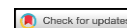






## THE RELATIONSHIP BETWEEN FARMERS' COGNITIVE FLEXIBILITY AND ADOPTION OF THE IMPROVED CASSAVA PROCESSING TECHNOLOGY



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### ABSTRACT

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Low acceptance to adoption of the innovated farming technologies has been reported elsewhere as a problem deserving investigation. Addressing low acceptance to adoption, the study resulting in this paper examined the relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology. About 360 participants including 181 (50.3%) males and 178 (49.7%) females were purposively selected from Mara, Mwanza and Kagera regions in Tanzania. Participants responded to questions on cognitive flexibility and adoption of improved cassava processing technology. Other variables such as sex, age, education level, attendance to training, intention to adopt cassava processing technology and participation in other economic activities were also included in the questionnaire. Binary logistic regression analysis indicated that cognitive flexibility alongside attendance to training on improved cassava processing technology and intention to adopt the technology predicted adoption. The paper concludes that cognitive flexibility partly explains adoption of improved cassava processing technology. It further discusses the implications for both practice and future research and further recommends training to farmers that involve developing cognitive flexibility tendencies for adoption of technologies in this ever changing world with diverse and progressive innovations.

**Contribution/ Originality:** This study contributes to the existing literature the role of cognitive variables in explaining adoption of farming technologies and of improved cassava processing technologies in particular. It also introduces a detailed manner of measuring adoption by following its implementation stages.

### 1. INTRODUCTION

Low acceptance to adoption of the innovated farming technologies has been reported elsewhere as a problem deserving investigation (Raffaelli, Glynn, & Tushman, 2016). The term adoption in the context of innovation refers to mental process through which one passes from hearing about an innovation to its implementation; following awareness, interest, evaluation, trial, and implementation stages (Honagbode, 2001). It is the integration of a new technology into existing practice and the extent to which farmers practice a new innovation in the future, given

adequate information about the technology and the potential benefits (Ntshangase, Muroyiwa, & Sibanda, 2018). The relevance of the latter definition in the field of agriculture should not be ignored. However, it is argued here that the future is uncertain and unspecific; thus, it is imperative, to promote farmers' acquisition of the innovations from the onset of the same. In this paper, the term adoption of the improved cassava processing technology refers to farmer's involvement in the pre-processing and processing tasks related to the improved cassava processing technology. It also includes utilisation of the processed cassava products such as HQCF, biscuits and bread. Pre-processing tasks are the activities that usually, accompany the improved cassava processing technology and that need to be accomplished before cassava is sent to the processing units. For example, timely uprooting the tubers and taking them to the processing site. Processing tasks are activities directly carried out that are interpreted as processing such as immediately washing after peeling, crushing, dewatering in the machines, drying the granules in the racks, milling and packaging. Lastly, utilisation of the processed cassava products refers to the consumption and use of the products made of cassava such as HQCF, biscuits, burns and bread.

Low acceptance to adoption of the innovated farming technologies has been reported in USA, whereby adoption rate of various precision agriculture technologies has not exceeded 22% across major U.S. field crops despite having introduced since 1990s (Daberkow & McBride, 2003; Schimmelpfennig, 2016). In Zambia, Arslan, McCarthy, Lipper, Asfaw, and Cattaneo (2013) informs about only 20% of adopters of conservation agriculture, within whom 80% were partial adopters despite its promotion for more than 15 years. In Nigeria, the better adoption rates of improved cassava processing technology (53%, 57.74% and 68%) are reported by Oparinde et al. (2016); Adebayo (2009); Abdoulaye et al. (2014) respectively. However, examining adoption of cassava processing techniques among rural women in Nigeria, Felicia and Olaniyi (2015) report low acceptance, whereby, 71% of respondents had adopted cassava processing techniques for a while and later abandoned. In Tanzania, introduction of the improved cassava processing technology about two decades ago went hand in hand with provision of grater and press machines for free among some farming groups and on credit to some Small and Medium Enterprises (SMEs) so as to commercialize cassava and improve farmers wellbeing (Keya & Rubaihayo, 2013). Unexpectedly to date, only about 15.9 percent of the provided processing units are in operation (Intermech Engineering Report Summary, 2003 – 2018).

The ramifications of low acceptance to adopt the improved cassava processing technology should not be ignored. In the first place, it is a means through which cassava value addition can be achieved for the improvement of farmers' livelihood as aspired by the AU Agenda 2063. The agenda looks forward for a prosperous Africa based on inclusive growth and sustainable development; with one of its goals being achievement of the modern agriculture for increased production, productivity and value addition. FAO (2016) and Hirschnitz-Garbers and Gosens (2015) argue that cassava productivity is a potential engine for the economic growth of African countries South of Sahara and in the world. This is due to the crop's potentiality in increasing employment opportunities, improved incomes of resource poor communities; being a source of livestock feed; serving as an industrial raw material and increasing foreign exchange earnings. Others are increasing interest in ethanol from renewable biomass for motor fuel (FAO, IFAD, & WFP, 2013; Hirschnitz-Garbers & Gosens, 2015).

