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Full Length Research paper

Analysis of Market Traders' Adoption Behavior Using the Theory of Planned Behavior and the Technology Acceptance Model

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Although new or enhanced technology can be used to reduce high tomato losses in the fruit supply chain, adoption behavior is rarely known. The use of lining material to improve tomato packaging in Tanzania serves as an example of how socio-psychological factors impact traders' adoption behavior of new postharvest handling technology. This study is based on the Theory of Planned Behavior and the Technology Acceptance Model. According to the study's findings, respondents' behavioral intention was primarily explained by their subjective norm and perceived behavioral control. Perceived utility and perceived ease of use had a considerable impact on attitude, even if attitude was not a significant determining factor. Given that the structural transformation of emerging economies depends on the adoption of technology, our findings offer fresh perspectives on behavioral acceptance study in the relevant developing countries' tomato production sectors.

Key words: Technology adoption, Vegetable traders, Developing country, Tomato supply chain, Tanzania JEL code: C38, C83, D71, D91, O13, Q13.

INTRODUCTION

Food loss due to spoiling and waste is a major problem, particularly in underdeveloped nations. Food losses worldwide account for almost one-third of total production (FAO, 2011), making it more difficult to expand the cultivation of marginal lands. Although this is undoubtedly a worldwide issue, the reasons for this tend to differ according on the situation. For example, low-income countries experience the biggest food losses during the postharvest and processing stages of the food supply chain, while developed countries mostly experience food waste at the consumer stage (FAO, 2011). The absence of innovative postharvest technology alternatives and infrastructure in underdeveloped nations to better handle perishable food has been identified as a possible contributing factor (Shewfelt et al., 2014). Affognon et al., 2015; Aidoo et al., 2014; Dome and Prusty, 2016; Kader, 2005; Kasso and Bekele, 2016; Kereth et al., 2013; Kitinoja et al., 2011; Parmar et al., 2016; Abbass et al., 2014; Affognon et al., 2014; Dome and Prusty, 2016; Kader, 2005; Kasso and Bekele, 2016; Kereth et al., 2013; Kitinoja et al., 2011; Parmar et al., 2016). Despite their variations, each of these problems affects the food's physical and quality characteristics, which can lead to a decline in the food's market value and lower profits for farmers, especially smallholders, in developing nations. The significance of technology development has thus been emphasized as one general tactic to lower postharvest losses in developing nations, given the frequency of such issues. Several solutions have been proposed, including the use of plastic crates or improved lining for non-plastic packaging (e.g., wood and baskets) (Campbell et al., 1986; Eaton et al., 2008; FAO, 2011; Kader, 2005; Kamrath et al., 2016; Kitinoja et al., 2011). However, the sluggish acceptance of new technology severely restricts the feasibility of such a plan. "A decision to make full use of an innovation as the best course of action available" is the broad definition of adoption (Rogers, 2003). As a result, numerous studies have examined how psychological concepts like motivation, attitude, and personality might account for individual decision-making (e.g. Ajzen, 1991). However, the individual is not the only one who decides what constitutes the "best course of action." Rather, a variety of social and economic factors can impact and impede the adoption of new or improved technology (Affognon et al., 2015; Kitinoja, 2013; Tenge et al., 2004; Wasala et al., 2014; Ali, 2012). Furthermore, in developing nations, it is reasonable to assume that the kinds of factors will vary greatly among socioeconomic and cultural groups, especially in those where social and cultural norms and other associated issues affect the adoption of new agricultural technologies (Yamano et al., 2015). Determining the kinds of elements that impact adoption behavior in the particular situation under investigation is therefore always required. As per Kitinoja et al. (2010), the adoption of technology in East Africa is largely dependent on the intended beneficiary's perception of its worth as well as a number of external circumstances. The authors list the following in relation to the latter: the perceived needs of clients, the relative advantage that is provided, the compatibility with socio-cultural values, the complexity of the technology and the possibility that actors will experiment with it, and lastly, the observability of effects and changes.
Farmers, traders, and consumers are the main players in the fresh fruit and vegetable food supply chain (Koenig et al., 2008). Traders hold a somewhat prominent position since they typically operate as middlemen between the different parties. Improving postharvest handling and procedures could be a driving force behind the implementation of technology, as it would enable traders to offer higher-quality produce and boost their earnings (Kitinoja et al., 2010). However, as far as we are aware, no studies have been conducted on traders' technology adoption patterns. Instead, the majority of research in this field tends to concentrate on the viewpoint of farmers. Furthermore, a number of studies have examined the psychological aspects of new technology adoption at the farm level. At the trader level, however, less is known about the factors driving the adoption of better packing materials, especially when it comes to their psychological constructions. As far as we are aware, no research on package acceptance has been done in Tanzania or in a poor nation. Consequently, addressing adoption practices by in order to lower losses in the food value chain, which guarantees improved marketing efficiency and acts as a model for further research, tomato traders should turn to postharvest technology in the tomato value chain.

