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COGNITIVE PREDICTORS OF THE LIKELIHOOD OF ADOPTION OF IMPROVED CASSAVA PROCESSING TECHNOLOGY

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ABSTRACT: *Low adoption rates innovated farming technologies have been reported in both, developed and developing world. The purpose of this paper was to predict the likelihood of adoption of improved cassava processing technology from cognitive traits in Tanzania. The study involved 360 participants [181 (50.3%) males and 178 (49.7%) females] who were purposively selected from Serengeti, Sengerema and Biharamulo districts in Mara, Mwanza and Kagera regions. Questionnaire was administered to all the respondents to obtain their socio-demographic data. The respondents' cognitive traits including Attitude, perceived self-efficacy and cognitive flexibility in relation to cassava processing technology were assessed using the attitude towards cassava processing (ACPT), perceived self–efficacy (PSE) and cognitive flexibility (CFS) scales, respectively. Likewise, the cassava processing technology adoption (CPTA) scale was administered to the respondents. Direct logistic regression analysis indicated that attitude, perceived self–efficacy, cognitive flexibility and training on improved cassava processing technology predicted adoption of improved cassava processing technology. It is concluded that cognitive variables such as attitude towards the improved cassava processing technology, perceived self–efficacy and cognitive flexibility partly explain adoption of the improved cassava processing technology. In addition, different implementation stages of adoption require different cognitive variables and even different components of the same cognitive variables. All in all cognitive variables play the crucial role in prediction of the likelihood of farmers' adoption of improved cassava processing technology in particular.*

KEY WORDS: adoption; adoption; attitude; self-efficacy; cognitive flexibility; cassava processing technology

INTRODUCTION

Evidence exist on existence of low adoption of innovated farming technologies from developed (Daberkow & McBride, 2003; Schimmelpfennig, 2016; Raffaelli, Glynn & Tushman, 2018) and developing (Arslan, McCarthy, Lipper, Asfaw, & Cattaneo, 2013;

Felicia & Olaniyi, 2015) world. The same is observed in Tanzania (Kapinga, Mafuru, Jeremiah & Rwiza, 2015; Amaza, Abass, Bachwenkiz & Towo, 2016; Intermech Engineering, 2018). Low acceptance as used in this study, refers to the reluctance or negative decision to use an innovation (Taherdoost, 2018). In this article, the term has been used to mean reluctance or negative decision of farmer to adopt improved cassava processing technology. Adoption of improved cassava processing technology has been used in this article to refer to farmer's involvement in the pre-processing tasks, processing tasks, and utilisation of the processed cassava products (Joshua, Massawe & Mwakalapuka, 2020).

Low acceptance to adoption of farming technologies has been associated with various factors. These include rainfall variability and exposure to technology (Arslan, McCarthy, Lipper, Asfaw, & Cattaneo, 2013), business model incompatibilities, poor resource allocation, technological demands and innovations framing (Raffaelli, Glynn & Tushman, 2018). Specific to adoption of improved cassava processing technology, Abdoulaye, Abass, Maziya-Dixon, Tarawali, Okechukwu, Rusike, Alene, Manyong and Ayedun (2014) reported that farmers who attended training on cassava processing technology registered higher adoption rates of the technology than those who did not. Close observation of these factors, however, reveals inadequate incarceration of variables inherent to individual farmers, which to great extent, might be independent of external variables such as infrastructure and access to technology. For instance, preliminary information from Serengeti district indicates that the district council introduced the cassava processing machines in some villages for free to enable farmers in the catchment areas to process their cassava. Nevertheless, to date, many farmers in the catchment areas have preferred their traditional cassava processing methods to the improved technology (Serengeti District Agriculture Office, 2018). This brings in the questions; why do farmers fail to adopt improved cassava processing methods despite the availed access? What goes on in the mind of the farmers that inhibits the same to adopt the methods? These questions attracted the interest of the current study to assess the farmers' cognitive attributes that may explain their adoption of improved cassava processing technology.

THEORETICAL UNDERPINNINGS AND CONCEPTUAL FRAMEWORK

Several theories and models exist that explain adoption of technologies in general, a few of which have been reviewed in this article. These include the theory of reasoned action (TRA), theory of planned behaviour (TPB), technology acceptance model (TAM), and social cognitive theory (SCT). The theory of reasoned action (TRA; Fishbein & Aijzen, 1975) holds that human behaviour is predicted and explained by attitudes, social norms, and behavioural intention. According to TRA, human behaviour is volitional, systematic and rational. TRA has been extensively applied in social–psychological and counselling studies for years. Recently, the theory has become an important model in applied research studies (Kuo, Roldan-Bau, & Lowinger, 2015).

The theory of planned behaviour (TPB; Ajzen, 1991) is an extension of the TRA model. Just like TRA, TPB holds that human behaviour is predicted and explained by attitudes, social norms, and behavioural intention. While in both TRA and TPB behavioural intention is key to behaviour, TPB adds the construct of perceived behavioural control to

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the model. According to TPB, some behaviours are non-volitional and might can be performed without intentionally planned by the actor. The perceived behavioural control construct accounts for the role of involuntary actions and takes into account the possibility of the influence of availability of resources and their perceived significance, opportunities and skills on the behaviour to be performed (Koul, & Eydgahi, 2017, Taherdoost, 2018). Another model, which is also founded on the ideas from TRA is the technology acceptance model (TAM). The model holds that human motivation to adopt technology is explained by perceived usefulness, perceived ease of use and attitude towards the use of the technology. TAM's departure from TRA lies on its elimination of subjective norms in the model equation. The model also calls for inclusion of external variables such as training of the technology user, characteristics of the technology, user participation in both designing and implementation of the technology (Lin, Fofanah & Liang, 2011).

