COGNITIVE CORRELATES OF ADOPTION OF IMPROVED CASSAVA PROCESSING TECHNOLOGIES AMONG FARMERS IN THE LAKE ZONE, TANZANIA

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A THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY OF THE SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA

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EXTENDED ABSTRACT

Low acceptance and adoption of farming technologies has been reported in various studies from both developed and developing countries. In Tanzania, an attempt to modernise cassava processing with modern technology has received low acceptance, thus, low adoption rates. Previous studies on low adoption rates of the improved cassava processing technology, however, have placed little emphasis on cognitive variables in their conceptual models. Consequently, little is known of how technology adoption is influenced by cognitive and behavioural factors. Through the psychological approach and with application of the Social Cognitive Theory, this study sought to investigate cognitive correlates of adoption of improved cassava processing technology among farmers in Tanzania. This study specifically sought to; examine the relationship between the farmers' attitudes towards improved cassava processing technology and its adoption; investigate the relationship between the farmers' perceived self-efficacy and adoption of the improved cassava processing technology; examine the relationship between the farmers' cognitive flexibility and adoption of improved cassava processing technology; and to explain adoption of the improved cassava processing technology from cognitive viewpoint when all intervening variables are put under control. Data were collected using a cross–sectional survey among purposively selected sample of 360 respondents. The sample included 181 (50.3%) males and 179 (49.7%) females from Mara, Mwanza and Kagera regions in Tanzania. The study respondents were exposed to a questionnaire with instruments that measured attitude, perceived self–efficacy, cognitive flexibility and adoption of the improved cassava processing technology. The questionnaire also comprised of socio-demographic variables such as age, sex, education level, training on cassava processing technology, participation in other economic activities and intention to adopt.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS V. 21). The Component Principle Analysis was used to check the psychometric structures of the scales; Chi square for independence was used to check the association between cognitive traits and adoption; The Pearson product moment correlation analysis was performed to assess correlation among cognitive traits and between them and adoption; and binary logistic analysis supplemented the analyses to explain adoption from cognitive traits while controlling for other non–cognitive variables. Binary logistic regression analysis indicated that cognitive traits such as attitude, perceived self–efficacy, cognitive flexibility as well as one non–cognitive trait (training on improved cassava processing technology) explained adoption of improved cassava processing technology. The thesis indicates that each cognitive trait explain adoption in specific implementation stage differently from the other. The thesis concludes that cognitive traits such as attitude towards improved cassava processing technology, perceived self–efficacy and cognitive flexibility partly explain adoption of the improved cassava processing technologies. It is recommended to adoption promotion agents including the Government and non-government stakeholders that from the onset of introduction of the cassava processing technologies, training that is given to farmers should be tailored in a way that it may enlist cognitive traits among the farmers. This may help improve adoption of improved cassava processing technologies in all its implementation stages.

DECLARATION

I, JOEL MATIKU JOSHUA, do hereby declare to the senate of the Sokoine University of Agriculture that this thesis is my own original work done within the period of registration, and that it has neither been submitted nor is it being concurrently submitted in any other institution for a similar degree or any other award.

Joel Matiku Joshua (PhD Candidate)	Date
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I thank the Almighty God of the Universe for His vigilance and grace over me throughout all the period I worked on this thesis. I also thank my parents for their patience during my childhood, the time which resulted in the existence of the Author of this thesis. Special thanks are extended to my family, who remained patient all the time when the work leading to this thesis seemed to separate us for a while. I do acknowledge technical supervision from the Department of Development Studies of the Sokoine University of Agriculture and the permission to conduct research in this area of interest. I specifically, thank Prof. Fatihiya Ally Massawe and Dr. Amani Angumbwike Mwakalapuka for their tireless supervision, without which, this thesis could not take its current form. I further acknowledge the assistance I received from the Regional Administrative Secretaries, District Administrative Secretaries, and Agricultural officers in the districts where data were collected during research. Special thanks are extended to the Village Executive Officers and all respondents whose support made this work successful. I further appreciate the constructive comments from members of the Department of Development Studies such as Prof. K. Kayunze, Prof. Mhando, Prof. J. Jeckoniah, Prof. Urasa, Dr. Hashim, Dr. T. Malisa, and Dr. G. Massawe. Their comments shaped this thesis document to its present form. I, however, declare that I remain responsible for the strengths and weaknesses of this thesis.