For the realization of the expected positive outcomes of cassava value addition, adoption of the innovations related to the improved cassava processing is inevitable. In Nigeria, Abdoulaye et al. (2014) found that adoption of cassava processing machinery motivated an increase in cassava yields per hector, implying that if adoption of cassava processing technology improves, the livelihood of farmers might improve as well. Despite potential benefits associated with adoption of improved cassava processing technology in Tanzania, its adoption has remained low among farmers (Amaza, Abass, Bachenkiz, & Towo, 2016; Kapinga, Mafuru, Jeremiah, & Rwiza, 2015). Low adoption of improved cassava processing technology and continued use of traditional methods threatens technology innovations and development and thus, calls for investigation (Abel et al., 1998; Promar Consulting, 2011). This is because the world is rapidly changing in terms of extreme and hostile climatic conditions, the increasing demand

for value addition of the harvests, energy crops and the debates surrounding genetically modified crops. These demands compel farmers to plan ahead and be able to think flexibly to cope and succeed in farming (Darnhofer, Bellon, Dedieu, & Milestad, 2010).

Thus, one question raises curiosity in this study was what could explain such low acceptance to adopt the improved cassava processing technology. Addressing similar question, previous researches have associated adoption with extension services, rainfall variability and exposure to technology (Arslan et al., 2013). Adoption has also been associated with resource allocation, technological demands, business model incompatibilities and the process by which top management teams frame innovations (Raffaelli et al., 2016). Specific to adoption of improved cassava processing technology, some researchers have associated it with cassava yield, access to grating machines, organizational membership and training on cassava processing technology (Abdoulaye et al., 2014). Researches done in Tanzania indicate that attitude towards the technology (technology was perceived as tedious) and lack of raw materials (Match Maker Associate, 2012; Promar Consulting, 2011) retarded adoption of improved cassava processing technology. Other studies have associated low acceptance to adoption with farmers' demographics and their access to financial institutions (Honagbode, 2001; Okpukpara, 2010; Sewando, Mdoe, & Mutabazi, 2011) characteristics of the innovation and socioeconomic variables such as market and infrastructure (Felicia & Olaniyi, 2015; Mwangi & Kariuki, 2015). Despite the crucial role these factors play in explaining adoption, a critical scrutiny provokes cues for more curiosity because a farmer as an individual with personal inherent cognitive variables leading to decision making seems to be left out of investigation.

## 2. THEORETICAL UNDERPINNINGS

The assumption that there would be a relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology was analogous to plausible explanations by the social cognitive theory (SCT; (Bandura, 1997; Bandura, 2001)). The term cognitive flexibility refers to the dynamic activation and modification of the cognitive processes involved in response to changes in the demands of tasks (Varanda & Fernandes, 2015). It involves the readiness of the cognitive systems to adapt and shift attentional focus so as to select information necessary to meet the demands of the context or new task and generate new plans and activation patterns, and then provide feedback to the body system (Deák & Narasimham, 2003). In this study one was considered cognitively flexible when one is inclined to adaptation to new technologies, technology acceptance, and open Mindedness to other people's ideas.

There are several social cognitive models that have been developed to explain behavioral adoption and change, three of which are reviewed in this work. These are the Theory of Planned Behavior (TPB; (Ajzen, 1991; Ajzen & Madden, 1986)) The Behavior Change Wheel (BCW) framework (Michie, Van Stralen, & West, 2011) and The Social Cognitive Theory (SCT; Bandura (1977)). Generally, these social cognitive models put forward crucial proximal factors underlying the adoption and performance of a particular behavior. The TPB is an extension of the theory of the reasoned action (TRA; (Ajzen & Fisbein, 1980; Fisbein & Ajzen, 1975)). Both TRA and TPB assert that attitudes, subjective norms, perceived behavioral control, intention and behavior may have an element of action, target, context, and time. The TPB, however, adds a proposal that understanding one's adoption and change of behavior depends much in understanding the role of one's intention to behave and or one's perceived behavioral control. On the other hand, one's intention to behave results from one's attitude towards the behavior, subjective norms and one's perceived behavioral control. The Behaviour Change Wheel (BCW) framework (Michie et al., 2011) postulates that for any behaviour to occur the person performing the behaviour needs to have the physical and psychological Capability to perform the behaviour, the social and physical Opportunity to perform the behaviour, and be more Motivated to perform the target behaviour than any other behaviour in the moment and time that the target behaviour is performed.

The review of the social cognitive theories reveals an overlap of the main concepts of the constructs in these theories. For example, the construct perceived behavioral control in the TPB means the same as the construct self efficacy in the SCT. The same concept is coined and construed as physical and psychological capability in the BCW. While this overlapping construct seems to be the central focus of the cited social cognitive models, the SCT has comprehensively captured the role of cognitive variables and has the potentiality of developing intervention design. The SCT has also captured both personal and environmental variables, which are factors external to human mental processes. The SCT assumes existence of the reciprocal influence among personal factors, environmental factors and behavior. Such a triadic interconnectedness works in such a way that one's behavior is explained in a combination from the forces of both personal and environmental variables. Personal variables involve a wide range of characteristics that cannot be directly measured (usually affective and cognitive) to the directly measurable (usually physical ones). The assumption of this study positions cognitive flexibility as one among so many cognitive traits analogous to personal factors in SCT; while on the other hand, adoption of cassava processing technology is analogous to behaviour. Some environmental and other personal variables might act as the intervening variables in the presumed relationship between cognitive flexibility and adoption. For example, farmers' demographic variables such as sex, age, education level, training on improved cassava processing, intention to adopt and farmers' engagement in other economic activities have been found to correlate with adoption (Amaza et al., 2016; Honagbode, 2001; Okpukpara, 2010; Sewando et al., 2011). The relationship between cognitive flexibility was thus, studied using the blueprint illustrated in Figure 1, with the double arrows indicating the interrelationship among variables.