Koul, and Eydgahi, (2017) commend TAM and TPB as the appropriate models in studying technology adoption. They argue that the models frameworks have been used in several other models in studying adoption of various technologies. TAM for example, has been applied to models studying internet usage (Horton et al, 2001), mobile commerce (Yang, 2005), advanced mobile services (Lopez-Nicolas, et al, 2008), online learning (Drennan, et al, 2005) social networking media (Lane & Coleman, 2012) and Smartphone usage (Park et al, 2013). Koul, and Eydgahi, (2017) further list examples of application of the theory of planned behaviour in the models studying e-commerce adoption (Pavlov & Fygenson, 2006), wireless internet services through mobile technology (Lu et al., 2005), high tech innovation (Kuviwalt et al., 2009) and alternative fuel vehicles (Janson et al., 2010).

Apparently, both, TRA and TPB hardly take into account the role of access, exposure and direct past experience to explain technology adoption. These variables are dealt with in Bandura's (1997) social cognitive theory (SCT). Access, exposure to and past experiences are considered here as crucial variables in the development of attitude, subjective norms, and behavioural intention. These need to be developed prior to adoption of a technology. Furthermore, elimination of subjective norms construct in the TAM is likely to limit application of the model to a restricted industrial work place (Taherdoost, 2018). The Social Cognitive Theory (SCT; Bandura, 1997) informs that human behaviour is influenced in a reciprocal relationship by both personal and environmental variables. The theory holds that self and society; personal determinants such as cognitive and affective factors; behavioural patterns; biological and environmental stimulus interactively determine each other in a bidirectional way (Bandura, 1997). According to SCT, the key understanding of the target behaviour lies on how social or environmental factors influence individual's cognitive processes to the ultimate point of adopting the target behaviour. This theory not only considers social role that has been ignored by TAM, but also puts in place the proposed intervention mechanisms for behavioural adoption. Self–efficacy, which is key to adoption, can be developed by teaching some adoption skills through mastery experience, vicarious experience, psychosocial state, and social persuasions (Usher & Pajares, 2009).

Conceptual Framework

Understanding the nature of low acceptance to adopt the improved cassava processing technology compels studying individual's cognitive traits, and how these might have influenced farmers' adoption of the technology. The framework gains its strength from the contribution of the reviewed theories, models and empirical studies on the determinants of behaviour change and adoption of technological innovations. The framework in this study assumes a reciprocal relationship among the variables. It is postulated that one's decision to adopt a target farming technology is explained in the context where the level and type of technology (whether incremental or non–incremental) and exposure to the technology is well defined. In such a context, adoption of farming technology is influenced by farmers' personal variables such as cognitive, affective, and demographic and environmental variables such as training on the target technology, education level and participation in other economic activities.

Three types of innovations, namely; incremental, discontinuous and architectural (Raffaelli et al., 2018) are described here. According to Raffaelli et al., (2018), incremental innovation is a type of innovation that requires minimal strategic change and thus, rules out the necessity to re-frame farmers' project plans, structures and even priorities. The discontinuous innovation type demands the farmer to restructure the present order, processes and knowledge to radically redefine and extend competencies to accommodate a new innovation. Similarly, with additional intensity, architectural innovations are complex as they require re-configuration of existing organisational components and frames while leaving core design concepts and the basic knowledge underlying the components untouched (Adner, 2012). The latter two categories can be combined to form non–incremental innovations and thus, two categories; incremental and non – incremental (Raffaelli, et al, 2018). The improved cassava processing technology in Tanzania is considered here as non–incremental, given that the farmer has to shift from the traditional processing methods of cassava to adopt the newly introduced improved ones. This is because despite the fact that the status of cassava in Tanzania is as high as the second staple food next to maize, its processing has remained traditional (Kapinga et al, 2015; Amaza et al, 2016).

It follows then that, farmers might have been comfortable with the traditional processing methods relative to the introduced improved cassava processing technology. Since the use of machines means an increase of the cassava bulk to be processed, adoption of the new technology would force farmers to expand production, learn new ways of improving yields, set apart the budget to construct the processing units (for farmers who want to invest in processing) and learn the new demands of the processing machineries. The processors need to prepare the structures to accommodate machines, to store the processed products and think of immediate market to sell the processed cassava products. All these complexities place the improved cassava processing technology in the non-incremental category of innovation such as discontinuous and architectural. Raffaelli, et al (2018), thus, argues that such non-incremental types of innovations can be successfully adopted when adopters reframe their cognition.

The conceptual framework illustrated in Figure 1 places cognitive variables as key predictors of adoption of improved cassava processing technology. The framework is comprised of the Determinant, Intervening and Outcome variables. It is assumed that a reciprocal relationship exists between cognitive variables (attitude, perceived self-efficacy, and cognitive flexibility) and adoption of improved cassava processing technology. It is expected that relative to their counterparts with positive attitude, farmers with negative attitude towards the improved cassava processing technology will demonstrate low acceptance to adopt the technology. Likewise, positive correlation is expected between the scores in perceived self-efficacy scale and adoption of the improved cassava processing technology. It was further assumed that scores in the cognitive flexibility would be positively correlated with adoption of cassava processing technology.

Other variables such as sex, age, intention to adopt cassava processing technology, education level, training on cassava processing technology, engagement of the farmer in other economic activities; and level and type of technology might interfere with the relationship between cognitive variables and adoption of improved cassava processing technology. In this study though, the level and type of technology were kept constant because the sample was assumed to share the same type and level of technology. The double arrows in Figure 1 imply the reciprocal relationship among variables.