DEDICATION

This work is dedicated to all cassava farmers in Tanzania.

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1. Joshua, J. M., Massawe, F. A. and Mwakalapuka, A. A. (2020a). Introduction of the cassava processing technology adoption scale (CPTA) as a measurement tool for adoption of improved cassava processing technology. *African Journal of Accounting and Social Science Studies*, 2(1), 21-35.
2. Joshua, J. M., Massawe, F. A. and Mwakalapuka, A. A. (2020b). The relationship between farmers' attitude towards the improved cassava processing technology and adoption. *International Journal of Agricultural Extension and Rural Development Studies,* 7 (1), 12-26.
3. Joshua, J. M., Massawe, F. A. and Mwakalapuka, A. A. (2020c). Validation of the Perceived Self-Efficacy Scale (PSE) Among Cassava Farmers in Tanzania. *Journal of Education, Humanities and Social Sciences* 9(1), 18 – 34.
4. Joshua, J. M., Massawe, F.A. and Mwakalapuka, A. A. (2020d). The relationship between farmers' perceived self–efficacy and adoption of improved cassava processing technology. *Accepted in East African Journal of Social Sciences and Humanities.*
5. Joshua, J. M., Massawe, F. A. and Mwakalapuka, A. A. (2020e). Validation of the cognitive flexibility scale (CFS) and its application in adoption of improved cassava technologies among cassava growers in Tanzania. *IFE PsychologIA*. 28(1), 142-158.
6. Joshua, J. M., Massawe, F. A. and Mwakalapuka, A. A. (2020f). The relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology. *International Journal of Asian Social Science.* 10(11), 685-697.
7. Joshua, J.M., Massawe, F.A. and Mwakalapuka, A.A. (2020g). Cognitive predictors of the likelihood of adoption of improved cassava processing technology. *British Journal of Psychology Research*, 28(1), 142-158.
8. Joshua, J.M., and Massawe, (2020h). Post-reform developments in the commercialization of cassava sub-sector. *Book Chaper* (Submitted).

DECLARATION

I, JOEL MATIKU JOSHUA, do hereby declare to the Senate of Sokoine University of Agriculture that the listed papers above that make this thesis summarize my independent efforts, it is my original work and will not be part of another thesis in the “published Papers” format in any other University.

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ACPT	Attitude towards Cassava Processing Technology
ATs	Adaptation to New Technologies
AU	African Union
BAQ	Blog Attitude Questionnaire
CAVAII	Cassava Adding Value for Africa Phase Two
CFS	Cognitive Flexibility Scales
CPTA	Cassava Processing Technology Adoption
FAO	Food and Agriculture Organization
FTL	Flexible Thinking in Learning Questionnaire
HCN	Hydrocyanic Acid
HQCF	High Quality Cassava Flour
NGOs	Non–Government Organizations
PATT-SQ	Pupils' Attitude toward Technology Short Questionnaire
PSE	Perceived Self–Efficacy
SCT	Social Cognitive Theory
SDGs	Sustainable Development Goals
SMEs	Small and Medium Enterprises
SPSS	Statistical Package for Social Sciences
TA	Technology Acceptance
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UNDP	United Nations Development Program

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Low acceptance of farming technologies has been reported as a problem in, both, developed and developing countries (Daberkow and McBride, 2003; Arslan, McCarthy, Lipper, Asfaw, and Cattaneo, 2013; Felicia and Olaniyi, 2015; Schimmelpfennig, 2016; Raffaelli, Glynn and Tushman, 2018). The same has generally been reported in Tanzania and specific to improved cassava processing technologies (Kapinga, Mafuru, Jeremiah and Rwiza, 2015; Amaza, Abass, Bachwenkiz and Towo, 2016; Intermech Engineering, 2018). Improved cassava processing technologies, also known as improved processing methods, involve production of high quality cassava flour (HQCF) and other products such as biscuits, bread, starch, ethanol, just to mention a few (Hirschnitz-Garbers, 2015).