This study fills this research vacuum by addressing two research questions: first, what psychological factors—such as attitude, social norms, and perceived control—are most important in influencing the adoption of a new kind of lining-equipped wooden crate designed to be practical for traders? Second, what are the primary explanatory factors that influence the psychological constructs of increased package acceptance, such as age, trade experience, knowledge, etc.? In light of this, this study aims to make two contributions to the body of existing work. Our first goal is to comprehend how traders who play a significant role in the tomato value chain accept technology in the particular context of tomato packaging. Second, we plan to provide complementary insights to advance the field's overall understanding and support the theoretical and methodological advancement of technology adoption in the agriculture sector in developing nations. In order to investigate these research issues, the Arusha region of Tanzania was chosen for this study. Therefore, before outlining the fundamental rationale for choosing Tanzania as a study region, the part that follows provides a basic overview of the adoption of new agricultural technologies in developing nations.

An analysis of the research on adoption practices in poor nations

The adoption of new technology in developing nations is discussed in the section that follows, with a special emphasis on postharvest management methods.

How new technology is adopted in agricultural contexts in underdeveloped nations

The significance of implementing better postharvest handling practices is demonstrated by the high rate of postharvest losses brought on by mechanical damage, which frequently contributes to the occurrence of illnesses. For a crop as perishable as tomatoes, it is especially relevant (Aba et al., 2012).

Few studies have evaluated adoption behavior at the farm level in the food value chain (Affognon et al., 2015; Yamano et al., 2015), despite the fact that the factors influencing adoption of various technologies and improved agricultural practices have been analyzed at the farmer level (Afari-Sefa et al., 2016; Affognon et al., 2015; Agwu et al., 2008; Aidoo et al., 2014; Ali, 2012; Feder et al., 1985; Hodges et al., 2011; Isgin et al., 2008; Lazaro et al., 2017; Tenge et al., 2004). Socioeconomic factors like age, gender, education, experience (Agwu et al., 2008; Hansson et al., 2012), income, lack of access to credit (Aidoo et al., 2014; Namara et al., 1997), knowledge and perception of technology and net benefits accrued from application of recommended practices (Adesina and Baidu-Forson, 1995; Adrian et al., 2005; Mbaga-Semgalawe and Folmer, 2000), as well as the underlying psychological construct—attitudes toward new technology, social norms, and perceived behavioral control (Hansson et al., 2012; Yamano et al., 2015; Yazdanpanah et al., 2014)—are the main observed factors that determine traders' adoption of recommended practices. According to some research, the actions of those involved in the value chain may encourage the development of more environmentally friendly technologies that can lower losses after harvest (Hodges et al., 2011; Parmar et al., 2016).

A summary of Tanzania's present tomato value chain

The tomato is a significant horticultural product in Tanzania, as it is in many developing nations, and it may be used for domestic use as well as as a significant cash crop that could help reduce poverty (Koenig et al., 2008). Despite their potential advantages, tomatoes' high water content, fast respiration rate, and soft texture make them extremely susceptible to food loss and spoiling (Isack and Monica, 2013). Accordingly, poor transportation facilities (i.e., reliance on feeder roads where travel is difficult), a lack of market infrastructure facilities (i.e., lack of cold storage), rough and poor post-harvest handling practices, poorly made packaging materials, and the use of open trucks to transport produce over longer distances are some of the major challenges in the rather complicated and opaque tomato supply chain (Mwagike and Mdoe, 2015). In Arusha, Tanzania, wholesalers currently use rough wooden crates that can store about 40 kg and are mostly used to transport tomatoes. This explains the high percentage of tomato losses due to cuts and bruises (Kamrath et al., 2016), which in underdeveloped nations ranges from 30 to 40% per crate (Kader, 2005; MUVI-SIDO, 2009). However, in order to foster a change in this value chain, it is essential to comprehend who is accountable for any hazards and, moreover, who decides what packaging materials to use. In general, Tanzania has several distinct tomato value chain channels (see Koenig et al., 2008 for a thorough explanation and illustration). Traders who purchase tomatoes from farmers and resell them at markets, however, are typically in charge of transportation and must thus bear all associated risks (Koenig et al., 2008; Mwagike and Mdoe, 2015). Consequently, wholesalers have a significant impact on the methods and kinds of packaging that are employed. However, it should be mentioned that farmers often handle the first packaging, while wholesalers or village collectors handle the transportation and market sales of the produce (Koenig et al., 2008; Mwagike and Mdoe, 2015).

Therefore, it is necessary to pay attention to the (cooperative) decisions made by farmers and traders in order to facilitate changes in the tomato value chain. According to Kamrath et al. (2016), the most straightforward and economical upgrade for use with conventional rough wooden crates for tomato packaging is perforated paper liner. Furthermore, the authors contended that supply chain participants did not accept the suggested improvements because they lacked awareness, expertise, and proof of any successful implementation. However, additional findings have demonstrated a favorable correlation between perceived net benefits and desire to use.