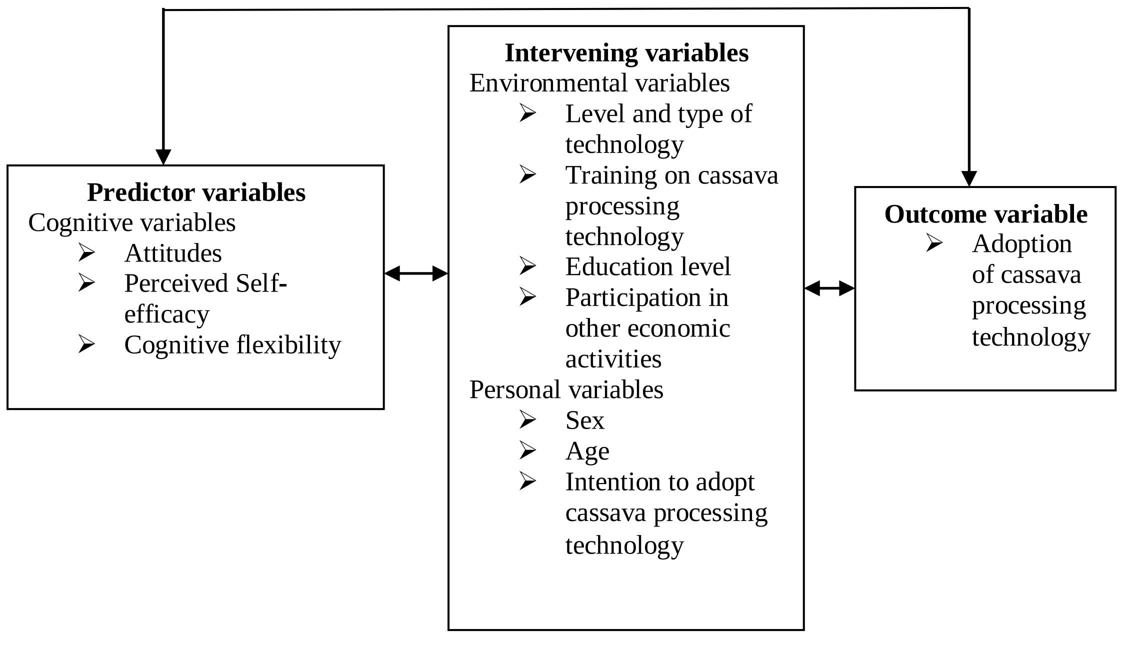

Figure 1: Conceptual Framework

METHODOLOGY

Study Design, Area and Sampling

This was a cross-sectional study conducted among cassava farmers in Serengeti, Sengerema, and Biharamulo Districts in Mara, Mwanza and Kagera regions, respectively, in Tanzania. The districts were selected due to their cassava farming potential and presence of the cassava processing units in operation. The criteria were considered important for motivating adoption of the improved cassava processing technology. Target population was farmers growing cassava in the areas surrounding the cassava processing units. Some cassava growing farmers in these areas process their cassava in the improved cassava processing units while others still process cassava using traditional methods. All two categories were important for adoption differentiation and, thus, for inclusion in the sample. The indefinite and scattered nature of the sampling frame of these groups of the farmers in the catchment area ruled out the effectiveness of randomization. Purposive sampling through invitation was, therefore, undertaken.

Consenting farmers were thus enlisted, making a total of 360 participants [181 (50.3%) males and 178 (49.7%) females]. This included 174 (48.3%) in young age group (<=35 years), 84 (23.3%) middle age group (36–44 years), and 102 (28.3%) in the old age group (45+). In terms of formal education, 70 (19.4%) participants reported no formal education, 138 (38.3%) reported primary education, and 152 (42.2%) reported secondary education level or above. Regarding farmers' participation in other economic activities, about 183 (50.8%) reported only farming, 36 (10%) reported farming and business, while 141 (39.2%) reported farming and other economic activities.

Instruments for Data Collection

Data were collected using one questionnaire comprised of instruments such as attitude towards cassava processing technology scale (ACPT), Perceived self – efficacy scale (PSE), cognitive flexibility scale (CFS) and cassava processing technology adoption scale (CPTA). The questionnaire was also consisted of questions inquiring farmers' age, sex, formal education level, participation on other economic activities, and attendance to training on improved cassava processing technology. ACPT was adopted from the pupils' attitude toward technology short questionnaire (PATT-SQ) (Ardies, De Maeyer, & Gijbels, 2013), Blog Attitude Questionnaire (BAQ) (Aryadoust & Shahsavar, 2016) and Ajzen's (2001) questionnaire based on the theory of planned Action. The adopted scale was pilot tested among 200 participants and found useful in measuring farmers' attitude towards adoption of improved cassava processing technology. PSE is a two factor scale with instrumental attitude and cognitive attitude subscales, whose internal consistency were found good ($\alpha = .85$ and $\alpha = .84$) for instrumental attitude and cognitive attitude sub-scales, respectively.

PSE was adopted from the 13 items of the perceived self-efficacy scale (Gangloff & Mazilescu, 2017) to measure farmers' perceived self-efficacy in Tanzania for two reasons. First, the items in the Gangloff and Mazilescu's (2017) scale are relevant to general domains and applicable to the population composed of more than one group (executives, employees and students). This criterion led to the assumption that the scale could fit farmers as well. Second, consideration was given to a few items of the scale that captured the construct validity of self–efficacy as explained in the SCT (Bandura, 1997). This criterion made the instrument relevant to the group of farmers, who, being realistic in personality, might not enjoy long dialogues in terms of questioning (Holland, 1994, 1997). The adopted PSE scale was designed to measure self-efficacy in terms of individual's beliefs in their capability to react, deal and cope with the difficult situations toward a planned goal (Gangloff & Mazilescu, 2017). In terms of reliability, Gangloff and Mazilescu (2017) report an adequacy of internal consistency ($\alpha = 0.86$) on the total scale.