Improved cassava processing employs the use of machines accompanied by some requirements such as timely harvesting (6 or 9 months after planting depending on cassava variety), processing being done within 24 hours after harvesting as well as pealing and washing of roots to remove impurities. It also involves grating and dewatering using modern mechanized machines such as grater and the press; drying or roasting as well as milling and packaging (Grace, Loyce, Rhoda, Beatus, and Tito, 2018). Conceivably, adoption of cassava processing technology in this study is not limited to possession of the cassava processing machines, whether in groups or individually. It captures the individual farmer's involvement in the pre–processing tasks, involvement in the processing tasks and their readiness to utilize the processing services provided in the processing units for pay. It also captures buying the processed cassava products such as HQCF, biscuits, breads or any other products made from the improved cassava processing technology.

Improved cassava processing technology is opposed to traditional processing methods, whereby cassava roots are soaked in water or covered using cassava leaves for some days for fermentation. After fermentation, they are spread on the sand or flat rocky surface where they can be dried to form dry cassava known as *makopa* in Kiswahili. In some areas, the roots are crashed before sun-drying, while in other areas they are dried without undertaking the fermentation process. Traditional processing methods differ from one area to the other in Tanzania (Keya and Rubaihayo, 2013).

The traditional processing methods have long been associated with poor quality of the cassava products (Keya and Rubaihayo, 2013). The argument by these authors is supported by FAO (2013) and Hirschnitz-Garbers (2015), who, in addition to the quality issue, associate traditional processing methods with problems such as depletion of starch, protein and fat in the cassava; sour or bitter taste of the flour and contamination with dust during the drying process. The authors further argue that carcinogenic compounds, such as hydrocyanic acid [HCN] are commonly retained in the traditionally processed cassava flower due to poor de-watering and that the compounds have been reported to be highly lethal, thus, unfit for human consumption. To address the problems associated with traditional cassava processing methods, the government of Tanzania has been promoting modernization of cassava processing technologies by providing processing machines such as graters and press to, both, cassava farmers' groups and Small and Medium Enterprises (SMEs) on credit (Silayo, 2003).

The anticipated modernization in cassava focused on value addition to the cassava products which would consequently improve income of the cassava farmers and the health of cassava consumers. Reports, however, show low acceptance of the use of the technology. There are also very few previously provided processing machines in

operation (Intermech Engineering, 2018). In Butiama District in Mara region, for example, of the 15 processing units (set of the processing machines) provided back in 2010, only one was in operation during the time this research was conducted (2018). In Serengeti District of the same region, two out of five units were in operation. In the entire country, it was estimated that only 75 units out of the 427 were in operation (Intermech Engineering, 2018). This is about 15.9 percent of all the provided processing units. One is likely to think of durability and maintenance issues in explaining dysfunction of the processing units. It was surprising to note that some machines which were provided for free to some farmers' groups had not been used for processing but were kept in the homes waiting for show casing during '*nanenane'* week (a week in Tanzania dedicated for farmers to celebrate and showcase their successful farming practices).

In the infusion of innovation studies, the term adoption is a mental process through which an individual passes from hearing about an innovation to its implementation. The whole process follows the awareness, interest, evaluation, trial, and implementation stages (Honagbode, 2001). This characterization places adoption as a cognitive process. It also evokes the cues that the concept should not be an event but the process with several implementation stages. Thus, when adoption underperforms it is logical to trace the cognitive variables that might have lead to adoption's underperformance through its implementation stages.

According to Promar Consulting (2011) and Asmelash (2014), low acceptance and adoption of the improved cassava processing technology among rural communities and, specifically, by farmers in Tanzania is partly responsible for the continued use of traditional methods in Cassava processing. Asmelash proceeds in reporting that studies elsewhere on why improved cassava processing units have not operated as expected

indicate that the technology was perceived as tedious, demanding significant labour force. Likewise, Promar Consulting adds that farmers in the rural areas have resisted processing their cassava in the availed machines, thus, the machines lacked raw materials and became dysfunctional.

Previous studies have assessed some determinants of the adoption of cassava processing technology relating to the farmers' demographic and environmental characteristics such as access to financial credits (Okpukpara, 2010; Sewando, Mdoe and Mutabazi, 2011; Muzari, Gatsi and Muvhunzi, 2012). However, the fact that the contexts of Nigeria and Ethiopia from which some of these studies were conducted, are different from Tanzania indicates that the reported factors do not necessarily imply in Tanzania. Others have looked at the characteristics of the innovation and socio – economic variables such as market and infrastructure (Tedla, 2011; Muzari, Gatsi and Muvhunzi, 2012; Ayodele *et al*., 2011; Mwangi and Kariuki 2015; Felicia and Olaniyi, 2015). These factors, however, have not adequately captured factors inherent to individual farmers, which are to a great extent independent of the external variables such as infrastructure and access to technology.

