooperative membership. In line with Tefera and Bijman (2019), who found significant socioeconomic differences among Ethiopian farmers who are members and non-members of farmer cooperatives, the sampled farmers' resource constraints might indeed have impeded their cooperative membership.

#### **5.4 | Differences in preferences for marketing attributes in relation to behavioral preferences**

Behavioral preferences were found to correlate with preference heterogeneity for several attributes (Table 5, columns 2–4). The model predicts that farmers with lower levels of risk aversion have a greater preference for immediate payments than farmers with higher levels of risk aversion (Table 5, column 2). This is somewhat surprising, especially as the focus group discussions suggested that delayed payment was perceived as a significant source of risk for small-scale producers. Our results further indicate that risk attitude does not influence farmers' preferences for provision of inputs and/or services. This result could indicate that the provision of inputs and/or services was not perceived as an essential aspect of mitigating risks at the farm level by the farmers in our sample.

Farmers with higher future orientation attached lower relative importance to immediate payments than farmers with lower future orientation (Table 5, column 3). This result corresponds to the research on pineapple farmers in Ghana (Fischer & Wollni, 2018), whereby higher future orientation resulted in willingness to wait a longer period for payment after purchase. Time orientation also had a strong effect on input and credit provision and written contract attributes; farmers with a higher future orientation were more likely to choose contracts with input provision, especially when combined with additional credit provision and written contracts compared with farmers with lower future orientation. This suggests that farmers with a long-term vision of the fruit business are well aware of the importance of farm inputs, credits, and written contracts. Clot et al. (2017) suggested that impatient farmers favor investing in fast-growing crops that generate immediate benefits compared with enrolling in long-term strategies, such as tree planting.

Trust (Table 5, column 4) influenced more attributes than risk and time preferences; farmers with higher trust levels attached lower relative importance to immediate payments, written contracts, and a personal relationship with a buyer than farmers with lower trust levels. These results are in line with the findings of other studies (Fischer & Wollni, 2018; Ochieng et al., 2017; Schipmann & Qaim, 2011b). Fischer and Wollni (2018) showed that

**TABLE 6** Willingness to pay estimates (in Rwandan Franc)

Attribute	WTP	95 % Confidence Interval	
Individual marketing	−4920.49	−8724.47	−1116.50
Immediate payment	15037.47	9497.55	20577.39
No input provision	−38492.81	−51061.90	−25923.73
Input and credit provision	11971.94	5486.33	18457.54
Input and training provision	29608.50	19118.03	40098.97
Written contract	12644.98	7952.84	17337.12
Buyer known personally	6589.72	1451.08	11728.36
Buyer not known at all	−8708.88	−14034.20	−3383.56

Notes: WTP estimates were derived from mixed logit parameter estimates (base specification), using the delta method. Number of observations  $n = 6,048$ . Exchange rate: 1 USD = 920 RWF (March 2020).

trust has economically negative effects on the WTP for transparent quality controls and found that increasing trust levels are associated with lower price premiums for high transparency. Ochieng et al. (2017) indicated that an unfavorable payment mode may be related to issues of farmers' distrust of buyers. In their study of farmers' marketing preferences for sweet peppers in Thailand, Schipmann and Qaim (2011b) noted that companies used written contracts as a result of distrust in farmers, without addressing the concerns of farmers. However, written contracts may also be desired by farmers when they have no confidence in the buyer. The design of written contracts must consider the needs of both producers and buyers to reduce mutual distrust and avoid withdrawal of one or both parties. Schipmann and Qaim (2011b) also indicated that farmers with higher levels of trust evaluate a personal relationship with the buyer as less decisive.

## 5.5 | Willingness to pay for marketing attributes

The model estimates (Table 5, column 1) can also be used to calculate farmers' WTP for or willingness to accept the different marketing profile attributes to better understand farmers' incentive structures and quantify their preference levels. WTP estimates are derived as the ratio of the value of the coefficient of interest to the negative of the cost attribute—in our case, investment costs. This approach is known as the calculation in preference space (Hole & Kolstad, 2012). WTP estimates and 95% confidence intervals are presented in Table 6. WTP estimates can be interpreted as the indicative amount of money that farmers are willing to pay, opt for, or accept a particular marketing profile feature.

