2.0 INTRODUCTION OF THE CASSAVA PROCESSING TECHNOLOGY ADOPTION SCALE (CPTA) AS A MEASUREMENT TOOL FOR ADOPTION OF IMPROVED CASSAVA PROCESSING TECHNOLOGY

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Abstract

With existence of everyday innovated agricultural technologies, researchers' curiosity on the adoption of farming technologies in general and on improved cassava processing technology in particular by farmers is increasingly. However, lack of effective instrument of measuring farmers' adoption of the improved cassava processing technology in particular has been restricting researchers from successfully predicting and describing the potential of farmers' adoption of technology. With such a restriction in mind, this paper intends to introduce Cassava Processing Technology Adoption scale (CPTA), as a valid and reliable instrument for measuring the adoption of improved cassava-processing technology. The tool was pilot - tested using across – section survey design conducted in Serengeti District in Mara region of Tanzania. The survey aimed at testing validity and reliability of the instrument among 200 participants purposively selected among cassava farmers, of these, 101 were males and 99 were females. The instrument measured three components of the adoption of improved cassava processing technology namely, involvement in the pre - processing tasks, involvement in the processing tasks, and utilization of the processed cassava products. The results indicate that the scale managed to categorize three implementation stages (sub - scale s) of adoption and reached reliability of $\alpha = .86$. $\alpha = .71$, and $\alpha = .79$ for involvement in the pre - processing tasks, involvement in the processing tasks, and utilization of the processed cassava products respectively. The reliability for the total adoption scale was $\alpha = .93$. There were low to moderate correlations among the three sub- scales indicating that they measured the same trait while at the same time they singly measured one implementation stage of the adoption of improved cassava processing technology. The instrument was further able to categorize participants in their performance by sex, age, and levels of education. The CPTA is, therefore, valid and reliable tool with multidimensional nature, which is relevant in measuring the adoption as a construct. It is, however, recommended that the tool requires further validation studies for more refinement as it is potential for application in other samples within and outside Tanzania. The paper discusses the potential applicability of the tool in the field of agriculture and its theoretical implications.

Key words: Socio - economic factors; Smallholder farmer; Value chain

1. Introduction

The existence of everyday innovated agricultural technologies attracts researchers' curiosity on farmers' adoption of farming technologies in general and on improved cassava processing technology in particular. However, lack of effective instrument of measuring farmers' adoption of improved cassava processing technology in particular has been restricting researchers from successfully predicting and describing the potential of farmers' adoption of the same. The term adoption has been defined in many ways depending on the field of study (Mwangi and Kariuki, 2015). For example, in the diffusion of innovation studies the term adoption is defined as a mental process through which an individual passes from hearing about an innovation to its implementation that follows awareness, interest, evaluation, trial, and implementation stages (Honagbode,2001). Adoptionis also defined as the integration of a new technology into the existing practice (Loevinsohn, Sumberg, and Diagne, 2012).More specifically in the agricultural technologies, the term refers to the extent to which farmers put into practice a new innovation in the future, given adequate information about the technology and the potential benefits (Ntshangase, Muroyiwa, and Sibanda, 2018). While the latter definition seems more relevant in the field of agriculture, it is unclear as to why farmers are expected to put into practice the innovations in the future rather than at the onset of the technology. The present paper agrees that adoption should be conceptualized as a process as Honagbode (2001) puts it, yet the definition remains too broad to measure. It is therefore, arguable that unless the process is reduced into measurable implementation stages, the term adoption will lack the common understanding among researchers.