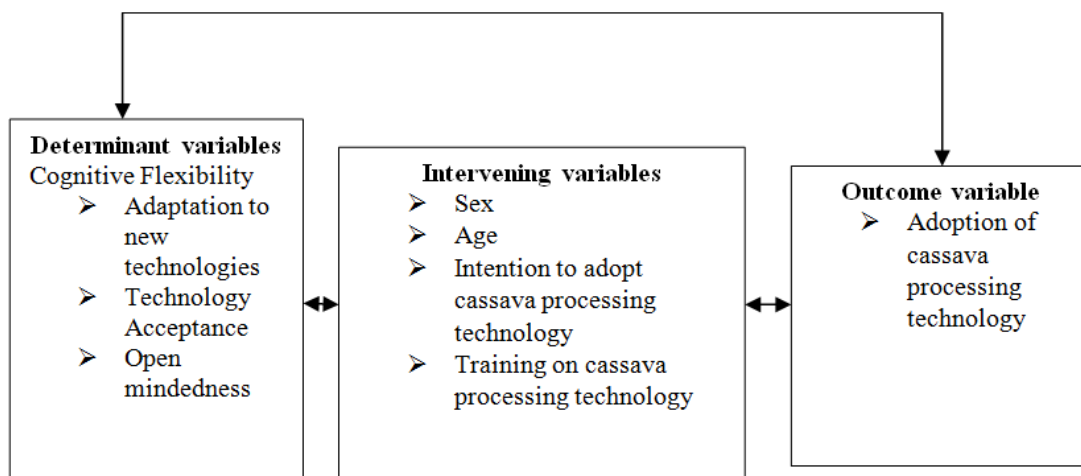


Figure-1. Conceptual framework on the relationship between cognitive flexibility and adoption. Source: Adopted from Barak and Levenberg (2016).

### 3. METHODOLOGY

#### 3.1. Study Design, Area and Sampling

This was a cross-sectional study conducted among cassava farmers in Serengeti, Sengerema, and Biharamulo Districts. The districts are found in Mara, Mwanza and Kagera regions respectively; in the Lake zone of Tanzania. Selection of these districts was due to their cassava farming potential and presence of the cassava processing sites. These criteria were considered relevant for the validity of information intended in the objective of the study. The target population for this study was cassava farmers in the catchment areas of the processing sites in operation. This was so because it was assumed that farmers with exposure to the cassava processing technology would be the reliable source of the relevant data with regard to its adoption. Two categories of cassava farmers were identified; first, farmers who were growing cassava and processed using the improved processing methods. The second category was farmers growing cassava but processed using traditional methods. Population of these farmers

in the areas serviced by the existing cassava processing units was not definite in terms of numbers. They were also scattered from various villages. Therefore, it was necessary to undertake purposive sampling through invitation. Consenting farmers were included in the sample, leading to a sample size of about 360 participants. The sample was composed of 181 (50.3%) males and 178 (49.7%) females. Participants were of heterogeneous nature. There were 174 (48.3%) young age group ( $\leq 35$  years), 84 (23.3%) middle age group (36 – 44 years), and 102 (28.3%) old age group (45+). In terms of education level, about 70 (19.4%) participants had no formal education, 138 (38.3%) reported primary education, and 152 (42.2%) had secondary education level or above. regarding economic activities, 183 (50.8%) reported only farming, 36 (10%) farming and business and 141 (39.2%) reported farming and other economic activities such as 'rearing cattle, poultry, casual labor in other farmers' farms, driving motor cycles, carpentry, selling charcoal and firewood, as well as bull-cart driving/dragging.

### 3.2. Data Collection Instruments

Questionnaire comprised of questions on both cognitive flexibility and adoption of cassava processing technology was administered. Questions capturing information on other variables such as sex, age, education level, economic activities, intention to adopt cassava processing technology and attendance on the training on cassava processing technology were also included in the same questionnaire. Cognitive flexibility was measured using cognitive flexibility scale (CFS). CFS was adopted from the Flexible Thinking in Learning Questionnaire (FTL) developed by Barak and Levenberg (2016). FTL was developed to measure learners' dispositional inclination to think flexibly in technology-enhanced learning. The instrument had 17 items measuring three main factors; namely technology acceptance, open mindedness and adapting to new situations. CFS had to be in place given the need to measure cognitive flexibility among farmers. Therefore, following the pilot study, the adopted CFS was found to be a three factor scale measuring adaptation to new farming technologies (AFT), technology acceptance (TA) and open mindedness (OM).