Similar reliability indices have been found in this study (α = 0.85 for the total PSE and α =0.79 in each subscale). With regard to validity, however, at a pilot study stage, it was observed that only 11 items could validly measure farmers' perceived self–efficacy. The PSE in this study thus, used 11 items measuring farmers' ability deal and cope with difficulties.

CFS was adopted from the Barak & Levenberg's (2016) Flexible Thinking in Learning Questionnaire (FTL). FTL was developed to measure learners' dispositional inclination to think flexibly in technology-enhanced learning. Its 17 items measure three main factors namely technology acceptance, open mindedness and adapting to new situations. The need to measure cognitive flexibility among farmers ruled out application of FTL, but rather, its adoption into CFS was inevitable. The adopted CFS was pilot tested and found to be a three factor scale measuring adaptation to new technologies (ATs), technology acceptance (TA) and open mindedness (OM). According to Barak, and Levenberg (2016) the Flexible Thinking in Learning (FTL) scale, from which CFS was adopted, has high internal consistency, with a Cronbach alpha coefficient of 0.91. In the present study, the internal consistencies were 0.85, α = 0.88, α = 0.86 and α = 0.80 for the total CFS, adaptation to new technologies, technology acceptance and open mindedness to other people's ideas respectively.Adoption of the improved cassava processing technology was measured using the cassava processing technology adoption scale (CPTA). The scale measured farmers' adoption in three components, namely; involvement in the pre-processing tasks, involvement in processing tasks, and utilisation of the processed products. Involvement in the pre-processing tasks refers to farmers' engagement in the activities that usually, accompany the improved cassava processing technology and that need to be accomplished before cassava is sent to the processing machines. Involvement in the processing tasks refers to the engagement by farmers in the activities directly defined as processing. The tasks include immediately washing cassava after pealing and taking the washed cassava to the cassava processing machines for crushing and dewatering to obtain High Quality Cassava Flour (HQCF). Utilisation of the processed cassava products refers to consumption of the products made from cassava, such as HQCF, biscuits, burns and bread. The internal consistency for the components has been found to be high (α = 0.87 for involvement in the pre-processing tasks, α = 0.72 for involvement in the processing tasks, and α = 0.81 for utilisation of the processed products subscale).

Data Analysis

Analysis was done by the assistance of the statistical package for social sciences (SPSS) version 21. After screening, the negatively worded items were reversed so that high scores in the cognitive scales represented high performance in the cognitive traits. So was done with adoption scale whereby low scores in the CPTA represented low, while high score represented high level of adoption of the improved cassava processing technology. In all the scales, mean score was used as a cut off point for separating high from low performance. To assess the relationships among the key variables of the study; and between them and adoption of improved cassava processing technology, Pearson product–moment correlation coefficient was performed. This was supplemented by direct logistic regression analysis for the purpose of predicting the likelihood of adoption of improved cassava processing technology from cognitive traits when other variables in the conceptual framework are put under control.

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RESULTS

Table 1 shows the relationships among the key variables of the study; and between them and adoption of improved cassava processing technology.

Table 1: The relationship between cognitive variables and adoption of improved cassava processing technology

Correlations											
Variables	**1**	**2**	**3**	**4**	**5**	***6***	***7***	***8***	**9**	**10**	**11**
1	1										
2	-.028	1									
3	-.057	.968**	1								
4	-.034	-.064	-.066	1							
5	-.020	-.154**	-.129*	-.045	1						
6	-.002	.145**	.132*	.218**	-.476	1					
7	.038	-.310**	-.299**	.119*	-.006	.311**	1				
8	.021	.073	.049	.384**	-.446	.661	-.053	1			
9	-.039	.289**	.291**	.140**	.068	.096**	-.055	.204**	1		
10	-.021	.220**	.191**	.195**	.007	.210**	.087**	.263**	.453	1	
11	.059	.240**	.241**	.234**	-.024	.151**	.008**	.313**	.315	.581**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Key to variables:
1 = Age
2 = Instrumental attitude
3 = Cognitive attitude
4 = Ability to deal with difficulties
5 = Ability to cope with difficulties
6 = Adapting to new technologies
7 = Technology acceptance
8 = Open mindedness to other people's ideas
9 = Involvement in pre–processing tasks
10 = Involvement in processing tasks
11 = Utilisation of the processed cassava products

The Relationship between Perceived Attitude and Adoption of Improved Cassava Processing Technology

Regarding the relationship between attitude and involvement in cassava processing tasks, Table 1 indicates that there was a small, positive but significant correlation ($r = 0.22^{**}$, $n = 360$, $p < 0.01$) between instrumental attitude and involvement in cassava processing tasks. Similarly, there was a small, positive but significant correlation ($r = 0.20^{**}$, $n = 360$, $p < 0.01$), between cognitive attitude and involvement in the processing tasks. This means that positive instrumental and cognitive attitude were both associated with high levels of involvement in processing tasks. Further results on the relationship between attitude and utilisation of the processed cassava products indicate that there was small, positive but significant correlations, ($r = 0.24^{**}$, $n = 360$, $p < 0.01$) and ($r = 0.24^{**}$, $n = 360$, $p < 0.01$), between instrumental attitude and utilisation of the processed cassava products and between cognitive attitude and utilisation of the processed cassava products respectively. This implied that the more positive the farmer's attitude towards the processed cassava products, the higher was the level of utilisation of the processed cassava products.