Because tomato traders not only hold an intermediate and largely dominant position in value chains, but they also stand to gain the most from any efficiency improvements in postharvest handling and practices, this study focuses specifically on their decisions (Kitinoja et al., 2010; Musebe et al., 2017). Farmers and "middlemen," or individuals who link local farmers with regional markets, typically engage in spot-market discussions where merchants have the majority of the bargaining power (Mwagike and Mdoe, 2015). Additionally, as intermediaries, traders must arrange their own produce transportation and packing when making additional purchases straight from the farmgate. Therefore, the traders decide what kind of postharvest treatment procedures are used. Middlemen typically take advantage of smallholders since they have little or no access to higher-value markets like supermarkets (Chagomoka et al., 2014). Therefore, when it comes to decisions about the adoption of new technology, concentrating just on farmers may be problematic. Since farmers in impoverished nations ultimately have little negotiating power in the tomato supply chain (Koenig et al., 2008), this study adopts a novel approach by concentrating on merchants' adoption behavior in relation to advancements in postharvest handling techniques.

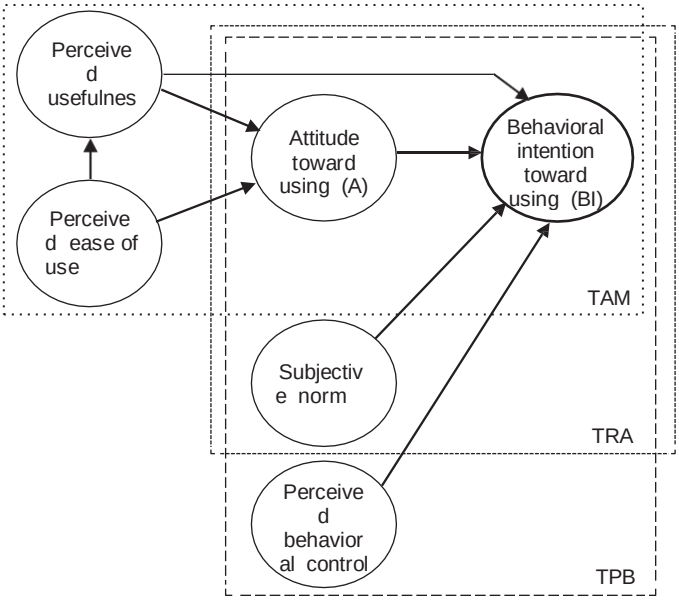
Conceptualization and hypothesis development

Two well-known and often used behavior theories—both of which are based on the Theory of Reasoned Action (TRA)—are selected in order to fill the gaps in the present research landscape on traders' adoption behaviors. According to the widely used TRA put forward by Fishbein and Ajzen (1975) (Ajzen, 1991; Venkatesh et al., 2007), behavioral attitude (A) and subjective norm (SN) both influence behavioral intention (BI), which in turn influences actual behavior. The

addition of perceived behavioral control (PBC) as a component determining behavioral intention is how the Theory of Planned Behavior (TPB) varies from the TRA (Ajzen, 1985). PBC can be used directly to predict actual behavior in conjunction with behavioral intention (Ajzen, 1991). Few studies have applied the Theory of Planned Behavior (TPB), a general model for analyzing human behavior, to the agricultural context, specifically at the supply chain level of smallholder farmers in developing nations (Hansson et al., 2012; Senger et al., 2017; Yamano et al., 2015; Yazdanpanah et al., 2014), but not at the trader level. The TPB has been used primarily to study technology adoption behavior and use in a number of cases (Mathieson, 1991).

The Technology Acceptance Model (TAM) was developed in the context of information technology systems (e.g., Holden and Karsh, 2010; Lee et al., 2003; Legris et al., 2003; Venkatesh and Morris, 2000; Venkatesh et al., 2007), and its significance and wide-ranging application were examined in technology-driven sectors (e.g., Holden and Karsh, 2010; Lee et al., 2003; Legris et al., 2003; Venkatesh and Davis, 2000; Venkatesh and Morris, 2000; Venkatesh and Morris, 2000; Venkatesh et al., 2007). Additionally, the TAM was applied to the acceptance of new agricultural technologies at the farmer level in the context of precision agriculture in the southeastern United States (Adrian et al., 2005) and dairy farming in New Zealand (Flett et al., 2004). As an adaption of TRA, the Technology Acceptance Model (TAM) was first presented by Davis et al. (1989) and makes the assumption that two fundamental beliefs—perceived usefulness (PU) and perceived ease of use (PEOU)—determine whether or not information technology is accepted (Davis et al., 1989; Morris et al., 2005).

Although TAM and TPB have different foci, they are both extensions of the TRA, which makes their inclusion logical, theoretically sound, and possibly even complementary. According to Chau and Hu (2002) and Mathieson (1991), PEOU and PU via TAM may be significant antecedents of attitude in TPB, which in turn may increase the explanatory power of TAM. The standard wooden crate with paper lining (improved packaging; see Kamrath et al., 2016) is used in this study to determine its usefulness and ease of use. Additionally, the variables attitude toward using (A), SN, and PBC by TPB may provide insight into factors disrupting the BI of new technology (Figure 1). PEOU and PU could therefore be significant antecedents of A. Explanatory variables that aid in understanding the psychological construct underpinning adoption behavior will have an impact on each determinant.