### 3.3. Validity and Reliability of the Instruments

CFS was found reliable in terms of its internal consistency. According to Barak and Levenberg (2016) the Flexible Thinking in Learning (FTL), from which CFS was adopted, has good internal consistency, with a Cronbach alpha coefficient of .91. In the present study, the Cronbach alpha coefficient for the CFS was .85. The internal consistency for the subscales in the FTL was reported as  $\alpha = .84$ ,  $\alpha = .90$  and  $\alpha = .84$  for adapting to new situations, technologies acceptance and open mindedness to other people's ideas respectively. In the present study, the Cronbach alpha coefficients for the subscales in the CFS were  $\alpha = .88$ ,  $\alpha = .86$  and  $\alpha = .80$  for adapting to new farming technologies, technologies acceptance and open mindedness to other people's ideas respectively.

Adoption of the improved cassava processing technology was measured using Cassava processing technology adoption scale (CPTA). CPTA is a three factor measurement scale made up of 18 items developed to measure three implementation stages of adoption of improved cassava processing technology. The three implementation stages are involvement in the pre-processing tasks, involvement in processing tasks, and utilization of the processed cassava products. The scale and its subscales reached acceptable reliability indices, greater or equal to  $\alpha = .7$  (Field, 2009; Pallant, 2011; Tabachnick & Fidell, 2007). The internal consistency indices were good for involvement in the pre-processing tasks ( $\alpha = .86$ ), involvement in the processing tasks ( $\alpha = .71$ ), utilization of the processed products ( $\alpha = .79$ ) and total adoption scale ( $\alpha = .93$ ) respectively. The scales also indicated low to moderate correlations among subscales. The correlations were  $r = -.32$  between involvement in the pre-processing tasks and involvement in the processing tasks subscales;  $r = -.23$  between involvement in the pre-processing tasks and utilization of the processed products; and  $r = .27$ , between involvement in the pre-processing tasks and utilization of the processed products. These correlations mean that the subscales measured the same trait of adoption and at the same time each subscale could be used as a measure of an independent subtheme.

### 3.4. Data Analysis

Questions soliciting information on variables such as sex, level of education, type of economic activities and intention to adopt cassava processing technology demanded categorical responses from respondents. Their coding for quantification was mainly nominal simply for categorization. On the other hand, the item in the CFS and CPTA scales demanded respondents to assign values to the numbers, and thus, quantifying the level of their flexibility and involvement respectively. Negatively worded items in these scales were reversed so that the higher the score the higher the level of both flexibility and involvement; and the lower the score the lower the level of both flexibility and involvement. To separate adopters from non – adopters in each of the three implementation stages of adoption, the mean score in each subscale was used as a cutoff point. So was the case with low versus high flexibility categories in each of the three subscales in the CFS. Such a categorization called for employment of chi – square statistical tool for analysis for checking the magnitude of association (through phi index) between adoption and cognitive flexibility. This was supplemented by the binary logistic regression analysis for the purpose of predicting the likelihood of farmers' adoption of improved cassava processing technology from cognitive flexibility upon controlling for other variables in the conceptual model.

## 4. RESULTS

In this section the findings are presented in two sub-sections. The first sub-section indicates the association between farmers' cognitive flexibility [adaptation to new farming technologies (AFT), technology acceptance (TA) and open mindedness (OM)] and adoption of improved cassava processing technology (involvement in pre-processing tasks, involvement in processing tasks and utilization of the processed cassava products).

### 4.1. Association between Farmers' Cognitive Flexibility and Adoption of Improved Cassava Processing Technology

A chi-square test for independence was performed to explore the association between farmers' cognitive flexibility and adoption. Table 1 shows the results.

#### 4.1.1. Association between Farmers' Cognitive Flexibility and Involvement in the Pre-Processing Tasks

Table 1 indicates that there was a significant difference,  $\chi^2(1, n = 360) = 4.64, p = .03, \phi = -.12$  in involvement in the pre-processing tasks with farmers' adaptation to new farming technologies. More farmers who reported high than their counterparts who reported low flexibility in adaptation of new farming technologies were more likely to report to have adopted the pre-processing tasks. However, the  $\phi = .12$  indicates that the magnitude of association was just small according to Cohen's criteria whereby a  $\phi$  value of .10 is considered small, .30 is moderate and .50 is high (Field, 2009; Pallant, 2011). On the other hand, there were no significant differences,  $\chi^2(1, n = 360) = 0.25, p = .62$  and  $\chi^2(1, n = 360) = 2.02$ , in adoption of the pre-processing tasks with farmers' technology acceptance (TA) and open mindedness (OM) to other peoples' ideas respectively. This can be interpreted that both farmers with low flexibility and their counterparts with high flexibility in acceptance to new farming technologies did not differ much in reporting involvement in pre-processing tasks. Neither did farmers with low nor high open mindedness differ in reporting involvement in pre-processing tasks. Any association observed might thus, be attributed to chance.