Adoption is a very important behaviour when it comes to the development of any technology innovation. This is because the ongoing innovated technologies have become a key to economic, social, political, and cultural development in human history since time immemorial though today the world is rapidly changing. Regarding agricultural technologies, the process of diffusion of innovations seems to follow the pattern whereby the source of innovation is usually agricultural researchers and food technologists while farmers play the recipient role of innovations through the education provided by extension agents (TARP II SUA, 2005). This pattern makes farmers' respond to the innovated technologies in terms of acceptance or rejection, to play the determinant role as to whether the technologies will be supported or not; and thus, achieving the purposes of innovating the technology. Common understanding is thus required among researchers and professionals on what constitutes adoption and how it can be measured, analyzed, summarized, and interpreted,

To measure successfully the adoption of farming technologies such as improved cassava processing, decisions must be made regarding how to measure adoption because a range of its conceptual definitions are not in common measurable criteria. In spite of the need to incorporate each criterion defining adoption of farming technologies in all implementation stages (Honagbode, 2001), it is usually difficult to implement this need in practice, since the contexts in question might determine what to include. For example, studying the adoption of Conservation Farming (CF) in Zambia, Arslan*et al,* (2013) excludes information on rotation in the adoption of CF despite their acknowledgement of the role of inclusion of all practices associated with the same in the ideal definition.

Thus, it is possible to distinguish farmers who have adopted a particular type of technology from their counterparts who have not based on the set criteria. From the reviewed literature in Tanzania, many researchers have measured the adoption in a discrete nature with binary response variables. This was simply done by indicating that the farmer was either the adopter or non-adopter of the technologies taking values of zero for the non-adopter and one for the adopter (Udensi *et al*,2011; Tarawali*et al*, 2012; Nyanda, 2015; Mombo, Pieniak, and Vandermeulen, 2016; Salum, 2016; Ntshangase,Muroyiwa, and Sibanda, 2018).

The argument in the present work is that this dichotomous approach in measuring adoption is suitable where the technology in question and the adoption assessment criterion are common to both the researcher and the farmers. Where the technology, is new and where the adoption criteria are many and not unanimously known among researchers and farmers, the criteria for measuring the adoption need to be known in measurable terms and in advance. For example, in measuring the adoption of chemical weed control among farmers in Panama, Martinez and Sain (1983) measured four measurable variables such as chemical weed control, the type of product, application time, and application rate. To measure chemical weed control, researchers measured whether the farmer used chemical weed control; and the type of product was measured by checking whether the farmer used Gesaprim or Gramoxone; application time was measured by looking at whether the farmer applied the Gesaprim within 0-5 days after planting and whether the farmer applied Gramoxone within 0-35 days after planting. Lastly, application rate was measured by looking at whether or not the farmer applied Gesaprim 1-3kg/ha, and Gramoxone at 1-3lt/ha. Such a multi variables approach of measuring the adoption of agricultural technologies is favoured in this work. However, the review found lack of measurement instrument specifically for measuring the adoption of cassava processing technology, thus, the necessity of developing Cassava Processing Technology Adoption scale (CPTA).

According to Social Cognitive Theory (SCT) Bandura (1997) informs that human behaviour is influenced in a reciprocal relationship by both personal and environmental variables. According to SCT, self and society, personal determinants such as cognitive, affective, and biological stimulus; behavioural patterns and environmental stimulus interactively determine each other in a bidirectional way (Bandura, 1997). From such a theoretical line of argument, exposure to the object is a key to the development of behaviour through observational learning. As one interacts with the object, one learns to become or imitates the rewarding aspects of the object and rejects the punishing aspects of the same object. This theoretical view enlightens our understanding of how social or environmental factors that influence individual's cognitive processes, which in turn, influence the adoption of the improved cassava processing technology. Therefore, guided by the SCT, this study intended to study CPTA focusing on three components, namely, involvement in the pre - processing tasks, involvement in the processing tasks and utilization of the cassava-processed products. These components are hereby defined as implementation stages of the adoption of improved cassava processing technology. Authors in this paper define the term involvement in the pre - processing tasks, as the activities that usually, accompany the improved cassava processing technology that need to be accomplished before cassava is sent to the processing units. The term involvement in the processing tasks is defined in this work as the engagement in activities directly carried out during processing such as immediately washing after pealing and taking the washed cassava to the cassava processing machines to obtain High Quality Cassava Flour (HQCF). The term utilization of the processed cassava products is hereby described as the use or consumption of the products made of cassava such as HQCF, biscuits, burns, bread, and the like.