Farmers are willing to pay about 15,037 RWF (US\$ 15.80) if an immediate payment at delivery is guaranteed; about 11,972 RWF (US\$ 12.60) if inputs and additional credit are made available; about 29,609 RWF (US\$ 31.16) if inputs,

additional credit, and training are offered; about 12,645 RWF (US\$ 13.30) if a written contract is provided; and about 6,590 RWF (US\$ 6.90) if the buyer is known personally. The highest WTP is observed for the attribute level referencing input provision, especially when combined with additional credit and training provision. The WTP coefficients of the other significant variables are negative. The negative WTP coefficients can be interpreted as the compensation that farmers would have to receive to accept the attribute compared with the other reference level. Farmers would need a cost reduction of about 4920 RWF (US\$ 5.20) if fruit is individually marketed; about 38,493 RWF (US\$ 40.50) if no inputs and/or services are provided; and about 8709 RWF (US\$ 9.20) if the buyer is not known personally. This suggests that buyers' provision of support services for farmers is essential to smallholder market participation. The results also indicate the importance of personal connections between buyers and farmers, which is probably related to issues of trust and an important result for improving contractual relationships in agri-food markets. However, the exact WTP values should be interpreted with caution, given the well-known HB that often afflicts stated preferences data. Specifically, WTP estimates might potentially be biased upward (Hensher, 2010).

## 6 | CONCLUSIONS

The intent of this study was to support the improvement of smallholder market participation by providing empirical insights into options to design appropriate policy intervention initiatives. To achieve this objective, we analyzed the relationship of farmers' behavioral preferences and their preferred contracts and marketing characteristics. We therefore obtained trust, risk, and time preference data from smallholder farmers in Rwanda applying behavioral economic experiments to investigate preferred key attributes or characteristics of fruit marketing profiles using a DCE. In coupling farmers' behavioral parameters



with DCE data, we were able to observe how trust, risk, and time preferences correlate with farmers' marketing choices. This allowed us to contribute empirical insights to the few existing DCE studies in this field of research (Fischer & Wollni, 2018; Vassalos et al., 2016). Our results are relevant to improving the design of marketing contracts to meet farmers' preferences and potentially increase adoption of mutually beneficial contracts. While we are aware that behavioral economic field experiments entail imperfections, our results correspond with observations of other studies and are sufficiently robust to draw relevant conclusions.

Our results demonstrate that the Rwandan farmers that participated in governmental agroforestry programs to plant fruit trees had a high interest in selling their produce. We were able to show that our farmers were characterized by high levels of risk aversion, future orientation (or patience), and trust. Still, they preferred collective fruit marketing and marketing options that guarantee immediate payments and input provision (i.e., seedlings and fertilizer), especially when combined with additional credit and training, written contracts, a personal relationship with the buyer, and low investment costs. Strengthening the role of cooperatives in supply chains is an allkey political task, as recommended by several other studies (Lutz & Tadesse, 2017; Tefera & Bijman, 2019). While farmers are willing to invest in certain marketing features, such as the provision of inputs, credit, and training, immediate payments, and written contracts, their willingness to accept a certain less preferred feature comes with compensation, including marketing profiles with no provision of inputs, no personal relationship with the buyer, and when marketing is performed individually rather than through a cooperative. While our data reveals a general WTP to join a cooperative, required investment costs are cited as a current barrier to cooperative membership. This emphasizes the importance of local financial markets, a promotion we strongly recommend. We also find that differences in the importance of marketing characteristics are associated with differences in individual behavioral preferences. Therefore, it is essential that tree planting programs do not apply a one-size-fits-all approach when designing marketing strategies. Policy interventions that aim to improve smallholder market participation must be participatory and adjusted to the contextual preferences of each community.

As highlighted earlier, the main challenge in measuring WTP using hypothetical DCEs is the inherent existence of HB. The use of non-hypothetical designs, for example, through the provision of economic incentives or real payments is regarded as a one of the best ways of ensuring sufficient behavioral realism that yields reliable WTP estimates. Yet often times, such approaches are not practical to operationalize in the field due the costs involved. A more

practical way is to use ex-ante and/or ex-post mitigation measures. While we have used an ex-ante mitigation measure in the form of ROOR to minimize the effects of HB in our DCE design, there is one main limitation of our WTP results. We were not able to measure the absolute HB based on our design as well as the extent the HB was minimized with the inclusion of the ROOR (Alemu & Olsen, 2018; Ladenburg & Olsen, 2014). This would have required comparing two samples, that is, a treatment group where the marketing profile choices include the ROOR and a control group where the ROOR is not included. Such a rigorous design would have offered interesting insights concerning the prevalence of the HB in hypothetical DCEs and the effectiveness of the ROOR as a mitigating strategy. However, such a design was beyond the scope of our research enquiry and maybe a useful extension for future research.