#### 4.1.2. Association between Farmers' Cognitive Flexibility and Involvement in the Processing Tasks

As shown in Table 1, there was no significant difference,  $\chi^2(1, n = 360) = 1.84, p = .18$  in farmers' involvement in the processing tasks with farmers' adaptation to new farming technology. Similarly, there was no significant difference,  $\chi^2(1, n = 360) = 0.35, p = .55$  in farmers' involvement in the improved processing tasks with farmers' technology acceptance. On the other hand, there was a significant difference,  $\chi^2(1, n = 360) = 11.64, p = .001, \phi = .19$  farmers' involvement in the improved processing tasks with farmers' open mindedness. This means

that farmers with high level of open mindedness to other people’s ideas were more likely to report involvement in processing tasks than respondents with low level of open mindedness. The magnitude of association was just small (Phi = 0.19).

**Table-1.** Association between farmers’ Cognitive Flexibility and adoption of the improved cassava processing technology.

| Cognitive Flexibility | Level | Adoption                                      |      |         |      | Chi-square test |    |       |      |
|-----------------------|-------|---|------|---------|------|-----------------|----|-------|------|
|                       |       | Involvement in the Pre-processing tasks       |      |         |      |                 |    |       |      |
|                       |       | Not adopted                                   |      | Adopted |      | X <sup>2</sup>  | df | p     | phi  |
| f                     | %     | f   | %    |         |      |                 |    |       |      |
| AFT                   | High  | 81  | 47.4 | 90      | 52.6 | 4.637           | 1  | .03   | 12   |
|                       | Low   | 112   | 59.3 | 77      | 40.7 |                 |    |       |      |
| TA                    | High  | 94  | 55.3 | 76      | 44.7 | .250            | 1  | .62   | 3    |
|                       | Low   | 99  | 52.1 | 91      | 47.9 |                 |    |       |      |
| OM                    | High  | 68  | 48.6 | 72      | 51.4 | 2.020           | 1  | .16   | 8    |
|                       | Low   | 125   | 56.8 | 95      | 43.2 |                 |    |       |      |
|                       |       | Involvement in the Processing tasks           |      |         |      |                 |    |       |      |
|                       |       | Not adopted                                   |      | Adopted |      |                 |    |       |      |
|                       |       | f   | %    | f       | %    | X <sup>2</sup>  | df | p     | phi  |
|                       |       |   |      |         |      |                 |    |       |      |
| AFT                   | High  | 206   | 57.2 | 154     | 42.8 | 1.835           | 1  | .176  | 7    |
|                       | Low   | 115   | 60.8 | 74      | 39.2 |                 |    |       |      |
| TA                    | High  | 94  | 55.3 | 76      | 44.7 | .351            | 1  | .553  | 4    |
|                       | Low   | 112   | 58.9 | 78      | 41.1 |                 |    |       |      |
| OM                    | High  | 64  | 45.7 | 76      | 54.3 | 11.637          | 1  | .001  | 19   |
|                       | Low   | 142   | 64.5 | 78      | 35.5 |                 |    |       |      |
|                       |       | Utilisation of the processed cassava products |      |         |      |                 |    |       |      |
|                       |       | Not adopted                                   |      | Adopted |      |                 |    |       |      |
|                       |       | f   | %    | f       | %    | X <sup>2</sup>  | df | p     | phi  |
|                       |       |   |      |         |      |                 |    |       |      |
| AFT                   | High  | 100   | 58.5 | 71      | 41.5 | .307            | 1  | .580  | 4    |
|                       | Low   | 104   | 55.0 | 85      | 45.0 |                 |    |       |      |
| TA                    | High  | 96  | 56.5 | 74      | 43.5 | .000            | 1  | 1.000 | 0.4  |
|                       | Low   | 108   | 56.8 | 82      | 43.2 |                 |    |       |      |
| OM                    | High  | 90  | 64.3 | 50      | 35.7 | 4.920           | 1  | .027  | 12.3 |
|                       | Low   | 114   | 51.8 | 106     | 48.2 |                 |    |       |      |

4.1.3. Association between Farmers’ Cognitive Flexibility and Utilization of the Cassava Processed Products

Results in Table 1 reveals no significant difference  $X^2(1, n = 360) = 0.31, p = .58$  in utilization of the cassava processed products with farmers’ adaptation to new farming technology, implying that farmers with low adaptation to new technologies did not differ much from farmers with high adaptation to new technologies in reporting utilisation of the cassava processed products. Similarly, there was no significant difference,  $X^2(1, n = 360) = 1.000, p = .04$  in utilisation of the cassava processed products with farmers’ technology acceptance. On the other hand, there was a significant difference,  $X^2(1, n = 360) = 4.92, p = 0.03, phi = 12.3$  in utilization of cassava processed products with farmers’ open mindedness. This means that farmers with high level of open mindedness to other people’s ideas were more likely to report utilization of the processed cassava products than respondents with low level of open mindedness to other peoples’ ideas.