Preliminary information from Serengeti District indicated 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 but, to date, many farmers in the catchment areas have preferred their traditional processing methods to the improved technology (Serengeti District Agriculture Office, 2018). This brings in the questions addressed in Joshua *et al.* (2020g): "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?" (pp. 2). Since adoption has been conceptualized as a

mental process, it is natural that any failure to adopt would logically call for curiosity in what might have gone wrong in the mental processes. The interest of the present study, thus, was based on cognitive attributes that may explain the farmers' resistance to adoption of improved cassava processing technology despite its relative advantages over traditional processing methods.

Studying cognitive variables in relation to adoption of cassava processing technology is a curious response to the postulates of the Social Cognitive Theory (SCT) as expounded by Bandura (1977; 1986). This thesis thus, takes psychological approach and uses SCT to study low acceptance and adoption of improved cassava processing technologies among farmers in Tanzania. According to the theory, any behaviour is a product of a person's reciprocal relationship with both personal and environmental variables. Environmental variables refer to physical and social factors external to the person that provide opportunities and individual's social support. Examples of environmental variables are social factors such as one's own family, neighbours and friends; and physical factors such as farm size, financial credits and cassava processing machines available around. Personal variables refer to any biological, demographic and cognitive factors characterizing a person.

Taking a psychological route to study farming technologies in general and specifically, cognitive correlates of adoption of improved cassava processing technologies was imperative. Firstly, despite the existence of the SCT and its plausible explanations, hardly could the researcher find review of previous studies on cognitive correlates of adoption of improved cassava processing technologies. Likewise, most previous studies were not guided by SCT to study cognitive correlates of improved cassava processing technology in Tanzania.

Secondly, although some previous studies have enquired on the relationship between attitudes and adoption of farming technologies, the studies which directly assessed such a relationship with cassava processing technology (Ogunsumi, 2011; Sewando, Mdoe and Mutabazi, 2011; Krichanont, Opal and Suneeporn 2014; Nyanda, 2015; Felicia and Olaniyi, 2015; Mombo, Pieniak and Vandermeulen, 2016 and Salum, 2016), reported mixed findings. For example, while some studies reported negative attitude (Felicia and Olaniyi, 2015) others reported positive attitude towards the technologies among farmers (Salum, 2016). Further, most literature reviewed did very little to show specific components of attitude determining adoption, particularly in cassava technology. Furthermore, the extent to which attitude towards improved cassava processing technology influenced adoption of the same in Tanzania was not covered. Based on this background, paper two of this thesis addressed the relationship between attitude towards improved cassava processing technologies and adoption (Joshua *et al.,* 2020b).

Thirdly, although previous studies acknowledge that perceived self–efficacy was associated with a number of human behaviours such as dental flossing, seat belt use, physical activity, dust mask wearing and dietary behaviours (Schwarzer, Schüz and Ziegelmann *et al.*, 2007; Schwarzer, 2016); little was covered on whether or not perceived self–efficacy could explain adoption of improved cassava processing technology among farmers in Tanzania. In addition, curiosity was on the specific components of self–efficacy that could specifically explain the implementation stages of adoption of improved cassava processing technology. Paper four of this thesis (Joshua *et al.,* 2020d), thus, addressed the relationship between perceived self–efficacy and adoption of improved cassava processing technology among farmers in Tanzania.

Fourth, most definitions of adoption refer to the necessity of cognitive traits as part of characterization of the concept itself. For example, Honagbode (2001) characterizes adoption with cognitive concepts such as mental process, awareness, interest, and evaluation. In addition, conception of adoption involves integration of a new technology into existing practice, given adequate information about the technology and the potential benefits (Loevinsohn, Sumberg and Diagne, 2012; Ntshangase, Muroyiwa and Sibanda, 2018). It is thus; logically convincing that when adoption is low there might be something to check in the cognitive system that might retard adoption. Past researchers did little if any in addressing how farmer's cognitive system is able to flexibly shift from traditional cassava processing technologies to the improved cassava processing technologies. That is why paper six of this thesis (Joshua *et al.,* 2020f) examined the relationship between farmers' cognitive flexibility and adoption of improved cassava processing technologies.