In addition, further study of the relationship between market participation and preference formation in agri-food markets in developing countries is required. Identification of factors that affect trust, risk, and time preferences would further contribute to a better understanding of choices related to farmers' behavior. While our study focused on six core attributes, additional marketing attributes could also be investigated. Finally, sustainable inclusion of smallholder farmers in agri-food markets can only be successful if the interests of producers and buyers coincide. Further analyses of buyers' preferences could make an important contribution to the examination.

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## REFERENCES

- Abebe, G. K., Bijman, J., Kemp, R., Omta, O., & Tsegaye, A. (2013). Contract farming configuration: Smallholders' preferences for contract design attributes. *Food Policy*, 40, 14–24. <https://doi.org/10.1016/j.foodpol.2013.01.002>
- Alemu, M. H., & Olsen, S. B. (2018). Can a Repeated Opt-Out Reminder mitigate hypothetical bias in discrete choice experiments? An application to consumer valuation of novel food products. *European Review of Agricultural Economics*, 45(5), 749–782. <https://doi.org/10.1093/erae/jby009>

- Anderson, C. L., Dietz, M., Gordon, A., & Klawitter, M. (2004). Discount rates in Vietnam. *Economic Development and Cultural Change*, 52(4), 873–887. <https://doi.org/10.1086/381111>
- Angerer, S., Glätzle-Rützler, D., Lergetporer, P., & Sutter, M. (2015). Donations, risk attitudes and time preferences: A study on altruism in primary school children. *Journal of Economic Behavior and Organization*, 115, 67–74. <https://doi.org/10.1016/j.jebo.2014.10.007>
- Barrett, C. B. (2008). Smallholder market participation: Concepts and evidence from eastern and southern Africa. *Food Policy*, 33(4), 299–317. <https://doi.org/10.1016/j.foodpol.2007.10.005>
- 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. <https://doi.org/10.1016/j.worlddev.2011.09.006>
- Bech, M., & Gyrd-Hansen, D. (2005). Effects coding in discrete choice experiments. *Health Economics*, 14(10), 1079–1083. <https://doi.org/10.1002/hec.984>
- Bello, M., & Abdulai, A. (2016). Impact of ex-ante hypothetical bias mitigation methods on attribute non-attendance in choice experiments. *American Journal of Agricultural Economics*, 98(5), 1486–1506. <https://doi.org/10.1093/ajae/aav098>
- Berg, J., Dickhaut, J., & McCabe, K. (1995). Trust, reciprocity, and social history. *Games and Economic Behavior*, 10(1), 122–142. <https://doi.org/10.1023/A:1009946125005>
- Blandon, J., Henson, S., & Islam, T. (2009). Marketing preferences of small-scale farmers in the context of new agrifood systems: A stated choice model. *Agribusiness*, 25(2), 251–267. <https://doi.org/10.1002/agr>
- Charness, G., & Viceisza, A. (2016). Three risk-elicitation methods in the field: Evidence from rural Senegal. *Review of Behavioral Economics*, 3(2), 145–171. <https://doi.org/10.1561/105.000000046>
- Chiputwa, B., Spielman, D. J., & Qaim, M. (2015). Food standards, certification, and poverty among coffee farmers in Uganda. *World Development*, 66, 400–412. <https://doi.org/10.1016/j.worlddev.2014.09.006>
- Clay, D., & Turatsinze, J. (2014). *Baseline Report on the Rwanda Horticulture Organisations Survey*. Retrieved from [https://www.canr.msu.edu/csus/uploads/458/49149/Baseline\\_Report\\_EU.RwandaHortSurvey.v15.with\\_Annexes.FINAL.pdf](https://www.canr.msu.edu/csus/uploads/458/49149/Baseline_Report_EU.RwandaHortSurvey.v15.with_Annexes.FINAL.pdf)
- Clot, S., Stanton, C., & Willinger, M. (2017). Are impatient farmers more risk-averse? Evidence from a lab-in-the-field experiment in rural Uganda. *Applied Economics*, 49(2), 156–169. <https://doi.org/10.1080/00036846.2016.1192277>
- Clot, S., & Stanton, C. Y. (2014). Present bias predicts participation in payments for environmental services: Evidence from a behavioral experiment in Uganda. *Ecological Economics*, 108, 162–170. <https://doi.org/10.1016/j.ecolecon.2014.07.026>