4.2. Predicting the Likelihood of Adoption of Improved Cassava Processing Technology from Cognitive Flexibility.

Binary logistic regression analysis was performed to assess the likelihood of adoption from cognitive flexibility. All independent and intervening variables in the conceptual framework were concurrently entered in the model. The variables were age, sex, education level, engagement in other economic activities, attendance to training on cassava processing and intention to adopt improved cassava processing technology. Other variables were adapting to new farming technologies, acceptance of new farming technologies and open mindedness to other people’s ideas. It was assumed that these variables would uniquely contribute to the likelihood of reporting each implementation

stage of improved cassava processing technology (involvement in pre-processing tasks, involvement in processing tasks and utilization of the processed cassava products). The two models were statistically significant, [ $\chi^2 (12, N = 360) = 29.74, p < .003$ ] and [ $\chi^2 (12, N = 360) = 26.52, p < .009$ ], for involvement in the pre-processing tasks and involvement in the processing tasks respectively. This means that the models were capable of distinguishing respondents who reported from those who did not report adoption of improved cassava processing technology. However, the third model for utilisation of the processed cassava products was statistically insignificant [ $\chi^2 (12, N = 360) = 20.10, p < .067$ ], implying chancy possibility in distinguishing the adopters from non-adopters.

Regarding the contribution of the variables to each of the three models, [Table 2](#) indicates the details.

#### *4.2.1. Predicting the Likelihood of Farmers' Involvement in Pre-Processing Tasks from Cognitive Flexibility*

The model explained between 7.9% (Cox and Snell R square) and 10.6% (Nagelkerke R squared) of the variance in involvement in pre-processing tasks, and successfully categorised 58.3% of non-adopters. Information in [Table 2](#) indicates that only four variables (attendance to the training on improved cassava processing technology, adaptation to farming technologies, age and intention to adopt processing) uniquely contributed to farmers' involvement in pre-processing tasks. The strongest predictor of reporting involvement in pre-processing tasks was attendance to training (Odds Ratio = 3.94), meaning that respondents who attended training on improved cassava processing technology were 3.94 times more likely to report involvement in the pre-processing tasks, than their counterpart farmers who had not attended. Adaptation to farming technologies followed (Odds Ratio = 1.67), meaning that respondents with high level of flexibility in adaptation to new farming technologies were 1.67 times more likely to report involvement in pre-processing tasks than their counterparts with low level of flexibility in the same. Farmers' age followed (Odds Ratio = .97). This indicates that farmers in the older age groups were .97 times less likely to report involvement in pre-processing tasks than farmers in younger age group ( $< = 34$ ). For example, 50% of the 43.9 percent respondents with age group of  $< = 34$  reported involvement in pre – processing tasks. This was a bit higher than 44.2% and 42.2% out of 38.3 percent and 17.8 percent of farmers in 35 – 44 and 45 – 54 age groups respectively; who reported involvement in pre-processing technology. However, the noticeable differences were between the groups rather than within the groups. Other variables such as sex, education level, engagement in other economic activities, intention to adopt improved cassava processing technology, acceptance of new farming technologies, and open mindedness to other people's ideas did not explain involvement in pre-processing tasks.

#### *4.2.2. Predicting the Likelihood of Farmers' Involvement in Processing Tasks from Cognitive Flexibility*

The model for predicting involvement in the processing tasks explained between 7.1% (Cox and Snell R square) and 9.5% (Nagelkerke R squared) of the variance in involvement in processing tasks, and categorised 63.1% of non-adopters. Further, [Table 2](#) indicates that two variables (Open mindedness and attendance to training) uniquely contributed to farmers' involvement in processing tasks. Open mindedness was the strongest predictor of involvement in processing tasks (Odds Ratio = 2.15) implying that farmers with high level of open mindedness to other people's ideas were 2.15 times more likely to report involvement in processing tasks than respondents with low level of open mindedness flexibility. Attendance to training followed (Odds Ratio = 2.76). This meant that respondents who reported attendance to training on improved cassava processing technology were 2.76 times more likely to report involvement in the processing tasks than those who had not attended. Other variables such as sex, education level, engagement in other economic activities, intention to adopt improved cassava processing technology, acceptance of new farming technologies, and open mindedness did not explain involvement in processing tasks.