The Relationship between Perceived Self – Efficacy and Adoption of Improved Cassava Processing Technology

An analysis of the relationship between perceived self–efficacy and involvement in pre–processing tasks found a significant and positive correlation, ($r = 0.14^{**}$, $n = 360$, $p < 0.01$) between the farmers' ability to deal with difficulties and involvement in pre–processing tasks. This implies that the higher the farmer's perceived self–efficacy, the higher was the level of involvement in the pre–processing tasks. On the other hand, the correlation between the farmers' ability to cope with difficulties and involvement in the pre–processing tasks was not statistically significant ($r = 0.07$, $n = 360$, $p < 0.01$), implying a precarious association between these variables. With regard to the relationship between perceived self–efficacy and involvement in processing tasks, results in Table 1 indicate that while there was a small but significant, positive correlation, ($r = 0.20^{**}$, $n = 360$, $p < 0.01$) between the farmers' ability to deal with difficulties and involvement in processing tasks, the correlation between the ability to cope with difficulties and involvement in the processing tasks small positive and statistically not significant ($r = 0.07$, $n = 360$, $p < 0.01$). This implies that the higher the farmer's ability to deal with difficulties, the higher was the level of their involvement in the processing tasks. The non-significant correlation, however, implies an inconsistent and chancy association between the farmer's ability to cope with difficulties and their involvement in processing tasks. In addition, analysis on the relationship between perceived self–efficacy and utilisation of the processed cassava products found existence of a small but significant, positive correlation, ($r = 0.23^{**}$, $n = 360$, $p < 0.01$) between the farmers' ability to deal with difficulties and utilisation of the processed cassava products. On the other hand, there was a smallnegative non-significant correlation ($r = - 0.03$, $n = 360$, $p < 0.01$), between the farmers' ability to cope with difficulties and their utilisation of the processed cassava products. This means that the higher the farmer's ability to deal with difficulties, the higher was their level of utilisation of the processed cassava products. On the other hand, a non-significant negative correlation implies an inconsistent and chancy association between the farmer's ability to cope with difficulties and their utilisation of the processed cassava products

The Relationship between Cognitive Flexibility and Adoption of Improved Cassava Processing Technology

Table 1 reveals existence of small but significant, positive correlation, ($r = 0.10^{**}$, $n = 360$, $p < 0.01$) between adaptation of new technologies and involvement in pre – processing tasks, implying that the higher the farmer's tendency to adaptation to new technologies, the higher was the level of their involvement in the pre – processing tasks. Further, there was small insignificant negative correlation ($r = - 0.06$, $n = 360$, $p < 0.01$), between farmers' technology acceptance and involvement in the pre – processing tasks, implying chancy association between these variables. Lastly, small significant positive correlation ($r = 0.20$, $n = 360$, $p < 0.01$) was found between farmers' open mindedness and involvement in the pre – processing tasks, implying that the more farmers were open minded to other people's ideas, the more was their involvement in pre-processing tasks. In addition, Data in Table 1 reveals existence of a small but significant, positive correlations, ($r = 0.21^{**}$, $n = 360$, $p < 0.01$); ($r = 0.09^{**}$, $n = 360$, $p < 0.01$); and ($r = 0.26$, $n = 360$, $p < 0.01$), between adaptation of new technologies and involvement in processing tasks, between technology acceptance and involvement in the processing tasks and between open mindedness and involvement in the processing tasks respectively. This implies that the higher the farmers' cognitive flexibility the higher their involvement in the processing tasks. Table 1 further reports a small but significant, positive correlations ($r = 0.15^{**}$, $n = 360$, $p < 0.01$) between adaptation of new technologies and utilisation of the processed cassava products, meaning that though with small magnitude, high cognitive flexibility was associated with high levels of utilisation of the processed cassava products. Further, a moderate correlation was found ($r = 0.31$, $n = 360$, $p < 0.01$) between open mindedness and utilisation of the processed cassava products, suggesting that the higher the farmers' cognitive flexibility the higher their involvement in the processing tasks. On the other hand, no correlation was found ($r = 0.01$, $n = 360$, $p < 0.01$) between technology acceptance and utilisation of the processed cassava products. This was interpreted that although cognitive flexibility was associated with utilisation of the processed cassava products, it is the two components (adaptation of new technologies and open mindedness to other people's ideas) but not technology acceptance which was responsible for such an association.

Predicting the Likelihood of adoption of improved cassava processing technology from Cognitive Variables

Binary logistic regression analysis was performed to assess the influence of age, sex, level of formal education, participation in other economic activities, attendance to training on cassava processing, intention to process, and the cognitive variables (attitude, perceived self–efficacy, and cognitive flexibility) on the likelihood that the respondents would report adoption of improved cassava processing technology. The assumption was that cognitive variables (attitude, perceived self – efficacy and cognitive flexibility would uniquely contribute to the likelihood of reporting adoption of improved cassava processing technology when all other variables in the conceptual framework are put under control. Analysis was performed separately to allow for the likelihood of each component of adoption of the improved cassava processing technology (involvement in the pre–processing tasks, involvement in the processing tasks and utilisation of the processed cassava products) to be predicted separately from the cognitive variables.

The three models were found statistically significant, [$\chi2$ (16, N = 360) = 51.01, $p < .001$], [$\chi2$ (16, N = 360) = 39.631, $p < .001$] and [$\chi2$ (16, N = 360) = 40.19, $p < .001$] for involvement in the pre-processing tasks, involvement in the processing tasks and utilisation of the processed cassava products, respectively. This indicates that the models were capable of distinguishing respondents who reported from those who did not report adoption of improved cassava processing technology. The model for predicting involvement in the pre-processing tasks predicted between 13.2% and 17.7% of the variance in involvement in pre-processing tasks, and was able to categorise 62.4% of non-

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adopters. The model for predicting involvement in the processing tasks explained between 10.5% and 14.0% of the variance in involvement in processing tasks, and distinguished 66.9% of non-adopters. The model for predicting utilisation of the cassava processed products explained between 10.6% and 14.2% of the variance in utilisation of the cassava processed products, and correctly distinguished 63.8% of non-adopters. Table 2 indicates the contribution of each independent variable to the specific model.