Fifth, although four papers in this thesis address cognitive variables as correlates of adoption of cassava processing technologies, these variables were dealt with in isolation from one another. Also, other studies indicate that it is imperative to include farmers' demographics such as sex, age, education level; and training on improved cassava processing, intention to adopt and farmers' engagement in other economic activities. In the studies involving cognitive correlates, however the demographic variables may confound the results on the relationship between cognitive variables and the target behaviour (Honogbode, 2001; Tabachnick, and Fidell, 2007; Okpukpara, 2010; Sewando, Mdoe and Mutabazi, 2011; Amaza *et al.,* 2016). In addition, despite the emphasis by the social cognitive theory that cognitive variables such as self–efficacy, attitude, and cognitive flexibility are key elements in behavioural determination and change, it is important to note that there some environmental factors that are likely to interfere with such a relationship. These are such as policy, laws and regulations, markets, labour force,

and infrastructures. That understanding was the motive of manuscript one, which was designed to position cassava processing technology in the entire cassava value chain and its commercialization evolutions in the Tanzania. In addition, it was not clear as to whether or not these cognitive variables are able to explain adoption upon controlling farmers' demographics and other variables reported in literature. Paper seven of this thesis, therefore, sought to predict adoption of improved cassava processing technologies from cognitive variables when other variables such as level and type of technology, training on cassava processing technology, education level, participation in other economic activities, sex, age and intention to adopt cassava processing technology are held constant.

1.2 Statement of the Problem

The present study seeks to address low acceptance and adoption of the improved cassava processing technology among cassava farmers. Previous studies have associated low acceptance and adoption with variables such as access to financial institutions, age, sex, marital status, household size, religiosity, education level, attitude, membership of the association, costs of the improved cassava processing technology, access to credit, access to extension services, farm size, and access to market (Mwangi and Kariuki 2015; Felicia and Olaniyi, 2015). Most of these variables, however, are non – cognitive in nature and not inherent to individual farmers. Plausible explanations by Social Cognitive Theory propose that cognitive variables such as attitude, self–efficacy and cognitive flexibility account for human behaviour (Bandura, 1977) such as adoption. Although attitude, which is a cognitive variable, has been reported to influence adoption, in most research in Tanzania, it has been measured dichotomously and thus, it is unclear from the past studies as to which specific component of attitude influenced which implementation stage of adoption of improved cassava processing technology.

Studies conducted elsewhere outside Tanzania, have associated self – efficacy with self-examination (Luszczynska and Schwarzer, 2005), physical exercise (Scholz, Sniehotta and Schwarzer, 2005); dental flossing, seat belt use, physical activity, dust mask wearing and dietary behaviours (Schwarzer, Schüz and Ziegelmann *et al.*, 2007; Schwarzer, 2016). In Tanzania, Kyaruzi (2019) reports the association between student's mathematics self–efficacy and mathematics performance. Not only studies associating cognitive flexibility and adoption of cassava processing technology in Tanzania are missing, but also, from the previous studies, it remains unclear as to what specific components of self – efficacy and cognitive flexibility influences which implementation stage of adoption of cassava processing technology. Therefore, this thesis is designed to investigate the cognitive correlates of adoption of the improved cassava processing technology in Lake Zone, Tanzania.

1.3 Justification for the Study

The study leading to this thesis has been in place timely and important as it contributes to the implementation of Sustainable Development Goals (SDGs) and African Union (AU) Agenda 2063, both of which look forward for achievement of the modern agriculture for increased production, productivity and value addition, which are believed to contribute to farmer and national prosperity and Africa's collective food security (Hirschnitz-Garbers, 2015; ECOSOC, 2016, UNDP, 2016). Lastly, the study is deemed timely and important given its contribution to the body of knowledge regarding cognitive correlates of adopting cassava processing technology. In the first place academicians will benefit from the information in the published articles including the newly introduced instruments measuring some of the cognitive traits studied in this thesis. The tools can be applied to other agricultural crops among farmers within and outside Tanzania. Conducting this study is also important as it might lead to understanding the factors, which if applied for

intervention might lead to the poverty reduction among farmers in the country, as a result of subsequent growth of cassava processing technologies.