- Collier, P., & Dercon, S. (2014). African agriculture in 50 years: Smallholders in a rapidly changing world? *World Development*, 63, 92–101. <https://doi.org/10.1016/j.worlddev.2013.10.001>
- Cook, R., Denbaly, M., Dimitri, C., Glaser, L., Jekanowski, M., Kaufman, P., ..., & Market, S. T. (2001). U.S. Fresh fruit and vegetables marketing: Emerging trade practices, trends, and issues. Agricultural Economic Report No. 795. In *Economic Research Service USDA*, Retrieved from [https://www.ers.usda.gov/webdocs/publications/41227/32247\\_aer795\\_002.pdf?v=8348.5](https://www.ers.usda.gov/webdocs/publications/41227/32247_aer795_002.pdf?v=8348.5)
- Cummings, R. G., & Taylor, L. O. (1999). Unbiased value estimates for environmental goods: A cheap talk design for the contingent valuation method. *The American Economic Review*, 89(3), 649–665. Retrieved from <https://www.jstor.org/stable/117038>
- Dagar, J. C., Sileshi, G. W., & Akinnifesi, F. K. (2020). Agroforestry to enhance livelihood security in Africa: Research trends and emerging challenges. In (J. C. Dagar, S. R. Gupta, & D. Teketay Eds.), *Agroforestry for Degraded Landscapes* (pp. 71–134). [https://doi.org/10.1007/978-981-15-4136-0\\_3](https://doi.org/10.1007/978-981-15-4136-0_3)
- Dave, C., Eckel, C. C., Johnson, C. A., & Rojas, C. (2010). Eliciting risk preferences: When is simple better? *Journal of Risk and Uncertainty*, 41(3), 219–243. <https://doi.org/10.1007/s11166-010-9103-z>
- Dave, R., Saint-Laurent, C., Murray, L., Antunes Daldegan, G., Brouwer, R., de Mattos Scaramuzza, C. A., ..., & Pearson, T. (2019). *Second Bonn Challenge progress report. Application of the Barometer in 2018*. Gland, Switzerland: IUCN. <https://doi.org/10.2305/iucn.ch.2019.06.en>
- De-Magistris, T., Gracia, A., & Nayga, R. M. (2013). On the use of honesty priming tasks to mitigate hypothetical bias in choice experiments. *American Journal of Agricultural Economics*, 95(5), 1136–1154. <https://doi.org/10.1093/ajae/aat052>
- Dijkxhoorn, Y., Gonzalez, Y. S., & Judge, L. (2016). Horticulture and floriculture in Rwanda: Identification of focus areas for sector development. *LEI Wageningen UR*, <https://doi.org/10.18174/370322>
- Eckel, C. C., & Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior*, 23(4), 281–295. [https://doi.org/10.1016/S1090-5138\(02\)00097-1](https://doi.org/10.1016/S1090-5138(02)00097-1)
- Eckel, C. C., & Grossman, P. J. (2008). Forecasting risk attitudes: An experimental study using actual and forecast gamble choices. *Journal of Economic Behavior & Organization*, 68(1), 1–17. <https://doi.org/10.1016/j.jebo.2008.04.006>
- Elagib, N. A., & Al-Saidi, M. (2020). Balancing the benefits from the water–energy–land–food nexus through agroforestry in the Sahel. *Science of the Total Environment*, 742, 140509. <https://doi.org/10.1016/j.scitotenv.2020.140509>
- Fang, D., Nayga, R. M., West, G. H., Bazzani, C., Yang, W., Lok, B. C., Levy C. E., & Snell, H. A. (2021). On the use of virtual reality in mitigating hypothetical bias in choice experiments. *American Journal of Agricultural Economics*, 103(1), 142–161. <https://doi.org/10.1111/ajae.12118>
- Fischer, E., & Qaim, M. (2012). Linking smallholders to markets: Determinants and impacts of farmer collective action in Kenya. *World Development*, 40(6), 1255–1268. <https://doi.org/10.1016/j.worlddev.2011.11.018>
- Fischer, E., & Qaim, M. (2014). Smallholder farmers and collective action: What determines the intensity of participation? *Journal of Agricultural Economics*, 65(3), 683–702. <https://doi.org/10.1111/1477-9552.12060>
- Fischer, S., & Wollni, M. (2018). The role of farmers’ trust, risk and time preferences for contract choices: Experimental evidence from the Ghanaian pineapple sector. *Food Policy*, 81, 67–81. <https://doi.org/10.1016/j.foodpol.2018.10.005>
- Frederick, S., Loewenstein, G., & O’Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature*, 40(2), 351–401. Retrieved from <https://www.jstor.org/stable/2698382>
- Gelaw, F., Spielman, S., & Van Huylenbroeck, G. (2016). Farmers’ marketing preferences in local coffee markets: Evidence from a choice experiment in Ethiopia. *Food Policy*, 61, 92–102. <https://doi.org/10.1016/j.foodpol.2016.02.006>