Table 2: Predicting adoption of improved cassava processing technology from cognitive variables

		B	S.E.	Wald	Df	Sig.	Odds Ratio	95% C.I.for Odds Ratio	
								Lower	Upper
Predicting involvement in pre – processing tasks from cognitive variables									
Step 1[a]	Age	-.033	.017	3.951	1	.047	.967	.936	1.000
	Sex(1)	-.041	.231	.031	1	.860	.960	.610	1.511
	Ednlevel(1)	-.044	.352	.016	1	.900	.957	.480	1.907
	Ednlevel(2)	.399	.381	1.100	1	.294	1.491	.707	3.145
	Econactivity(1)	.482	.435	1.230	1	.267	1.620	.691	3.797
	Econactivity(2)	-.137	.327	.176	1	.675	.872	.460	1.654
	Econactivity(3)	-.618	.488	1.608	1	.205	.539	.207	1.401
	Everattend(1)	1.453	.436	11.103	1	.001	4.278	1.819	10.057
	Intendprocess(1)	-.553	.294	3.546	1	.060	.575	.323	1.023
	BTInstrumental(1)	-.539	.386	1.949	1	.163	.583	.274	1.243
	BTCognitive(1)	-.098	.389	.064	1	.801	.907	.423	1.942
	BTDeal(1)	.602	.274	4.823	1	.028	1.826	1.067	3.126
	BTCop(1)	.681	.267	6.483	1	.011	1.976	1.170	3.338
	BTAFT3(1)	.659	.252	6.830	1	.009	1.932	1.179	3.166
	BTTA3(1)	-.643	.258	6.226	1	.013	.526	.317	.871
	BTOM3(1)	.259	.279	.858	1	.354	1.295	.749	2.239
Predicting involvement in processing tasks from cognitive variables									
Step 1[a]	Age	.003	.016	.033	1	.855	1.003	.971	1.036
	Sex(1)	.209	.229	.834	1	.361	1.233	.787	1.931
	Ednlevel(1)	.442	.359	1.520	1	.218	1.556	.771	3.142
	Ednlevel(2)	.612	.385	2.534	1	.111	1.844	.868	3.920
	Econactivity(1)	-.018	.422	.002	1	.966	.982	.430	2.245
	Econactivity(2)	.363	.323	1.261	1	.262	1.437	.763	2.706
	Econactivity(3)	.490	.483	1.032	1	.310	1.633	.634	4.204
	Everattend(1)	.950	.415	5.234	1	.022	2.586	1.146	5.837
	Intendprocess(1)	.245	.286	.734	1	.392	1.278	.729	2.238
	BTInstrumental(1)	-.890	.388	5.256	1	.022	.411	.192	.879
	BTCognitive(1)	.138	.391	.124	1	.725	1.148	.533	2.469
	BTDeal(1)	.231	.270	.735	1	.391	1.260	.743	2.138
	BTCop(1)	.178	.264	.455	1	.500	1.195	.712	2.004
	BTAFT3(1)	.197	.247	.637	1	.425	1.218	.751	1.976
	BTTA3(1)	-.102	.253	.164	1	.686	.903	.550	1.482
	BTOM3(1)	.730	.274	7.122	1	.008	2.076	1.214	3.549
Predicting utilisation of the processed cassava products from cognitive variables									
Step 1[a]	Age	.016	.017	.989	1	.320	1.017	.984	1.050
	Sex(1)	-.301	.228	1.738	1	.187	.740	.474	1.157
	Ednlevel(1)	-.400	.350	1.307	1	.253	.670	.337	1.331
	Ednlevel(2)	-.730	.384	3.621	1	.057	.482	.227	1.022
	Econactivity(1)	.590	.416	2.011	1	.156	1.804	.798	4.076
	Econactivity(2)	.415	.326	1.621	1	.203	1.514	.799	2.868
	Econactivity(3)	-.422	.496	.724	1	.395	.656	.248	1.734
	Everattend(1)	-.896	.433	4.285	1	.038	.408	.175	.954
	Intendprocess(1)	.297	.285	1.082	1	.298	1.345	.769	2.352
	BTInstrumental(1)	-.447	.404	1.221	1	.269	.640	.290	1.413
	BTCognitive(1)	1.397	.408	11.692	1	.001	4.042	1.815	9.000
	BTDeal(1)	-.035	.271	.017	1	.896	.965	.567	1.643
	BTCop(1)	-.043	.263	.027	1	.870	.958	.572	1.603
	BTAFT3(1)	-.084	.248	.116	1	.734	.919	.565	1.494
	BTTA3(1)	.306	.254	1.451	1	.228	1.358	.825	2.235
	BTOM3(1)	-.635	.282	5.081	1	.024	.530	.305	.920

Predicting involvement in pre–processing tasks from cognitive variables

As indicated in Table 2, the strongest predictor of reporting involvement in pre-processing tasks was attendance to training on improved cassava processing technology (Odds Ratio =4.28, p=0.01), implying that respondents who attended training on improved cassava processing technology were 4.28 times more likely to report involvement in the pre-processing tasks than those who did not attend any training on the same. Perceived self–efficacy (Ability to cope with difficulties) followed (Odds Ratio = 1.97, P = 0.01). This finding implied that farmers with perceived high ability to cope with difficulties were almost twice more likely to report involvement in the pre-processing tasks than farmers with low ability to cope with difficulties. Cognitive flexibility (adaptation to new farming technologies) followed (Odds Ratio = 1.93, P = 0.01), implying that farmers with high tendency to adaptation to new technologies were 1.93 times more likely to report involvement in the pre-processing tasks than their counterpart farmers with low tendency to adaptation to new technologies.