2. Methodology

2.1 Development and Design

The study took a quantitative approach under which cross – sectional survey design was employed, whereby data were concurrently collected. The study was carried out in Serengeti District, which is located on the Eastern part of Mara region. The district was selected because it is one of the areas hosting the improved cassava processing units; it is also potential for the actual cassava growing plans and practice (Serengeti Agriculture Office, 2018). Development of the CPTA was crucial following a need of measuring farmers' adoption of cassava processing technology specifically in Tanzania. Illuminated by the past technology adoption measures, the measuring criteria were developed basing on the tasks which were expected to cover cassava processing technology. The criteria were further established through discussions with three Senior Agricultural Officers who have experience in cassava processing technology. As such, the adoption of the improved cassava processing technology is defined as the extent of farmers' involvement in the pre- processing and processing tasks, and utilization of the processed cassava products, given adequate information about the technology and the potential advantages. The processed products involve but not limited to high quality cassava flour (HQCF), biscuits, bread, starch, ethanol; just to mention a few (Hirschnitz-Garbers*et al*, 2015). The technology employs the use of machines, accompanied by some requirements such as timely harvesting (between 6 and 12 months after planting depending on the cassava variety), processing done within 24 hours after harvesting, pealing and washing of the roots to remove impurities. It also involves grating and dewatering using modern mechanized machines such as grater and the press respectively; drying or roasting as well as milling and packaging.

The discussion resulted into 18 items, which were then translated into Kiswahili language. The translation was done by two experienced translators. The first translator translated from English to Kiswahili and the second expert back translated the Kiswahili version into English. Both translations were harmonized by the researcher and then discussed with the three experts in the field of agriculture to obtain the version which was pilot tested. The pilot tested CPTA comprised of 18 items, presented in a 5-point scale including always involved, usually involved, sometimes involved, rarely involved, and not involved. Data collection followed a cross section design in the sense that data were collected at one point in time since information was self-reported from the same individuals and could be reported concurrently without affecting the results.

The study targeted the population of farmers cultivating cassava around the areas where the improved cassava processing units exist. Two categories of farmers were identified namely, cassava growers who also processed cassava using improved cassava processing technology, and farmers who were growing cassava and processing their cassava using traditional methods. With indefinite population frame and the scattered nature of the target population, purposive sampling was opted for through invitation whereby a farmer who consented and appeared in the cassava-processing unit was included in the sample. About 200 participants in all two processing units available in the district were selected. The sample-involved participants of diverse nature as indicated in Table 1. Age classification was done during the analysis basing on the report by Fin Scope Tanzania (2017). According to Fin Scope Tanzania (2017), farmers in Tanzania are of diverse nature including youth and the elderly whereby dedicated farmers aged between 18 and 24 years constituted 26percent of all farmers; between 25 and 44 years were 45 percent and 45+ years were 21 percent. Thus, participants were within the productive age (18 – 64). The same report informs that farming is carried out by both educated and non-educated farmers as follows, no formal education were 15 percent, primary education were 65 percent, secondary education were 18 percent and tertiary education were 3 percent. In addition, farming is usually done by both males and females practicing farming in a combination of other economic activities. Table 1 is the detailed categorization of the sample and their proportion in the study.

Table 1: Characteristics of Participants

Variables	Levels	Proportion *f*	%
Sex	Males	101	50.5
	Females	99	49.5
Age	<= 35	67	33.5
	36 – 44	76	38.0
	45+	57	28.5
The Highest Education level of the Respondent	No formal education	37	18.5
	Primary education	77	38.5
	Secondary education and above	86	43.0
Economic Activities	Only farming	102	51.0
	Farming and business	83	41.0
	Farming and other economic activities	15	7.5

Other economic activities mentioned by 7.5 percent as indicated in Table 1 include cattle rearing, poultry, driving motor cycles for commercial purposes, carpentry, selling charcoal and firewood, and bull-cart pushing/dragging. As Table 1 indicates, the results from CPTA using characteristics of the sample would be reliable given both representative and prototype nature of the sample included.