**Table-2.** Predicting the Likelihood of adoption of improved cassava processing technology from Cognitive Flexibility.

| Involvement in Pre-processing tasks           |        |      |        |    |      |             |                         |       |
|---|--------|------|--------|----|------|-------------|-------------------------|-------|
|   | B      | S.E. | Wald   | df | Sig. | Odds Ratios | 95% C.I. for Odds Ratio |       |
|   |        |      |        |    |      |             | Lower                   | Upper |
| Age   | -.032  | .016 | 3.790  | 1  | .052 | .969        | .938                    | 1.000 |
| Sex(1)  | -.089  | .223 | .159   | 1  | .690 | .915        | .590                    | 1.417 |
| Ednlevel(1)                                   | -.209  | .336 | .386   | 1  | .535 | .812        | .420                    | 1.568 |
| Ednlevel(2)                                   | .198   | .365 | .292   | 1  | .589 | 1.218       | .595                    | 2.494 |
| Econactivity(1)                               | .636   | .415 | 2.351  | 1  | .125 | 1.889       | .838                    | 4.258 |
| Econactivity(2)                               | -.168  | .315 | .283   | 1  | .595 | .846        | .456                    | 1.569 |
| Econactivity(3)                               | -.540  | .475 | 1.296  | 1  | .255 | .583        | .230                    | 1.477 |
| Everattend(1)                                 | 1.370  | .416 | 10.819 | 1  | .001 | 3.935       | 1.740                   | 8.901 |
| Intendprocess(1)                              | -.539  | .280 | 3.722  | 1  | .054 | .583        | .337                    | 1.009 |
| AFT3(1)                                       | .510   | .241 | 4.473  | 1  | .034 | 1.666       | 1.038                   | 2.673 |
| TA3(1)  | -.279  | .234 | 1.424  | 1  | .233 | .756        | .478                    | 1.196 |
| OM3(1)  | .172   | .235 | .532   | 1  | .466 | 1.187       | .748                    | 1.883 |
| Constant                                      | .917   | .709 | 1.675  | 1  | .196 | 2.502       |                         |       |
| Involvement in Processing Tasks               |        |      |        |    |      |             |                         |       |
| Age   | .004   | .016 | .050   | 1  | .823 | 1.004       | .972                    | 1.036 |
| Sex(1)  | .190   | .224 | .720   | 1  | .396 | 1.209       | .780                    | 1.875 |
| Ednlevel(1)                                   | .226   | .345 | .429   | 1  | .512 | 1.254       | .638                    | 2.465 |
| Ednlevel(2)                                   | .441   | .373 | 1.404  | 1  | .236 | 1.555       | .749                    | 3.227 |
| Econactivity(1)                               | .002   | .407 | .000   | 1  | .996 | 1.002       | .451                    | 2.225 |
| Econactivity(2)                               | .297   | .314 | .891   | 1  | .345 | 1.345       | .727                    | 2.491 |
| Econactivity(3)                               | .435   | .472 | .850   | 1  | .356 | 1.545       | .613                    | 3.893 |
| Everattend(1)                                 | 1.014  | .400 | 6.437  | 1  | .011 | 2.757       | 1.259                   | 6.035 |
| Intendprocess(1)                              | .201   | .275 | .535   | 1  | .465 | 1.223       | .713                    | 2.098 |
| AFT3(1)                                       | .104   | .240 | .187   | 1  | .665 | 1.110       | .693                    | 1.777 |
| TA3(1)  | .143   | .233 | .376   | 1  | .540 | 1.154       | .731                    | 1.821 |
| OM3(1)  | .764   | .235 | 10.539 | 1  | .001 | 2.148       | 1.354                   | 3.407 |
| Constant                                      | -1.530 | .716 | 4.564  | 1  | .033 | .217        |                         |       |
| Utilization of the processed cassava products |        |      |        |    |      |             |                         |       |
| Age   | .014   | .016 | .786   | 1  | .375 | 1.014       | .983                    | 1.047 |
| Sex(1)  | -.311  | .221 | 1.984  | 1  | .159 | .733        | .475                    | 1.130 |
| Ednlevel(1)                                   | -.191  | .332 | .331   | 1  | .565 | .826        | .431                    | 1.583 |
| Ednlevel(2)                                   | -.593  | .366 | 2.632  | 1  | .105 | .552        | .270                    | 1.131 |
| Econactivity(1)                               | .623   | .402 | 2.408  | 1  | .121 | 1.865       | .849                    | 4.100 |
| Econactivity(2)                               | .347   | .314 | 1.219  | 1  | .269 | 1.415       | .764                    | 2.619 |
| Econactivity(3)                               | -.301  | .483 | .388   | 1  | .533 | .740        | .287                    | 1.907 |
| Everattend(1)                                 | -.991  | .418 | 5.625  | 1  | .018 | .371        | .164                    | .842  |
| Intendprocess(1)                              | .261   | .272 | .927   | 1  | .336 | 1.299       | .763                    | 2.211 |
| AFT3(1)                                       | -.031  | .238 | .017   | 1  | .896 | .969        | .608                    | 1.545 |
| TA3(1)  | .006   | .230 | .001   | 1  | .978 | 1.006       | .641                    | 1.579 |
| OM3(1)  | -.568  | .237 | 5.730  | 1  | .017 | .567        | .356                    | .902  |
| Constant                                      | -.214  | .696 | .094   | 1  | .759 | .808        |                         |       |

#### 4.2.3. Predicting the Likelihood of Farmers' Utilisation of the Processed Cassava Processed Products from Cognitive Flexibility

The model for predicting utilisation of the cassava processed products explained between 5.4% (Cox and Snell R square) and 7.3% (Nagelkerke R squared) of the variance in utilisation of the cassava processed products. As indicated in Table 2, only two variables (open mindedness to other people's ideas and attendance to training on improved cassava processing technology) made unique statistically significant contribution to the model explaining utilization of the processed cassava products. Open mindedness to other people's ideas was the strongest predictor of utilization of the processed cassava products (Odds Ratio = 0.57), indicating that respondents with low level of open mindedness were 0.57 time less likely to report utilisation of the processed cassava products than their counterparts whose level of open mindedness was high. Attendance to the training on improved cassava processing

technology followed by recording odd ratio of 0.37, implying that farmers who had not attended training on cassava processing technology were 0.37 times less likely to report utilisation of the processed cassava products than farmers who had attended. Other variables such as sex, age, education level, engagement in other economic activities, intention to adopt improved cassava processing technology and acceptance of new farming technologies did not explain involvement in pre-processing tasks.