Technology acceptance (Component of cognitive flexibility) followed (Odds Ratio = 0.526, p = 0.01), meaning that farmers with low tendencies to accept technologies were 0.526 times less likely to report involvement in pre–processing tasks relative to their counterpart farmers with high tendencies to accept technologies. Ability to deal with difficulties, a component of perceived self–efficacy, followed (Odds Ratio = 1.83, p = 0.03), showing that farmers with high ability to deal with difficulties were 1.83 times more likely to report involvement in the pre–processing tasks than farmers with low ability to deal with difficulties. Age was the last predictor of involvement in the pre – processing tasks (Odds Ratio = 0.967, p = 0.05) indicating that farmers in young age and old groups were 0.967 time less likely to report involvement in pre–processing tasks than those in middle age groups. Other variables in the conceptual model such as sex, level of formal education, participation in other economic activities, intention to process and attitude did not explain involvement in pre–processing tasks.

Predicting involvement in processing tasks from cognitive variables

Table 2 indicates that only three variables (open mindedness, instrumental attitude and training on improved cassava processing technology) uniquely contributed to farmers' involvement in processing tasks. Open mindedness, a component in cognitive flexibility, was the strongest predictor of involvement in processing tasks (Odds Ratio=2.08, p=0.01) implying that farmers with high level of open mindedness to other people's ideas were 2.08 times more likely to report involvement in processing tasks than their counterparts with low level of open mindedness to other people's ideas. the second predictor of involvement in the processing tasks was instrumental attitude (Odds Ratio = 0.41, p=0.02) meaning that respondents with negative instrumental attitude were 0.41 times less likely to report involvement in the processing tasks than respondents with positive instrumental attitude. This was followed by attendance to the training on improved cassava processing (Odds Ratio=2.59, p=0.02) indicating that farmers who had attended training on improved cassava processing technology were 2.59 times more likely to report involvement in the processing tasks, than their counterpart farmers who had not attended any training on improved cassava processing technology. Other variables in the conceptual model such as age, sex, level of formal education, participation in other economic activities, intention to process and self-efficacy did not explain involvement in processing tasks.

Predicting utilisation of the processed cassava products from the cognitive variables
Further, Table 2 indicates that only three variables (cognitive attitude, open mindedness, and attendance to the training on improved cassava processing technology) made unique statistically significant contributions to the model. Cognitive attitude was the strongest predictor of reporting utilisation of the processed cassava products (Odd Ratio=4.01, p = 0.001). This meant that farmers with positive cognitive attitude were 4.04 times more likely to report utilisation of the processed cassava products than their counterpart farmers with negative cognitive attitude towards improved cassava processing technology. Open mindedness followed by recording Odds Ratio of 0.53 (p=0.02), indicating that farmers with low levels of open mindedness were 0.53 times less likely to report utilisation of the processed cassava products than their counterparts with high levels of open mindedness to other people's ideas. Attendance to the training on improved cassava processing technology followed (Odds Ratio=0.41, p=0.04), conveying the meaning that farmers who farmers who had not attended any training were 0.41 times less likely to report utilisation of the processed cassava products than farmers who attended training on cassava processing technology. Other variables in the conceptual model such as age, sex, level of formal education, participation in other economic activities, intention to process and self-efficacy did not explain involvement in processing tasks.

DISCUSSION

This study has affirmatively responded to the quest as to whether or not cognitive variables could predict adoption of improved cassava processing technology. The results in this study are similar to those reported by other researchers (Abdoulaye et al., 2014; Bukchin & Kerret, 2018; Raffaelli, Glynn & Tushman, 2018). For example, Bukchin & Kerret (2018) found that cognitive traits such as creativity and cognitive flexibility predicted adoption of farming technologies. Likewise, Raffaelli, Glynn and Tushman (2018) report that framing flexibility of the top management teams predicted adoption of farming technologies in incumbent organisations. It has also been found that farmer's attendance in the trainings on the improved cassava processing technology predicted adoption of the same. Similar finding was reported by Abdoulaye, Abass, Maziya-Dixon, Tarawali, Okechukwu, Rusike, Alene, Manyong and Ayedun (2014). However, the distinct contribution of this work relative to other past works is its specificity in pointing out specific components of these cognitive traits in the prediction of specific implementation stage of adoption of the improved cassava processing technology.

In the first place involvement in the pre–processing tasks, which is the first implementation stage of adoption of improved cassava processing technology, was predicted by cognitive flexibility and self-efficacy. Besides, farmers' attendance to the training on improved cassava processing technology has been found the strongest predictor of adoption of improved cassava processing technology at this stage. These traits might be necessary in the early stage of adoption of the newly introduced farming technologies such as the improved cassava processing technology for some reasons. First, when the technology is new and introduced for the first time, some efforts to make farmers aware of the technology are required. The fact that attendance to training on improved cassava processing technology has explained involvement in pre – processing tasks proves the role of training as the motivating factor to encourage participation in the newly introduced innovations. Second, it is argued here that training might have been responsible for developing both self –efficacy and cognitive flexibility among farmers who reported involvement in the pre–processing tasks. This argument is in line with the assumption that self–efficacy is developed through training of mastery experience, vicarious experience, psychosocial state, and social persuasions (Usher & Pajares, 2009). Third, it is interesting to note that adaptation to new technologies and technology acceptance traits were specifically necessary components of cognitive flexibility alongside perceived self–efficacy that predicted initial implementation stage of adoption of improved cassava processing technology. From this finding, it is argued here that both adaptation to and acceptance tendencies might be achieved when one is efficacious enough to accept and adapt to new technologies.