2.2 *Data collection and analysis*

After introduction and explaining the purpose of the visit, farmers were asked for their informed consent to participate in the study. Among the participants, few farmers could not read and write properly. This group was separated and have their questionnaires filled with the assistance of researchers who had to read for the farmers and document the responses. On the other hand, , the CPTA questionnaire, pencils and rubbers were distributed to the group of farmers who had no problems with writing and the researcher read the items and the participants wrote their responses on the questionnaire.

The 18 items of the of the Cassava Processing Technology adoption scale (CPTA) were entered in the SPSS version 21. The CPTA consists of both negatively and positively worded items. The negatively worded items were reversed so that high score in a particular sub– scale indicated high level of adoption while low score indicated low adoption. The reversed items were CPTA10, CPTA11, CPTA13, CPTA14, CPTA15, CPTA16, CPTA17, and CPTA18. Each sub - scale was then totalized separately to obtain the scores for each sub – scale. The three sub – scales are:

Involvement in the pre- processing tasks: The sub - scale is made of 8 CPTA items. The items are CPTA1, CPTA2, CPTA3, CPTA14, CPTA15, CPTA16, CPTA17, and CPTA18. The central theme bringing these items in a common cluster is their intent to know whether the farmer is practicing the tasks mandatory to be accomplished before cassava is placed in the machines.

Involvement in processing tasks: The sub - scale is made of 3 CPTA items. The items are CPTA4, CPTA5, and CPTA6.These items assess farmers' involvement in the tasks, which are directly carried out during the processing in the factory.

Utilization of the processed products: The sub - scale is made of 6 CPTA items. The items are CPTA7, CPTA8, CPTA9, CPTA10, CPTA11, and CPTA12. This sub – scale high level of adoption where the farmer not only has adopted cassava processing technology for the business purposes but has also enjoyed the consumption of the products made of the cassava processed using the improved technology.

The score for the entire CPTA scale was obtained by totalizing the scores for each of the sub - scale. To categorize the groups of adopters, the total scores for each sub - scale and for the entire CPTA scale were binned in a one-third ratio so that the three categories reflected the original responses in the CPTA. The lower one third represented the non-adopters category, the middle one third represented the partial adopters 'category and the higher one third represented the adopters' category.

3.0 Results

Reliability of the CPTA

CPTA is a three-factor measurement scale comprised of 18 items measured in a three-point scale; namely, Not Involved, partially involved, and Involved. The three factors (sub - scale s) of the CPTA are involvement in the pre - processing tasks, processing tasks, and utilization of the processed products. The analysis of results revealed that both sub – scales and the entire scale reached an acceptable reliability index (greater or equal to 0.7, Tabachnick and Fidel, 2007; Field, 2009; Pallant, 2011). These were $\alpha = .86$. $\alpha = .71$, $\alpha = .79$, and $\alpha = .93$ for involvement in the pre - processing tasks, the processing tasks, utilization of the processed products, and total adoption scale respectively. Concerning validity, there were low to high correlations among sub - scales and between each sub - scale and total scale.

Validity of the CPTA

The correlations were: significant moderate negative correlation ($r = -.32$, $p < .01$) between the involvement in the pre - processing tasks and the involvement in the processing tasks sub - scale

s. There was low but significant negative correlation (r = -.23, $p < .01$) between the involvement in the pre - processing tasks and the utilization of the processed products. And there was low but significant negative correlation (r = .270, $p < .01$) between the involvement in the pre - processing tasks and the utilization of the processed products. Other correlations were: significant moderate positive correlation (r = .35, $p < .01$) between the involvement in the pre - processing tasks and the total adoption scale. There was significantly high positive correlation (r = .60, $p < .01$) between the involvement in the processing tasks and the total adoption scale. And there was high positive correlation (r = .61, $p < .01$) between the utilization of the processed products and the total adoption scale. These correlations imply that the sub - scale s measure common trait of adoption and at the same time each sub - scale can be used as a measure of an independent subtheme.