- GoR. (2018). *Strategic Plan for Agriculture Transformation 2018–24*. Government of Rwanda. Ministry of Agriculture and Animal Resources. Retrieved from <http://extwprlegs1.fao.org/docs/pdf/rwa180543.pdf>
- Gramzow, A., Batt, P. J., Afari-Sefa, V., Petrick, M., & Roothaert, R. (2018). Linking smallholder vegetable producers to markets - A comparison of a vegetable producer group and a contract-farming arrangement in the Lushoto District of Tanzania. *Journal of Rural Studies*, 63, 168–179. <https://doi.org/10.1016/j.jrurstud.2018.07.011>
- Hagos, A., Dibaba, R., Bekele, A., & Alemu, D. (2019). Determinants of market participation among smallholder mango producers in assosa zone of Benishangul Gumuz region in Ethiopia. *International Journal of Fruit Science*, 20(3), 323–349. <https://doi.org/10.1080/15538362.2019.1640167>
- Harrison, G. W., Lau, M. I., Rutström, E. E., & Sullivan, M. B. (2005). Eliciting risk and time preferences using field experiments: Some methodological issues. In (G. W. Harrison, J. Carpenter, & J. A. List Eds.), *Field experiments in economics (research in experimental economics)* (Vol., 10). [https://doi.org/10.1016/S0193-2306\(04\)10005-7](https://doi.org/10.1016/S0193-2306(04)10005-7)
- Hensher, D. A. (2010). Hypothetical bias, choice experiments and willingness to pay. *Transportation Research Part B: Methodological*, 44(6), 735–752. <https://doi.org/10.1016/j.trb.2009.12.012>
- Hensher, D. A., Rose, J. M., & Greene, W. H. (2015). Experimental design and choice experiments. In (D. A. Hensher, J. M. Rose, & W. H. Greene Eds.), *Applied choice analysis*. Second Edition. Cambridge University Press (pp. 189–287). <https://doi.org/10.1007/9781316136232>
- Hole, A. R. (2007). Fitting mixed logit models by using maximum simulated likelihood. *The Stata Journal*, 7(3), 388–401. <https://doi.org/10.1177/1536867x0700700306>
- Hole, A. R., & Kolstad, J. R. (2012). Mixed logit estimation of willingness to pay distributions: A comparison of models in preference and WTP space using data from a health-related choice experiment. *Empirical Economics*, 42, 445–469. <https://doi.org/10.1007/s00181-011-0500-1>
- Holmes, T. P., & Adamowicz, W. L. (2003). Attribute-based methods. In (P. A. Champ, K. J. Boyle, & T. C. Brown Eds.), *A primer on nonmarket valuation. The economics of non-market goods and resources* (pp. 171–219). <https://doi.org/10.1007/978-94-007-0826-6>
- IFC. (2019). *Creating markets in Rwanda: Transforming for the jobs of tomorrow. Country private sector diagnostic*. Washington, DC: International Finance Corporation. <https://doi.org/10.1596/32400>
- Iiyama, M., Mukuralinda, A., Ndayambaje, J. D., Musana, B., Ndoli, A., Mowo, J. G., Garrity D., Ling S., & Ruganzu, V. (2018). Tree-Based Ecosystem Approaches (TBEAs) as multi-functional land management strategies-evidence from Rwanda. *Sustainability*, 10(5), 1–24. <https://doi.org/10.3390/su10051360>
- Jagwe, J., Machethe, C., & Ouma, E. (2010). Transaction costs and smallholder farmers' participation in banana markets in the Great Lakes Region of Burundi, Rwanda and the Democratic Republic of Congo. *African Journal of Agricultural and Resource Economics*, 6(1), 1–16. <https://doi.org/10.22004/ag.econ.156668>
- James, A., & Zikankuba, V. (2017). Postharvest management of fruits and vegetable: A potential for reducing poverty, hidden hunger and malnutrition in sub-Sahara Africa. *Cogent Food & Agriculture*, 3(1), 1312052. <https://doi.org/10.1080/23311932.2017.1312052>