The second implementation stage of adoption of improved cassava processing technology (involvement in processing tasks), was predicted by the components of cognitive flexibility and attitude. Specifically, open mindedness was the strongest predictor of involvement in processing tasks followed by instrumental attitude. Though farmer's attendance to the training on the improved cassava processing technology was also the predictor, it was not the strongest at this stage. This brings the message home that before a farmer makes decision regarding involvement in the processing tasks, a farmer might employ assessment skills, searching for the expected benefits (both advantages and disadvantages) of the innovation to be adopted. Such assessment needs employment of high thinking faculties such as analysis and open mindedness because the farmer assesses strengths and weaknesses of the ideas of other people introduced to the farmer during training and then make decision to engage in actual processing. They might compare the new technology to the previously used technologies and when they find the new technology advantageous their decision to adopt might affirmatively be reached. This assumption is in line with the postulate that development of positive attitude needs to be related to recall, which translates symbolic conceptions into appropriate courses of action through a conception-matching process in which conceptions guide the construction and execution of behaviour patterns that are then compared against the conceptual model for adequateness on the basis of the comparative information to achieve close correspondence between conception and action (Bandura, 2001). This might explain why self – efficacy or other components of cognitive flexibility such as adaptation and acceptance to new technologies tendencies could not explain this stage of adoption as they did explain involvement in pre–processing tasks.

It has also been found that cognitive attitude, open mindedness and attendance to training on the improved cassava processing technology predicted utilisation of the processed cassava products. It is important to note that although attitude has predicted adoption of the improved cassava processing technology, its power to predict adoption of the same was not uniform across all three implementation stages of adoption. While instrumental attitude predicted involvement in processing tasks it could not predict utilisation of the processed cassava products. On the other hand, while cognitive attitude predicted utilisation of the processed cassava products, it could not predict the early two implementation stages. Similar observation needs attention with regard to the power of cognitive flexibility in predicting adoption. Indeed, cognitive flexibility predicted adoption of improved cassava processing technology in all its implementation stages, with its different components predicting different implementation stages of adoption. Specifically, adaptation to new technologies and technologies acceptance tendencies

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predicted involvement in pre – processing tasks, while open mindedness predicted both involvement in the processing tasks and utilisation of the processed cassava products.

Unlike other cognitive variables in the conceptual model, it has been found that perceived self–efficacy (with all its components) was specific in predicting early implementation stage (involvement in pre–processing tasks) of adoption of improved cassava processing technology but not the next implementation stages (involvement in processing tasks and utilisation of the processed cassava products). This calls for an assumption that this cognitive trait might be required at early stages of adoption of farming technologies than at other stages. This is because during the early stages of engagement in new tasks, one needs both abilities to deal and cope with uncertainties, problems and difficulties, which are usually accompanied with initiation of new business. Again, the role of attendance to training on the improved cassava processing technologies should not be ignored. This variable has predicted adoption of improved cassava processing technologies in all its implementation stages, implying that training on the technology to be adopted is required probably it also motivates the development of cognitive variables such as attitude, self-efficacy and cognitive flexibility.

Implication to Research and Practice

Findings in this study have indicated that attendance to training in improved cassava processing technology explained farmers' involvement in processing tasks. This might be because, in these trainings farmers are exposed to the benefits related to involvement in processing tasks. Farmers might use this information to improve their attendance to the training for them to benefit from the knowledge and experiences shared in the trainings. Researchers might use this information to study the content in these training programmes that make the difference between farmers attending and those who do not attend. It has also been found that instrumental attitude explained adoption.

The details of instrumental attitude towards improved cassava processing technology evaluated were palatability, accessing the products, market for the products, preparation time and safety in terms of consumer health. This information may be used by processors of the products to ensure quality of the processed cassava products. The most catching items were those related to farmers' easiness to access the processed products and easiness to sell their processed cassava products. This implies that if farmers are sure of where they can easily sell the improved processed cassava products, at comparable better price than how they can sell the traditionally processed ones, they might be able to easily adopt the processing technology. Likewise, those who want to buy the processed cassava products make the comparison of palatability and access to the products. This information may also be useful to marketing strategies aiming at convincing farmers to adopt the improved cassava processing technology, as they may realize that training content needs to include accompanying issues related to palatability, accessing the products, market for the products, preparation time and safety in terms of consumer's health.

Introduction of farming technology to farmers should consider accompanying the introduced technology with practical training of farmers with special focus on both exposure and expected advantages and disadvantages of the same. It is also potential application in assessing individual differences in instrumental and cognitive evaluation towards the ongoing introduced agricultural technologies among farmers. For successful utilisation of the processed cassava products one might require developing positive cognitive attitude towards the products through mere exposure effect to the products in addition to training on their making. It is also worth noting that training needs to precede both instrumental attitude and intention for successful adoption of the technology.

CONCLUSIONS

From these findings, therefore, it is concluded that cognitive variables such as attitude towards the improved cassava processing technology, perceived self–efficacy and cognitive flexibility partly explain adoption of the improved cassava processing technology. However, cognitive variable are not the only and sufficient factors explaining adoption of improved cassava processing technology. Attendances to the training in improved cassava processing technology and age have made a vital contribution to the variance in explaining adoption. The influence of cognitive variables on adoption of the improved cassava processing technology is not the same across the components of adoption of the improved cassava processing technology. Different implementation stages of adoption require different cognitive variables and even different components of the same cognitive variables. All in all cognitive variables play the crucial role in prediction of the likelihood of farmers' adoption of farming technologies at large and improved cassava processing technology in particular.

Recommendation for Future Research

Future research is provoked on more cognitive variables such as metacognition, convergent versus divergent thinking; creativity and planning and their link to adoption of improved cassava processing and other farming technologies. The link may be studied by collecting data either concurrently or subsequently. The link between cultural ties to cassava processing among farmers is another specific research theme one can explore. For example, some people do not trust the effectiveness of the processing machines in removing toxic elements in cassava. Future research may address how market links can be assured when more cassava products can upscale as a response to farmers' adoption.

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