Performances in the CPTA Scale

The analysis of results has indicated that, CPTA was able to discriminate farmers in their adoption of cassava processing technology by sex, age group, and education level. All these demographics were distinguished in all three implementation stages (sub – scales) of the adoption of cassava processing technology. Tables 2 through5 present farmers' performances in the three-implementation stages (sub – scales) of the adoption (involvement in the pre – processing tasks, the involvement in processing tasks and utilization of the processed cassava products) by farmers' demographics

Table 2: Performances in the CPTA

			Responses					
			Not Adopted		Partially Adopted		Adopted	
Sub-scale	Mean	Std. Deviation	*f*	%	*f*	%	*f*	%
Involvement in the Pre - processing Tasks	24.22	3.81	85	42.5	49	24.5	66	33.0
Involvement in the processing tasks	7.88	3.62	77	38.5	67	33.5	56	28.0
Utilization of the Processed Products	18.71	3.25	70	35.0	68	34.0	62	31.0
Total Adoption Scale	50.80	5.49	75	37.5	60	30.0	65	32.5

Table 2 indicates that, about most (75) (37.5% of the) participants were non - adopters compared to 32 percent (65) of adopters in the total CPTA. Similar results were observed in all the sub - scales of the CPTA. In addition, though relatively, partial adopters were fewer than were in each of the rest of the groups in the total CPTA, their proportion was significantly high, promising the potential increase of the adoption in the future.

Table 3: Performances in the CPTA Scale by Sex

Sub-scale	Responses											
	Males (N=101)						Females (N=99)					
	Not Adopted		Partially Adopted		Adopted		Not Adopted		Partially Adopted		Adopted	
	F	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Involvement in the Pre - processing Tasks	42	41.6	26	25.7	33	32.7	43	43.4	23	23.2	33	33.3
Involvement in the processing tasks	30	29.7	40	39.6	31	30.7	40	40.4	28	28.3	31	31.3
Utilization of the Processed Products	43	42.6	32	31.7	26	25.7	34	34.3	35	35.4	30	30.3
Total Adoption Scale	32	31.7	40	39.6	29	28.7	43	43.4	20	20.2	36	36.4

Table 3 indicates that more females about 36.4 percent (36) than males about 28.7 percent (29) reported to have adopted cassava-processing technology in the total CPTA. On the other hand, more males about 39.6 percent (40) than females about 20.2 percent (20) reported partial adoption, promising potential increase of adoption among males in the future

Table 4: Performances in the CPTA Scale by Level of Education

Sub-scale	Responses																	
	No formal Education (N = 37)						Primary Education (N = 77)						Secondary and Above (N = 86)					
	Not Adopted		Partially Adopted		Adopted		Not Adopted		Partially Adopted		Adopted		Not Adopted		Partially Adopted		Adopted	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Involvement in the Pre - processing Tasks	14	37.8	9	24.3	14	37.8	32	41.6	20	26.0	25	32.5	39	45.3	20	23.3	27	31.4
Involvement in the processing tasks	15	40.5	11	29.7	11	29.7	30	39.0	25	32.5	22	28.6	32	37.2	31	36.0	23	26.7
Utilization of the Processed Products	12	32.4	13	35.1	12	32.4	29	37.7	24	31.2	24	31.2	29	33.7	31	36.0	26	30.2
Total Adoption Scale	10	27.0	16	43.2	11	29.7	35	45.5	16	20.8	26	33.8	30	34.9	28	32.6	28	32.6

Table 4 indicates that more farmers 33.8% (26) with primary education than followed by 32.6 percent (28) with secondary education and 29.7 percent (11) with no formal education adopted improved cassava processing technology. However, the difference was minimal