The following describes the seven hypotheses that we get from the theoretical framework. The "degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" is how Ajzen (1991) defines attitude (A). TAM and TPB claim that consumers' behavioral intentions are influenced by their attitude toward utilizing new technology. When supply chain participants develop a favorable opinion of better tomato packaging, they will be more inclined to embrace it and use it. This is applicable to the case of enhanced tomato packaging. The first hypothesis of this study is:

H_1: Behavioral attitude (A) toward improved packaging is positively related to the behavioral intention (BI) to use improved packaging.

In addition to the direct impact of a belief (like PU) on BI, the link between A and BI is essential to TRA and modified in the TAM (Davis et al., 1989). The two main tenets of TAM are PU, or the degree to which utilizing a technology will increase productivity, and PEOU, or the degree to which using a technology will be effortless (Davis et al., 1989). The main assumptions are that a user's attitude will be impacted by PU and PEOU. The traders who participated in this survey stated that the usefulness (PU) and ease of use (PEOU) of novel packaging materials for enhancing their business operations are what determine their acceptability. Therefore, "usefulness" in this sense refers to whether or not traders think that the enhanced packing enhances job performance and will be advantageous to them. It is believed that improved job performance will have a favorable impact on attitudes regarding produce packaging. Additionally, merchants will give the packaging a lower rating the more difficult it is to use the upgraded package. The second and third hypotheses of this study are as follows:

H_2: PU is positively related to attitude toward improved packaging (A).

H_3: PEOU is positively related to attitude toward improved tomato packaging (A).

Further, it is argued that the more traders' value improved packaging as easy to use, the more useful they consider the improved packaging technology. This hypothesis is adapted from the original theory by Davis *et al.* (1989). Therefore, fourth hypothesis of this study is:

H_4: PEOU is positively related to PU of improved tomato packaging.

Furthermore, TAM identifies a causal relationship between PEOU and PU, meaning that PEOU will indirectly influence behavioral intention through PU (Davis et al., 1989). Therefore, it is expected that a trader will find an upgraded packaging alternative more valuable if it is easier for them to identify the improvement in produce packing. Additionally, it is anticipated that when traders view the proposed better packaging to be beneficial and easy to use, they are more inclined to embrace it. The following hypotheses are thus formulated:

H_5: PU is positively related to BI to use improved packaging.

TPB defines SN as the users' perception that their neighbors and/or other group members would view them favorably (or unfavorably) if they acted in a particular manner (Ajzen, 1991). Members of the group may include friends, family, members of a similar ethnic group, members of a social group, opinion leaders, or anyone in positions of power, all of whom are likely to have significant and influencing opinions for the individual. Understanding how one's peer group might ascertain one's own intents is essential in this context. Notably, the opinions of others are likely to have a particularly significant impact during the early stages of adopting new technology because this is the time when the individual making the decision has the least amount of experience with the technology and is therefore likely to be more receptive to the responses and suggestions of significant members of their peer group. To put it another way, these factors make the direct impact of SN on BI very likely to be favorable and large (Venkatesh and Morris, 2000). Based on a similar premise, Kamrath et al. (2016) discovered that less seasoned traders may be swayed by more influential peers in the group, such as more seasoned traders and the chairman of the traders' association of the tomato supply chain in Tanzania's Arusha region, when making decisions and opinions. This implies that traders' intention to use better packaging will be influenced by the influence of peers who have the greatest say in decision-making, hence this study postulated that:

H_6: SN will have a positive effect on the BI to use improved packaging.

Additionally, the perceived ease or difficulty of carrying out the behavior is known as perceived behavioral control (PBC) (Ajzen, 1991). This indicates that a person is thought to possess the tools, skills, and sense of control needed to carry out the behavior successfully (Lu et al., 2009). Through BI, the PBC can either directly or indirectly affect behavior. Users still need to know where they may obtain the resources (paper lining), even though the enhanced packaging, a wooden box with lining, is a simpler technique. Additionally, merchants must comprehend the financial advantages and the process of integrating those enhanced boxes into the tomato supply chain. Thus, it is posited that:

H_7: PBC is positively related to the BI to use an improved packaging.

Another argument that might be made in the context of this study is that PBC is always influenced by PU and PEOU when it comes to the adoption of the enhanced packaging. It will be simpler for dealers to adopt and oversee the new packaging technology if they believe it will be worth their time. However, we were unable to locate any pertinent literature to back up this expected association.

The operational description of the components is summed up in Table 1, and an overview of the hypotheses within the suggested research paradigm is shown in Table 2.

MATERIALS AND METHODS

Study area and sampling approach

This study focuses on the choices made by traders in the tomato value chain in order to investigate the adoption of novel technologies more generally. The study, which was carried out in June 2014 in the Tanzanian province of Arusha, employs a sample of 80 traders, including 48 wholesalers, 13 local collectors, and 19 retailers. Since the sampled population of wholesalers, village collectors, and merchants was unknown in the study region, our initial goal of using a stratified sampling approach was ultimately unsuccessful. As a result, we made the decision to speak with almost every wholesaler and village collector that was present at the Kilombero wholesale market when the sample was taken.