## 5. DISCUSSION

It has been found in this study that cognitive flexibility influenced adoption of improved cassava processing technology in all its three implementation stages. Besides, farmer's attendance to the training on improved cassava processing technology has been found to influence adoption, suggesting that some farmers for whom adoption of improved cassava processing technology is intended to be profitable are not fully aware of the same. These results are in line with findings by some previous studies (Abdoulaye et al., 2014; Bukchin & Kerret, 2018; Raffaelli et al., 2016). In their review paper (Bukchin & Kerret, 2018) report that in Israel; creativity, the trait specifically characterized by being independent, nonconformist, unconventional, openness to new experiences and cognitive flexibility explained adoption of farming technology. The same message is conveyed by Raffaelli et al. (2016) whose findings relates adoption of farming technologies to framing flexibility of the top management teams in incumbent organizations. This paper makes a departure in knowledge contribution by informing that the influence of cognitive flexibility on cassava processing technology is not uniform across the three implementation stages of adoption of the technology. While tendency to adaptation to new farming technologies explained involvement in pre-processing tasks, open mindedness to other people's ideas explained both involvement in processing tasks and utilization of the processed cassava products. The fact that attendance to the training on the improved cassava processing technology explained adoption in all its implementation stages clings the cues that training is required to enable farmers develop intention to adopt farming technologies. This is similar to the findings by Abdoulaye et al. (2014) that training on the introduced farming technologies was associated with adoption of the same and recommended that introduction of new technologies should be backed up by training and provision of complementary services.

Practical implications of these findings should not be ignored. Farmers live in the continuous and rapidly emerging changes in the world, including unexpected extreme climatic events, the demand for value addition of the harvests, energy crops and the debates surrounding genetically modified crops. In such a world, farmers need to learn to become cognitively flexible to cope and succeed in farming (Darnhofer et al., 2010). In daily arising new technologies and market strategies, agricultural companies and individual farmers have to make decisions to adopt new ways of life, failing of which might result into putting a farmer off road (O'Reilly & Tushman, 2016). To those who wish to invest in improved cassava processing technology, it should be clear to them that for successful adoption they need cognitive flexibility. For example they might start investing in grater and press machines with sun drying, while preparing for flexible framing to adopt when higher technologies such as flash driers become the order of the day, failure of which might lead to inability to withstand market competitiveness. To business company who think to invest in selling the processed cassava product, both training and cognitive flexibility are required to raise awareness and shift consumers' mind set from buying the products they are accustomed with to the use of cassava products. Theoretical implications are of two kinds. First, the findings support the postulates by SCT that personal variables (cognitive flexibility) and environmental variables (attendance to training) interact reciprocally to influence behaviour (adoption of improved cassava processing technology). Second, the conceptual framework developed for this study has been found significant and able to distinguish between farmers who reported non – adoption from those who reported adoption. This means that development of farmers' cognitive flexibility and assisting them through training on the cassava processing technology might help improve their adoption of improved cassava processing technology.

## 6. CONCLUSIONS

From the findings therefore, it is concluded that cognitive flexibility partly explains adoption of the improved cassava processing technology. Attendance to the training in improved cassava processing technology and intention to adopt improved cassava processing technology are also the variables influencing adoption. The power of influence of cognitive flexibility on adoption of the improved cassava processing technology differs depending with the implementation stage of adoption. Adaptation to new farming technologies tendencies seems to be more likely to explain involvement in pre-processing tasks. On the other hand, open mindedness to other people's ideas are more likely to explain both pre – processing and utilisation of the processed cassava products.

## 7. RECOMMENDATIONS

Innovations associated with cassava processing methods are many and progressive. This is so with the processed cassava products. Their adoption therefore, requires approaches for promoting cassava processing intervention to be flexible enough to produce sustainable responses to promotional efforts. To farmers, a need to develop cognitive flexibility tendencies is inevitable in this ever changing world with diverse innovations. To policy makers and promoters of cassava processing methods, promotion of the introduced cassava processing methods should go hand in hand with training in that particular promoted technology. Further, the conceptual model guiding this study argues that cognitive flexibility influences adoption of farming technology in general as it has been found to influence improved cassava processing technology controlling for other personal and environmental variables. This does not mean that cognitive flexibility is entirely able to explain adoption of cassava processing technology. Future research might find its way in investigating the roles farmers' cognitive and affective inter – relationship might play together to enhance adoption of farming technologies. A research studying variables influencing adoption might think of distinguishing between the type of innovation to be adopted whether incremental or non – incremental as these might set a line of demarcation as to what particular variable could have an impact while limited by other types of innovation (Raffaelli et al., 2016). Future research might search on whether or not farmers' past experience in dealing with challenging tasks might make difference in adoption of the newly introduced farming technologies. This is because past works informs the association between past experiences in dealing with similar challenges and performance in learning new tasks (Joshua, 2012; Joshua., 2014).

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