Table 5: Performances in the CPTA Scale by Age Group

Sub-scale	Responses																	
	<= 35 (N = 67)						36– 44 (N =76)						45+ (N = 57)					
	Not Adopted		Partially Adopted		Adopted		Not Adopted		Partially Adopted		Adopted		Not Adopted		Partially Adopted		Adopted	
	f	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*	*f*	*%*
Involvement in the Pre - processing Tasks	34	50.7	11	16.4	22	32.8	28	36.8	22	28.9	26	34.2	23	40.4	16	28.1	18	31.6
Involvement in the processing tasks	24	35.8	23	34.3	20	29.9	30	39.5	26	34.2	20	26.3	23	40.4	18	31.6	16	28.1
Utilization of the Processed Products	23	34.3	22	32.8	22	32.8	31	40.8	25	32.9	20	26.3	16	28.1	21	36.8	20	35.1
Total Adoption Scale	**26**	**38.8**	**20**	**29.9**	**21**	**31.3**	**28**	**36.8**	**21**	**27.6**	**27**	**35.5**	**21**	**36.8**	**19**	**33.3**	**17**	**29.8**

Discussion

The analysis of results has indicated that, CPTA is an effective instrument of measuring farmers' adoption of improved cassava processing technology. The instrument is potentially useful in its application both as research tool for researchers and as a self-assessment tool among farmers. It can be used to assess individual differences in the adoption of improved cassava processing technology and as a framework for the development of measurement instrument for other agricultural technologies among farmers. As a self-assessment instrument, farmers can use CPTA reflectively to measure and raise awareness on several aspects related to the ongoing improved cassava processing technologies. The instrument is also potential for generalizability in other samples and contexts provided the level of cassava processing technology is similar to the level of technology where the instrument has been pilot-tested. There are also possibilities of its applicability with the adoption of all other agricultural technologies provided the restatement of the items is geared towards the crop or technology in question. Its applicability to other farmers is possible due to the heterogeneous distribution nature of the sample at which the instrument has been tested.

In the present sample, the proportion structure of farmers in terms of education level [no formal education (18.5%), primary education (38.5%), secondary education and above (43%) and tertiary education (3)], was slightly different from what was reported by Fin Scope Tanzania (2017) [no formal education (15%), primary education (65%), secondary education and above (21%)]. However, the results in terms of the adoption reflect the same picture whereby the adoption of the technology increased with an increase of the level of formal education. Likewise, the results revealed that the adoption was higher among farmers with middle and older age (between 36 and 54) than in young ages (< = 35). These findings are similar to those in Fin Scope Tanzania (2017) that revealed that dedication of farmers in the productive age group was lower among farmers in the young age group (16 -24) and higher among farmers aged between 25 and 54 years. However, the application of the CPTA with other studies needs to be handled with care due to some likelihood of its limitations. First, since the instrument was pilot – tested for the first time in the cassava processing technology among farmers in Tanzania, it was not possible to make comparison with other past studies in terms of reliability and validity of the instrument. Second, the instrument was developed and tested among farmers in the country with low level of cassava processing technology. This implies that the instrument might need to be contextualized with the increasing levels of cassava processing technology. For example, in cultures with high levels of cassava processing technology, and where the processing is automated, the items related to processing stages such as washing and pealing, which are purely manual, might need to be restated to reflect the levels of technology reached. Yet such items are relatively too negligible to raise doubts against the applicability of the CPTA.