- Jamnadass, R. H., Dawson, I. K., Franzel, S., Leakey, R. R. B., Mithöfer, D., Akinnifesi, F. K., & Tchoundjeu, Z. (2011). Improving livelihoods and nutrition in sub-Saharan Africa through the promotion of indigenous and exotic fruit production in smallholders' agroforestry systems: A review. *International Forestry Review*, 13(3), 338–354. <https://doi.org/10.1505/146554811798293836>
- Kamoyo, M., & Makochekeka, A. (2018). The impact of poverty, risk aversion and time preference on maize marketing channel choice decisions: The case of Zvimba and Makonde districts of Zimbabwe. *Agrekon*, 57(3–4), 233–250. <https://doi.org/10.1080/03031853.2018.1523016>
- Katchova, A. L., & Miranda, M. (2004). Two-step econometric estimation of farm characteristics affecting marketing contract decisions. *American Journal of Agricultural Economics*, 86(1), 88–102. <https://doi.org/10.1111/j.0092-5853.2004.00564.x>
- Kehlenbeck, K., Asaah, E., & Jamnadass, R. (2013). Diversity of indigenous fruit trees and their contribution to nutrition and livelihoods in sub-Saharan Africa: Examples from Kenya and Cameroon. In (J. Fanzo, D. Hunter, T. Borelli, & F. Mattei Eds.), *Diversifying Food and Diets: Using agricultural biodiversity to improve nutrition and health* (Vol., 3, pp. 257–269). <https://doi.org/10.4324/9780203127261>
- Khan, A. S., Yi, H., Zhang, L., Yu, X., Mbanzamihiho, E., Umuhumuza, G., Ngoga T., Igor S., & Yevide, S. I. A. (2019). An integrated social-ecological assessment of ecosystem service benefits in the Kagera River Basin in Eastern Africa. *Regional Environmental Change*, 19(1), 39–53. <https://doi.org/10.1007/s10113-018-1356-0>
- Ladenburg, J., & Olsen, S. B. (2014). Augmenting short cheap talk scripts with a repeated opt-out reminder in choice experiment surveys. *Resource and Energy Economics*, 37, 39–63. <https://doi.org/10.1016/j.reseneeco.2014.05.002>
- Leakey, R. R. B. (2018). Converting 'trade-offs' to 'trade-ons' for greatly enhanced food security in Africa: Multiple environmental, economic and social benefits from 'socially modified crops.' *Food Security*, 10(3), 505–524. <https://doi.org/10.1007/s12571-018-0796-1>
- Liebenehm, S., & Waibel, H. (2014). Simultaneous estimation of risk and time preferences among small-scale cattle farmers in West Africa. *American Journal of Agricultural Economics*, 96(5), 1420–1438. <https://doi.org/10.1093/ajae/aau056>
- Loomis, J. B., Journal, S., Economics, R., April, N., & Loomis, J. B. (2014). 2013 WAEA keynote address: Strategies for overcoming hypothetical bias in stated preference surveys. *Journal of Agricultural and Resource Economics*, 39(1), 34–46. Retrieved from <http://www.jstor.org/stable/44131313>
- Lutz, C., & Tadesse, G. (2017). African farmers' market organizations and global value chains: Competitiveness versus inclusiveness. *Review of Social Economy*, 75(3), 318–338. <https://doi.org/10.1080/00346764.2017.1300317>
- Mbitsemunda, J. P. K., & Karangwa, A. (2017). Analysis of factors influencing market participation of smallholder bean farmers in Nyanza district of southern province, Rwanda. *Journal of Agricultural Science*, 9(11), 99. <https://doi.org/10.5539/jas.v9n11p99>
- Moser, R., Raffaelli, R., & Notaro, S. (2014). Testing hypothetical bias with a real choice experiment using respondents' own money. *European Review of Agricultural Economics*, 41(1), 25–46. <https://doi.org/10.1093/erae/jbt016>
- Mugwagwa, I., Bijman, J., & Trienekens, J. (2020). Typology of contract farming arrangements: A transaction cost perspective. *Agrekon*, 59(2), 169–187. <https://doi.org/10.1080/03031853.2020.1731561>
- Mujawamariya, G., D'Haese, M., & Speelman, S. (2013). Exploring double side-selling in cooperatives, case study of four coffee