Notably, one of the largest wholesale markets for tomatoes in Tanzania's Arusha region is the Kilombero wholesale market. The Kilombero market was chosen as the study's backdrop since it is, in fact, the only wholesale tomato market in Arusha. In order to ascertain the number of tomato retailers operating in the Kilombero wholesale market (roughly 160 retailers) and the proportion of retailers outside the market that typically source and purchase their produce from this market, we also obtained approximate census data from the market manager. Nineteen retailers were then chosen at random from the generated list.

The study's theoretical model was tested using a structured survey questionnaire. Three enumerators received training on the proper way to conduct the survey. In the course of their training, enumerators were instructed to learn about the enhanced packaging, how to explain the idea to traders, and how to contextualize the interview (Supplementary Methods S1). Traders saw an example of the suggested lining material. After the survey instrument was pre-tested, in-person interviews were held in the market using a paper-based questionnaire that had been translated from English to Swahili.

Measurement of psychological constructs

Known as latent constructs (DeVellis, 2012), psychological constructs are not observable; instead, they are represented by quantifiable observable indicators that can be either formative or reflective (Hair et al., 2014). The following reflective items (see Table 3) have been derived from a large body of literature to measure the latent constructs (Adrian et al., 2005; Davis, 1986; Davis et al., 1989; Hansson et al., 2012; Venkatesh and Bala, 2008; Yazdanpanah et al., 2014). We operationalized the constructs BI, A, PU, PEOU, SN, and PBC with the exception of item BI4 (Table 3) by applying the six psychological latent constructs (Table 3) to the research context of the improved tomato packaging materials in the Arusha region of Tanzania. These constructs were measured on a five-point Likert scale, ranging from (1) "strongly disagree" to (5) "strongly agree." This is in line with earlier studies on technology acceptance. BI4 ('will make an effort to transition to the wooden crates with lining') has the following response options: (1) never; (2) by the next year; (3) by the following month; (4) by the following week; and (5) by the following day. The study model's constructs and source are compiled in Table 3. The demographics, socioeconomic traits, trading activities, marketing infrastructure, and social capital of the respondents were the main topics of the second section of the survey.

Analytical framework

Employing the SmartPLS 3 software package (Smart PLS version 3.2.6, SmartPLS GmbH, Boenningstedt, Germany), the variance, which is based on the Structural Equation Modeling (SEM) technique employing partial least squares (PLS), was utilized to investigate the association among variables. Theories like TPB and TAM have been tested using SEM, which is often intended to assess theoretical models (Aboelmaged, 2010; Chen and Chao, 2011; Lu et al., 2009; Nasri and Charfeddine, 2012). Wold (1975, 1982) and Lohmöller (1989) developed the partial least square approach to structural equation modeling (PLS-SEM), which is based on exploratory research to develop theories. It is a variance-based approach that also enables the analysis of datasets with smaller sample sizes for which the assumption of a normal distribution is not true (Hair et al., 2013). It integrates regression analysis (inner model) and confirmatory factor analysis (outer model) into a single framework (Hair et al., 2013).

In Overall, the combined model of TAM and TPB uses PLS-SEM, with PEOU, SN, and PBC as exogenous (independent) factors that are important determinants for dependent constructs, and PU, A, and BI as endogenous (dependent) variables. An inner model is thought of as the direct connections between latent constructs, which are unobserved variables that are represented by measurable variables.

According to Hair et al. (2013), PEOU is also thought to have a mediator effect through PU to A, which is also referred to as an indirect effect and indicates that at least one intervening construct is involved in the relationship. Reflective measured factors determine the outer model. The maximum number of arrows pointing toward BI is four arrowheads, in accordance with the necessary sample size. Based on Cohen (1992), Hair et al. (2013) state that a sample size of more than 65 observations with four arrowheads pointing at BI is required to reach a statistical power of 80% for identifying R2 values at least 0.25 (with a 5% likelihood of error). As a result, our study's 80 observations surpass the cutoff point.

We used a two-stage evaluation process for this study in accordance with the recommendations made by Hair et al. (2013): (1) assessment of the outside model, or reflecting measurement model; (2) evaluation of the inner model, or structural model, and hypothesis testing.

All three subsamples are regarded as a homogeneous trading group because of the limited sample size of the subgroups. Additional statistical tests (the FIMIX technique and the Kruskal-Wallis-Tests) support this, but no significant moderating effects that could account for group segmentation were found.

RESULTS

Tomato traders' history and their function in tomato packaging

The majority of the traders in our sample are men, have been in the tomato business for an average of 15 years, and primarily employ conventional hardwood crates (STA) without any lining material, according to the survey results (Table 4). Village collectors primarily utilize plastic basins as alternative packaging. The usage of lining material for the typical wooden containers was unfamiliar to any trader. When asked if they would be willing to use or purchase wooden crates with linings, almost 45% of the traders said "yes." The availability of the liner in tomato-growing areas and its use during the rainy season were issues.