1.4 Objectives of the Study

(i) The overall objective of this thesis study was to establish cognitive correlates of adoption of improved cassava processing technology among cassava farmers in Lake zone, Tanzania.

(ii) The overall objective was realized through the following specific objectives:

1. Establish the relationship between farmers' attitudes and adoption of improved cassava processing technology.
    a. Review post – reform developments in the commercialization of cassava sub – sector in Tanzania
    b. Develop and introduce cassava processing technology adoption scale (CPTA)
    c. Examine the relationship between farmers' attitudes and adoption of improved cassava processing technology
2. Investigate the relationship between farmers' perceived self-efficacy and adoption of improved cassava processing technology
    a. To validate the Perceived Self – Efficacy (PSE) scale among cassava farmers in Tanzania
    b. Explore the relationship between farmers' perceived self – efficacy and adoption of improved cassava processing technology
3. Examine the relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology
    a. To validate and apply the Cognitive Flexibility Scale (CFS) in adoption of improved cassava processing technologies among cassava growers in Tanzania
    b. Analyse the relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology

4. Explain the adoption of the improved cassava processing technology from cognitive variables when other personal and environmental variables are held constant.

1.5 Research Hypotheses

1. There is a relationship between farmers' attitudes and adoption of improved cassava processing technology
2. There is a relationship between farmers' perceived self-efficacy and adoption of improved cassava processing technology
3. There is a relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology
4. Cognitive variables explain adoption of the improved cassava processing technology when other personal and environmental variables are put under control.

1.6 Conceptual Framework

Understanding the nature of low acceptance and adoption of 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 and empirical studies on the determinants of behaviour change and adoption. Social Cognitive Theory (SCT) is has to the large extent informed the development of the conceptual framework guiding this study. According to LaMorte (2019) the development of SCT followed the modification of the Social Learning Theory (SLT) by Bandura in 1986. LaMorte proceeds in describing that SLT is in view that there is a dynamic reciprocal interaction of a person with all past experiences, environment, and behaviour. It is also postulated that people are capable of performing an actual behaviour through essential knowledge and skills. According to the

theory, one's behaviour is changed as a result of the way such behaviour affects the environment in which one lives.

The SLT further argues that people can witness and observe others exhibit behaviour and imitate the behaviour through modelling. According to this argument, people are capable of successfully imitate the rewarding than the punishing behaviour. Once the imitated behaviour is initiated people could hardly maintain the behaviour without reinforcement. Reinforcement, which can be either positive or negative, comes from the environment and thus, environmental factors become very important variables in this model. Yet the environmental variables connect with one's outcome expectations for successful adoption and maintenance of the adopted behaviour.

The modifications from SLT to SCT added self – efficacy construct in the model, making self – efficacy a key to behavioural change explanations. Self – efficacy is described by LaMorte (2019) as one's confidence in one's ability to successfully perform behaviour. The SCT has been criticised for its silence on how changes in the environment automatically leads to person's behaviour change. Also it is accused for its inability to tell the extent to which each variable influences other variables, its silence on biological and hormonal predispositions, as well as its silence on the role of emotions and motivation on behaviours regardless of past experience. However, since the central focus of the present study was not on causality but correlates, the criticisms addressed in this paragraph could not affect the research process.

The conceptual framework that guided this study assumed existence of a reciprocal relationship among the variables. It is postulated that one may or may not adopt any target behaviour depending on the extent to which one's personal and environmental variables interact to operate as forces towards internalization of the target behaviour. One's

adoption of the behaviour may also influence one's personal and environmental variables in a reciprocal way.

The assumption is illustrated in in Figure 1.1. The framework is comprised of the Determinant, Intervening and Outcome Variables. It is assumed that the reciprocal relationship exists between attitude, perceived self–efficacy, cognitive flexibility; and adoption of improved cassava processing technologies. It was expected that relative to their counterparts with positive attitude, farmers with negative attitude towards the improved cassava processing technology will demonstrate low acceptance of the technology. Likewise, positive correlation was expected between the scores in perceived self–efficacy scale and adoption of the improved cassava processing technology.