- cooperatives in Rwanda. *Food Policy*, 39, 72–83. <https://doi.org/10.1016/j.foodpol.2012.12.008>
- Murphy, J. J., Stevens, T. H., & Weatherhead, D. (2005). Is cheap talk effective at eliminating hypothetical bias in a provision point mechanism? *Environmental and Resource Economics*, 30(3), 327–343. <https://doi.org/10.1007/s10640-004-4224-y>
- Mutonyi, S. (2019). The effect of collective action on smallholder income and asset holdings in Kenya. *World Development Perspectives*, 14, 100099. <https://doi.org/10.1016/j.wdp.2019.02.010>
- Nahayo, A., Omondi, M. O., Zhang, X. H., Li, L. Q., Pan, G. X., & Joseph, S. (2017). Factors influencing farmers' participation in crop intensification program in Rwanda. *Journal of Integrative Agriculture*, 16(6), 1406–1416. [https://doi.org/10.1016/S2095-3119\(16\)61555-1](https://doi.org/10.1016/S2095-3119(16)61555-1)
- Nguyen, Q., Villeval, M. C., & Xu, H. (2016). Trust under the prospect theory and quasi-hyperbolic preferences: A field experiment in Vietnam. *Economic Development and Cultural Change*, 64(3), 546–572. <https://doi.org/10.1086/685434>
- NISR. (2012). *EICV3 District Profile. East - Bugesera. Republic of Rwanda*. National Institute of Statistics of Rwanda. Retrieved from <https://www.statistics.gov.rw/publication/eicv-3-bugesera-district-profile>
- NISR. (2019). *Seasonal Agricultural Survey 2019 Annual Report. The Republic of Rwanda*. National Institute of Statistics of Rwanda. Retrieved from <https://www.statistics.gov.rw/publication/seasonal-agricultural-survey-2019-annual-report>
- Ochieng, D. O. (2020). *Beyond the passbook relationship: Assessing preferences for contracts among cotton and tea farmers and companies in Malawi. IFPRI Strategy Support Program, Working Paper (No. 34)*. <https://doi.org/10.2499/pi15738coll2.133675>
- Ochieng, D. O., Veetil, P. C., & Qaim, M. (2017). Farmers' preferences for supermarket contracts in Kenya. *Food Policy*, 68, 100–111. <https://doi.org/10.1016/j.foodpol.2017.01.008>
- OECD/FAO. (2016). *OECD-FAO Agricultural Outlook 2016–2025. Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade*. [https://doi.org/10.1787/agr\\_outlook-2016-5-en](https://doi.org/10.1787/agr_outlook-2016-5-en)
- Ola, O., & Menapace, L. (2020a). Revisiting constraints to smallholder participation in high-value markets: A best-worst scaling approach. *Agricultural Economics*, 51(4), 595–608. <https://doi.org/10.1111/agec.12574>
- Ola, O., & Menapace, L. (2020b). Smallholders' perceptions and preferences for market attributes promoting sustained participation in modern agricultural value chains. *Food Policy*, 97, 101962. <https://doi.org/10.1016/j.foodpol.2020.101962>
- Omotayo, A. O., & Aremu, A. O. (2020). Underutilized African indigenous fruit trees and food–nutrition security: Opportunities, challenges, and prospects. *Food and Energy Security*, 9(3), 1–16. <https://doi.org/10.1002/fes3.220>
- Poku, A. G., Birner, R., & Gupta, S. (2018). Making contract farming arrangements work in Africa's bioeconomy: Evidence from cassava outgrower schemes in Ghana. *Sustainability*, 10(5), 8–10. <https://doi.org/10.3390/su10051604>
- Rid, W., Haider, W., Ryffel, A., & Beardmore, A. B. (2018). Visualisations in choice experiments: Comparing 3D film-sequences and still-images to analyse housing development alternatives. *Ecological Economics*, 146, 203–217. <https://doi.org/10.1016/j.ecolecon.2017.10.019>
- Romero Granja, C., & Wollni, M. (2018). Dynamics of smallholder participation in horticultural export chains: Evidence from Ecuador. *Agricultural Economics*, 49(2), 225–235. <https://doi.org/10.1111/agec.12411>
- Ruml, A., & Qaim, M. (2020). Effects of marketing contracts and resource-providing contracts in the African small farm sector: Insights from oil palm production in Ghana. *World Development*, 136(1), 105110. <https://doi.org/10.1016/j.worlddev.2020.105110>