The analysis of CPTA has brought to light a serendipitous observation. Most of the respondents reported involvement in the pre - processing tasks, which are necessary before the genesis of processing tasks and the utilization of the processed products. The number of adopters decreased in the involvement in the processing tasks but increased in the utilization of the processed tasks. This might mean that those who adopt the pre - processing tasks are the foundation or potential adopters of the next stage tasks; namely, the involvement in the processing tasks; however, it is not necessarily that only the adopters of the early stages will adopt the last stage of utilization of the processed products. This means that even non - adopters of the early two categories of tasks might adopt the last stage of utilization of the processed products provided they are exposed to the products. This assumption is in line with the arguments propounded in the social cognitive theory (Bandura, 1997). The theory holds that observational learning brings in cognitive skills, preconceptions, and value preferences of the observers, all of which determine what a person is more likely to adopt. For a person to be influenced by the observed object, he/she must be able to remember the object. In addition, for more possibility of adoption, the retention of the object in one’s mind must take place because what a person retains in the mind regarding the object exerts biases about the object. At the same time, acquisition of the behaviour undergoes an evaluation of positive and negative outcomes because people are more likely to engage in a modelled behaviour if the behaviour brings the valued outcomes than is the case if it brings unrewarding or punishing outcomes to the role model. In this regard, people might adopt some tasks of the same technology that they consider rewarding and consciously decide to reject those aspects of the technology that they consider punishing. Even when people realize the advantages of an action, they do not automatically adopt it but rather they compare the action with their personal moral standards. Then people are more likely to pursue the actions that they judge as self-satisfying and that bring them worth in the society and reject the activities that they personally disapprove. In the same line of argument, Krosnick *et al.* (2005) holds that a person is likely to possess in the mind so many connections with a particular object, each of the connections might have evaluative implications. When a summary of the person's evaluation toward the object is required, then one gives an index of the total summary depending on the points of emphasis the researcher requires. The mechanism for translating cognition into action involves both transformational and generative operations. The execution of a skill must be constantly varied to suit the changing circumstances. Adaptive performance, therefore, requires a generative conception rather than a one-to-one mapping between cognitive representation and action (Bandura, 2001).

4.0 Conclusions and Recommendation

This paper intended to introduce Cassava Processing Technology Adoption scale (CPTA), as a valid and reliable instrument for measuring the adoption of improved cassava processing technology. The results indicate that the tool is structured into three implementation stages (sub - scales), namely; the involvement in the pre - processing tasks, the involvement in the processing tasks, and utilization of the processed cassava products. Both sub - scales and the entire scale reached an acceptable reliability indices and discriminant validity among sub - scales indicating their ability to measure common behaviour (adoption) and at the same time independently measure different implementation stages of the adoption of improved cassava processing technology. It is therefore concluded that the CPTA is an effective tool for measuring the adoption of improved cassava processing technology. It is also a valid, reliable, and potential instrument for farmer's self-assessment regarding their adoption tendencies. Further, the adoption of farming technology is well captured when its diverse aspects of implementation stages are included in the measurement scales than when it is measured as a uni-dimension trait. It is recommended that researchers in the adoption of the improved cassava processing technology should use CPTA scale in measuring farmers' adoption of cassava processing technology and the adoption of technology across other crops. However, before generalizing these findings to other samples, researchers need to consider the level of technology and the exposure of the technology, whose adoption is to be evaluated. This is because according to SCT, which has been supported by these results, exposure to the object is a key to the development of behaviour through observational learning. Thus, the adoption of improved cassava processing technology as a cognitive process can successfully be measured where the technology has been introduced and farmers have been exposed to it**.** Future research can focus on improving the instrument through validation studies by testing its effectiveness in measuring the adoption of technologies in other crops.

References

Arslan, A., McCarthy, N., Lipper, L., Asfaw, S. and Cattaneo, A. (2013). Adoption and intensity of adoption of conservation farming practices in Zambia. *Agricultural Development Economics Division (ESA) Working paper No. 13-01.30pp.*

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control.* Freeman, New York. 604pp

Bandura, A. (2001). Social Cognitive Theory of Mass Communication. *Media Psychology,* 3: 265–299

Field, A. (2009). *Discovering Statistics Using SPSS*. London: Sage Publications, 821pp.

FinScope Tanzania. (2017). Dedicated farmers: Their needs how can they be served? *Agriculture Niche Report, 2017*. 66pp.

Honagbode, A. C. (2001). *The role of off-farm income and gender issues in technology adoption in farming families in Southern Benin*. A PhD thesis submitted to University of Hohenheim, Germany.

Hirschnitz-Garbers, M. and Gosens, J.(2015).*Producing Bio-Ethanol from Residues and Wastes: A Technology With Enormous Potential in Need of Further Research and Development.* Policy Brief No. 2. Berlin. 12pp.