Results and evaluation of reflective measurement model

Because each latent variable's elements are highly connected and interchangeable, the outer model is derived from reflective measured constructs (Hair et al., 2013). After six rounds, the PLS-SEM algorithm was able to establish a stable solution (Table 5).

Convergent validity

Convergent validity, which Hair et al. (2014) define as "items that are indicators of a specific construct should converge or share a high proportion of variance in common," was examined first. Thus, two measures are made: the average variance extracted (AVE) values should beyond the threshold of 0.50, and the outer loadings of the indicators should surpass the threshold of 0.708 to be strong (Hair et al., 2013). Based on the findings shown in Table 5, every latent construct satisfies both requirements.

■ *Internal consistency reliability*

Furthermore, Cronbach's alpha value and composite reliability were used to test the internal consistency reliability, which is defined as the "measure of the degree to which a set of indicators of a latent construct is internally consistent based on how highly interrelated the indicators are with each other" (Hair et al., 2014). Composite dependability and Cronbach's alpha are typically understood similarly. Variables that measure the same occurrence are not preferred if their values are more than 0.95 (Hair et al., 2013). According to the research model's findings, PEOU, A, and PBC are internal consistent reliable constructs, while PU, SN, and BI are not because respondents thought the questions were the same for each of the latent variables. Therefore, the issue for the structures PU, SN, and BI was resolved by removing the items PU1, PU2, and further SN2, in addition to BI2 and BI3.

■ *Discriminant validity*

Lastly, discriminant validity—defined as "the extent to which a construct is truly distinct from other constructs" (Hair et al., 2014)—is produced by the PLS-SEM. When a construct's square root of its AVE is less than its maximum correlation with any other construct, it is deemed to lack discriminant validity according to the Fornell-Larcker criterion (Hair et al., 2013). With the exception of the latent constructs PEOU and A, the correlation matrix demonstrates that the constructs are discriminant valid (Table 6). Both constructs are retained for additional analysis since the correlation of PEOU on A (0.887) just marginally outweighs the square root of AVE of the construct A (0.857). It is not recommended to combine the PEOU and A surveys since they are different and measure various hidden viewpoints.

Assessment of structural model

Following validity and reliability assessments, Smart PLS3 is used to analyze the structural equation model and determine how the TAM and TPB constructs affect acceptance behavior. Using a bootstrapping process with 5,000 subsamples, a significance level of 0.05, and a two-tailed test, the hypotheses were tested to see if the path coefficients were significant. The findings are displayed in Table 7 and Figure 2.

■ *Multicollinearity assessment*

When multicollinearity issues are first tested, VIF values less than 5 show that there is no collinearity issue between the predictor components in the structural model (Hair et al., 2013). Values in this investigation ranged from 1.000 (PU) to 4.126 (BI), suggesting that collinearity had no detrimental effects on the findings.

■ *Coefficient of variance (R^2)*

According to Hair et al. (2014), the explanatory strength of endogenous latent variables is described by R2 values of 0.75, 0.5, and 0.25, respectively, which indicate significant, moderate, and weak power. As a result, A has a high R2 value and the endogenous variables PU and BI have a substantially explained variance in the suggested structural model.

f^2 effect size

Analyzing the importance of constructs in explaining the endogenous latent constructs is made possible by the ‘2 effect size. According to guidelines for evaluating ‘2, small, medium, and large impacts on the exogenous latent variable are represented by values of 0.02, 0.15, and 0.35, respectively (Hair et al., 2013). PU (0.026), A (0.043), and SN (0.107) are predictors that explain a comparatively little portion of the BI R2 value. According to the general guidelines for the ‘2, the PBC impact size (0.335) is almost as large. PBC hence has the greatest explaining influence on BI. PEOU (1.029) accounts for a larger portion of the variance of A than PU (0.208). PEOU (1.411) significantly affects PU's R2 value.

■ *Cross-validated redundancy (Q^2)*

Using a blindfolding process, the Stone-Geisser's Q2 value for reflective items—which was devised by Geisser (1974) and Stone (1974)—indicates the predictive relevance of the model for values greater than zero, while a value less than zero indicates a lack of predictive significance. Following the blindfolding process, the Q2 of all three endogenous components—A (0.599), BI (0.508), and PU (0.488)—have values greater than zero, suggesting that the model has predictive validity for these constructs.

■ *The path coefficients*

PBC has the greatest influence when taking into account the endogenous construct BI (0.618). The selection of wooden crates lined with paper allows for the 5%-significant level of confirmation of hypothesis H7 (Figure 2). To put it another way, traders who believe they can use wooden crates with lining material are more likely to decide to use them.

The study on the adoption of hardwood containers with lining supports hypothesis H6. At a significance level of 5%, merchants

are more likely to switch to hardwood crates with lining if they believe that other influential people would support their use of better packaging. This is the second most important factor influencing BI.