- Russell, D., & Franzel, S. (2004). Trees of prosperity: Agroforestry, markets and the African smallholder. *Agroforestry Systems*, 61–62(1–3), 345–355. <https://doi.org/10.1023/B:AGFO.0000029009.53337.33>
- Schipmann, C., & Qaim, M. (2011a). Modern food retailers and traditional markets in developing countries: Comparing quality, prices, and competition strategies in Thailand. *Applied Economic Perspectives and Policy*, 33(3), 345–362. <https://doi.org/10.1093/aep/ppr018>
- Schipmann, C., & Qaim, M. (2011b). Supply chain differentiation, contract agriculture, and farmers' marketing preferences: The case of sweet pepper in Thailand. *Food Policy*, 36(5), 667–677. <https://doi.org/10.1016/j.foodpol.2011.07.004>
- Senapati, A. K. (2020). Evaluation of risk preferences and coping strategies to manage with various agricultural risks: Evidence from India. *Heliyon*, 6(3), 1–13. <https://doi.org/10.1016/j.heliyon.2020.e03503>
- Tanaka, T., Camerer, C., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review*, 100(1), 557–571. <https://doi.org/10.1257/aer.100.1.557>
- Tefera, D. A., & Bijman, J. (2019). Cooperatives in modern food supply chains: A case study of the malt barley sector in Ethiopia. In (J. Windsperger, G. Cliquet, G. Hendrikse, & M. Srećković Eds.), *Design and Management of interfirm networks. Contributions to management science* (pp. 217–237). [https://doi.org/10.1007/978-3-030-29245-4\\_12](https://doi.org/10.1007/978-3-030-29245-4_12)
- Train, K. E. (2009). Mixed Logit. In (K. E. Train Ed.), *Discrete choice methods with simulation*. Cambridge University Press (Second ed., pp. 134–150). <https://doi.org/10.1017/CBO9780511805271>
- UNEP. (2011). *Rwanda. From post-conflict to environmentally sustainable development*. United Nations Environment Programme. Retrieved from <https://www.unenvironment.org/resources/report/rwanda-post-conflict-environmentally-sustainable-development>
- Van Damme, P. (2018). The role of tree domestication in green market product value chain development In Africa. *Afrika Focus*, 31(2), 115–128. <https://doi.org/10.1163/2031356X-03102009>
- van Rijsbergen, B., Elbers, W., Ruben, R., & Njuguna, S. N. (2016). The ambivalent impact of coffee certification on farmers' welfare: A matched panel approach for cooperatives in central Kenya. *World Development*, 77, 277–292. <https://doi.org/10.1016/j.worlddev.2015.08.021>
- Vassalos, M., Hu, W., Woods, T., Schieffer, J., & Dillon, C. (2016). Risk preferences, transaction costs, and choice of marketing contracts: Evidence from a choice experiment with fresh vegetable producers. *Agribusiness*, 32(3), 379–396. <https://doi.org/10.1002/agr.21450>
- Verhofstadt, E., & Maertens, M. (2014). Smallholder cooperatives and agricultural performance in Rwanda: Do organizational differences matter? *Agricultural Economics*, 45(S1), 39–52. <https://doi.org/10.1111/agec.12128>
- Ward, P. S., & Singh, V. (2015). Using field experiments to elicit risk and ambiguity preferences: Behavioural factors and the

- adoption of new agricultural technologies in rural India. *The Journal of Development Studies*, 51(6), 707–724. <https://doi.org/10.1080/00220388.2014.989996>
- Whitehead, J. C., & Cherry, T. L. (2007). Willingness to pay for a Green Energy program: A comparison of ex-ante and ex-post hypothetical bias mitigation approaches. *Resource and Energy Economics*, 29(4), 247–261. <https://doi.org/10.1016/j.reseneeco.2006.10.001>
- Wossen, T., Abdoulaye, T., Alene, A., Haile, M. G., Feleke, S., Olanrewaju, A., & Manyong, V. (2017). Impacts of extension access and cooperative membership on technology adoption and household welfare. *Journal of Rural Studies*, 54, 223–233. <https://doi.org/10.1016/j.jrurstud.2017.06.022>
- Zheng, X., Vukina, T., & Shin, C. (2008). The role of farmers' risk aversion for contract choice in the US hog industry. *Journal of Agricultural & Food Industrial Organization*, 6(1), 1–20. <https://doi.org/10.2202/1542-0485.1220>

## SUPPORTING INFORMATION

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