Krosnick, J.A., Judd C.M., and Wittenbrink, B. (2005). *Attitude measurement. In D. Albrracin, B.T. Johnson, and M.P. Zanna (Ed), Handbook of attitudes and attitude change.* Mahwa, NJ: Erlbaum. 77pp.

Loevinsohn, M., Sumberg, J., Diagne, A. (2012). *Under what circumstances and Conditions does adoption of technology result in increased agricultural productivity? Protocol.* London: EPPI Centre, Social Science Research Unit, Institute of Education, University of London.

Mombo, F., Pieniak, Z., and Vandermeulen, V. (2016). Modelling Environmental Attitudes of the Users of Kilombero Valley Wetlands, Tanzania. *Journal of Water Resource and Protection, 8, 1078-1089.*

Mwangi, M. and Kariuki, S. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development*, 6 (5), 208-216

Ntshangase, N.L., Muroyiwa, B. and Sibanda, M. (2018). Farmers' Perceptions and Factors Influencing the Adoption of No-Till Conservation Agriculture by Small-Scale Farmers in Zashuke, KwaZulu-Natal Province. *Sustainability*, 10, 555, 1-16, doi: 10.3390/su10020555

Nyanda, D.S. (2015). Factors influencing adoption of improved cassava production technologies in Mkuranga District, Tanzania. *A dissertation submitted in partial fulfilment of the requirements for the degree of masters of science in Agricultural Education and Extension Sokoine university of Agriculture.*

Panama, Martinez, J.C, and Sain, G. (1983) as cited by CIMMYT Economics Program.

(1993). *The Adoption of Agricultural Technology: A Guide for Survey Design*. Mexico, D.F.: CIMMYT. 88pp.

Pallant, J. (2011). *Spss Survival Manual*: A step by step guide to data analysis using

SPSS. CrowsNest: Allenand Unwin, 345pp.

Salum, A.K. (2016). Factors Influencing Adoption of Improved Cassava Varieties in

Increasing Farm Yield. A Case of Magharibi District, Zanzibar, Tanzania. *A Dissertation Submitted In Partial Fulfilment of The Requirements for the Degree of Master of Science In Agricultural Education and Extension of Sokoine University of Agriculture. Morogoro, Tanzania*.85pp.

Tabachnick, B. G.,and Fidel, L.S. (2007). *Using Maltivariate Statistics*. Boston: Pearson

Education Inc, 980pp.

Tarawali, G., Iyangbe, C., Udensi, U.E., Ilona, P., Osun, T., Okater, C., and Asumugha,

G.N. (2012). Commercial-scale adoption of improved cassava varieties: A baseline study to highlight constraints of large-scale cassava based agro-processing industries in Southern Nigeria. *Journal of Food, Agriculture and Environment.10 (3and4), 689-694.*

TARP II SUA (2005). *Adoption of Technologies for Sustainable Livelihoods*: Assessment of the

effects of TARP II-SUA research projects Sokoine University of Agriculture, Morogoro, Tanzania. 312pp.

Salum, A.K. (2016). Factors Influencing Adoption of Improved Cassava Varieties in

Increasing Farm Yield. A Case of Magharibi District, Zanzibar, Tanzania. *A Dissertation Submitted In Partial Fulfilment of The Requirements for the Degree of Master of Science In Agricultural Education and Extension of Sokoine University of Agriculture. Morogoro, Tanzania*.85pp.

SerengetiAgriculture Office (2008). Improving cassava production at Miseke village in Serengeti

District. *Unpublished Official Information Document*: Serengeti District Council.

Udensi, U.E., Tarawali, G., Favour, E.U., Asumugha, A., Ezedinma, C., Okoye, B.C.,

Okarter, C., Ilona, P., Okechukwu, R., and Dixon A. (2011). Adoption of selected improved cassava varieties among smallholder farmers in South-Eastern Nigeria. *Journal of Food, Agriculture and Environment, 9 (1), pp 329-335.*