Given the lack of significance of the associations, hypotheses H1 and H5 must be disproved. A and PU do not significantly affect BI in this study, despite the fact that both associations have been thoroughly studied in the literature in other situations (e.g., Aboelmaged, 2010; Hansson et al., 2012; Mathieson, 1991; Nasri and Charfeddine, 2012). At the five percent significance level, the hypothesis H2 is supported. Therefore, it is substantiated that merchants' attitudes about the wooden crates with lining are positively correlated with how beneficial they perceive the packaging to be. PEOU is a very important influencing factor for both constructions A and PU. Therefore, hypotheses H3 and H4 are validated and supported, demonstrating that usefulness and attitude are positively impacted by ease of use.

Discussion, Implications and Limitations

This study investigated how underlying psychological constructs can explain traders' decisions to switch from traditional wooden crates to wooden crates with a new lining material using a combined model of TAM and TPB. By using this innovative framework, we are able to obtain fresh perspectives for this situation.

Additionally, the moderate (PU, BI) and large (A) values for R2 support the applicability of this combined theoretical method to explain new package acceptance behavior. As the ‘2 and Q2 effect sizes show, the model fits the data well overall. Furthermore, it has been demonstrated that traders' behavioral intentions are highly predicted by both subjective norm and perceived behavioral control. However, there is no discernible impact of attitude toward the package. Furthermore, based on the findings, we can conclude that the successful adoption of innovative packaging—as well as the general perception of the technology—is due to social networks and the allocation of power in value chains and market structures. Observations of market activity during the data collection period further supported these conclusions. For example, we found that the Chairman of the Kilombero Market Association, or the head of the local association of tomato traders, played a vital (and ubiquitous) role in deciding who would be allowed entry to the market and, more generally, influencing the knowledge and viewpoints of traders. In this sense, the increased complexity of social and commercial networks and traders' increased desire to cooperate can also be used to explain the substantial impact of subjective norms. The fact that the majority of wholesalers belonged to the Kilombero Market Association is arguably the best example of this. Additionally, while purchasing tomatoes from farmers at the farmgate, a lot of traders bring their own crates. According to Parmar et al. (2016), this suggests that traders possess a certain amount of resources, which enhances the noteworthy impact of perceived behavioral control. However, it should be highlighted that social structure traits can vary significantly throughout African nations. The female "market queens" in Ghana, for instance, typically hold the most sway in the tomato supply chain (Lyon, 2003).

Furthermore, explanatory factors such trader traits, packaging type, network, trading patterns, profit, and transportation issues did not, in general, predict traders' adoption behavior. This may be partially explained by the study's limited sample size. However, a number of research have generally proven the significance of socioeconomic characteristics (such as gender) for adoption behavior (e.g. Abass et al., 2014; Affognon et al., 2015; Aidoo et al., 2014; Ali, 2012; Feder et al., 1985; Tenge et al., 2004). Because of this, it would seem reasonable to presume that these considerations will also probably be important when traders are making adoption decisions.

The negligible link between A and BI and between PU and BI appears to be in conflict with the large relationship between perceived usefulness and attitude. A person's positive attitude toward the better packaging is observed to be strengthened if they hold more positive opinions regarding its utility. are unable to locate evidence, however, to support either the direct correlation between behavioral intention and perceived usefulness or a further impact of these characteristics on behavioral intention. This lack of importance may be explained by the fact that, although traders appreciate the concept of lowering losses through better packaging, they may not be confident in the actual application of the packaging to extend the shelf life of produce. One possible explanation for this could be that the new lining's feasibility for the rainy season has not yet been proven. Another explanation would be that merchants would rather stick with the status quo and are hesitant to change. In fact, our field findings made this hesitancy rather obvious. Additionally, traders who embrace new line technology may demand—and perhaps expect—higher profits on their assets. Nonetheless, because wholesalers in particular exhibit oligopolistic conduct, traders may be more likely to transfer marketing losses to farmers and other stakeholders rather than take accountability for them. Therefore, even if they have strong intentions and expressed attitudes to modify their behavior, the incentive to do so is probably minimal (e.g. Lagerkvist et al., 2013). In light of the possibility that higher (perceived) risks could surpass any anticipated rewards, traders who are more cautious must be persuaded of the possible benefits of adopting technology. All of the aforementioned factors combined may thus explain why the enhanced packaging has not been adopted.

As a potential direction for future study, it could be helpful to expand the model to incorporate other significant factors such perceived net benefit—the conviction that the technology will yield more advantages than disadvantages—as another prospective predictor of adoption intentions. Specifically, this might act as a mediator in the connection between behavioral goals and perceived utility (Adrian et al., 2005). Assessing merchants' problem awareness, as suggested by Subedi et

al. (2009), may potentially provide further information about how traders may act if they were given more urgency to lower postharvest losses. Similarly, the technology readiness index developed by Parasuraman (2000) can be viewed as an additional explanatory component in the technology acceptance model to determine whether and why traders do not adopt new technology because they are unwilling to change their behavior. Specifically, this element may help to explain perceived utility and simplicity of use (Walczuch et al., 2007). As a result, we see even more opportunity to expand our innovative framework and enhance our comprehension of adoption choices throughout the supply chain by taking these modifications into account.

However, there are several possible drawbacks and, consequently, recommendations that might be applied to enhance such research in the future. First, it cannot be assumed that all findings and assertions can be applied to all Tanzanian traders because of the small sample size of 80 traders. Instead, it is more likely that these findings' validity has broad implications for this group and the study area. Similarly, because various systems exist in other regions of Tanzania, the tomato value chain in the Arusha region is not representative of Tanzania as a whole. Nonetheless, as previously said, this area is one of Tanzania's main tomato markets. In addition, a few problems surfaced during the data collection process. Many traders, for example, gave the assertions for a single latent construct the same score (PU1–PU5, all with a "4" Likert scale), which may indicate that the activity at hand did not receive the full attention it required. As anticipated, traders continued to do business during the field interviews. It appears that the busy, noisy, and crowded market setting may not always be the best place to gather high-quality data. Naturally, problems like these are inherent to the social sciences' use of field research. On the other side, the comparable statement structure could be another reason why traders would have provided the same response for every item in the previously indicated construct. Limitations pertaining to the field observation task also include the possible (biasing) influence of the traders association chairs and well-known responders. Therefore, it cannot be ruled out that the market context in which data collecting occurred had no influence on the respondents' responses. On the plus side, as individual traders are unlikely to decide on the adoption of new technology alone, the existence of these components may also be viewed as adding additional realism to the experiment. Lastly, it was also true that not all enumerators understood the statements and queries for the explanatory variables during the data collection process. In other words, despite a training and pre-test followed by discussion, there is still a lot of space for improvement, such as creating new statements for latent constructs, improving further applications of the theories, and more fully standardizing the questionnaire to fit the actual interview context (as was the case when translating English to Swahili for this study). By making these enhancements, it will be feasible to guarantee that these surveys are more widely appropriate for a variety of experimental situations and that they can yield data that can be used to a wider range of situations involving traders' adoption decisions. Given the attitude-behavior gap, a true experimental design would be ideal to further develop our understanding of the factors influencing technology adoption.

Conclusions

It is crucial to comprehend how users embrace new packaging or improved postharvest handling methods in order to successfully deploy them. The factors impacting adoption behavior provide ideas for developing technologies and introducing them in the supply chain, despite the fact that merchants were unaware of the paper lining technology and that awareness and acceptance rates are low (Kamrath et al., 2016).

To the best of our knowledge, there hasn't been much systematic, model-based study done at the level of traders in developing nations. Future study is needed for more in-depth investigations in this area, as traders are the dominant actors in the fresh fruit and vegetable supply chain in the developing world, representing a unique and significant role. The psychological makeup of traders in the tomato supply chain can be inferred from the underlying elements that influence their acceptance or rejection of technology, such as attitude, perceived behavioral control, and social/subjective norms. Since peers appear to have a disproportionate amount of influence over decisions about technology adoption, the findings of the significant influence of subjective norms indicate that we need to look into the complete network. The second crucial element is perceived behavioral control, which has a big impact on adoption behavior. Perceived utility has a positive impact on the factor attitude toward the package, whereas perceived ease of use has no discernible effect on adoption behavior. This is helpful for future studies on tomato packing to satisfy consumer needs and keep traders safe. Because the samples and research areas were chosen with purpose, the results of this study might not be generalizable, although in other developing nations, traders are crucial to the food value chain and the reduction of postharvest losses. Therefore, it is conceivable that our findings could be applied to other emerging nations that face comparable circumstances to Tanzania.

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Table 1. Definitions of latent constructs within research model.

Variable	Construct	Operational definition
BI	Intention to use packaging	An individual's behavioral intention to use improved packaging
A	Attitude toward using	An individual's overall evaluation toward using improved packaging
SN	Subjective norm	Users' perception of whether peers within their group perceive they should use improved packaging
PBC	Perceived behavioral control	Users' perception if they have the necessary resources and capability in successfully using improved packaging
PU	Perceived usefulness	An individual's perception that using improved packaging will enhance job performance
PEOU	Perceived ease of use	An individual's perceived exerted efforts when using improved packaging

Table 2. Hypotheses of research model.

Relationship	Hypotheses	
A → BI	H_1	Behavioral attitude toward improved packaging is positively related to the behavioral intention to use improved packaging.
PU → A	H_2	Perceived usefulness is positively related to attitude toward improved packaging.
PEOU → A	H_3	Perceived ease of use is positively related to attitude toward improved tomato packaging.
PEOU → PU	H_4	Perceived ease of use is positively related to perceived usefulness of improved tomato packaging.
PU → BI	H_5	Perceived usefulness is positively related to behavioral intention to use improved packaging.
SN → BI	H_6	Subjective norm will have a positive effect on the individual's intention to use improved packaging.
PBC → BI	H_7	Perceived behavioral control is positively related to the behavioral intention to use an improved packaging.