It was further assumed that cognitive flexibility ability would be positively correlated with adoption of cassava processing technology. However, other personal variables such as sex, age, intention to adopt cassava processing technology, education level, training on cassava processing technology might intervene the relationship between cognitive variables and adoption of cassava processing technology. The model recognises the role of environmental factors such as policies, laws and regulations, market for cassava products, labour costs and infrastructures in determining adoption of cassava processing technology. The double arrows imply the reciprocal relationship among variables.

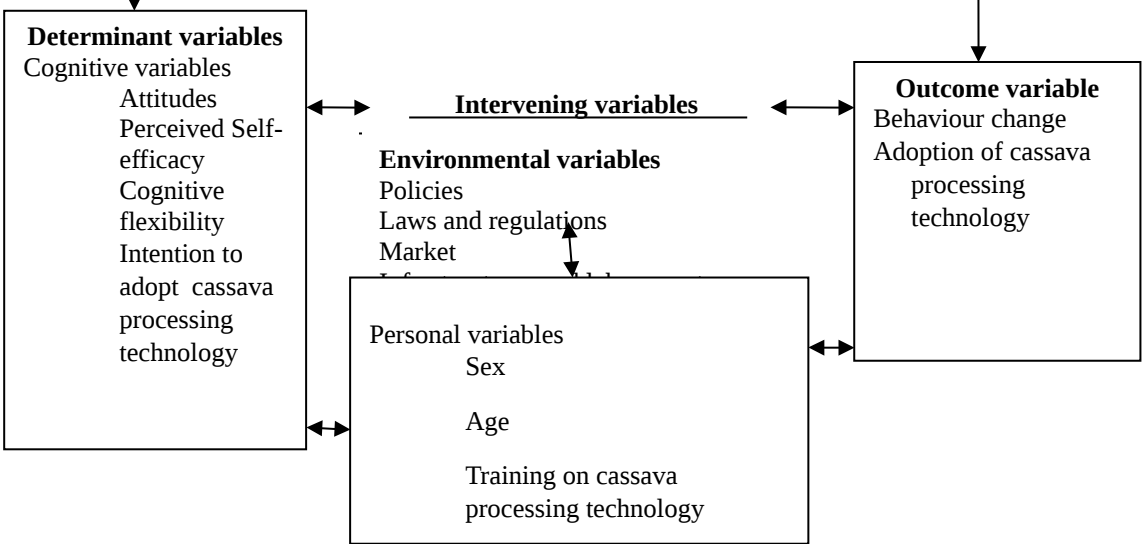

Figure 1.1: Conceptual Framework Deduced from SCT and TPB Models
Source: Bandura, 1977; Ijzen, 2001; Barak and Levenberg, 2016.

1.7 Methodology

1.7.1 Philosophical orientation

Researcher in this study shares philosophical stance with both positivism and interpretivism world views. With positivists, this work shares belief that reality is external to researcher so that its properties should be studied through objective rather than subjective methods. Such methods must take rigorous process of scientific investigation (Gray, 2013). It is from the positivism world view where quantitative approach in research is prioritized (Critelton and Seers, 2001; Scotland, 2012). This is because the objective truth can be deduced from a theory or hypothesis through scientific knowledge (Mack, 2010). Following this shared belief, variables formulating the specific objectives of this study were deduced from the Social Cognitive Theory and Theory of Planned Behaviour. The choice of positivism approach took into consideration the nature of the study whereby theoretical plausible explanations were to be tested for their match in explaining acceptance and adoption of cassava processing technology. This was in line with the purpose, the research objectives, and hypotheses of this study as it was intended to explain relationships; and generate quantitative data from which predictions and generalizations could be made.

Researcher is also aware of the opposing interpretative world view which denies existence of the objective reality but puts much emphasis on the multiple realities as a

result of different perception of reality by various persons (Mack, 2010; Creswell, 2009). As such, interpretative philosophy underpins the general approach of qualitative research, focusing on understanding, explaining, and demystifying social reality through the eyes of different participants (Cohen *et al.*, 2007). Since the nature of this study and its objectives were to great extent opposed to the interpretive philosophical world view, researcher preferred the positivism to interpretivism without ruling out some useful beliefs of interpretive philosophical world view. For example, in the situation where there are sound theoretical plausible explanations of the phenomenon, but without theoretical proposed instruments measuring the theoretical constructs, as it was in the case for this study, it was necessary to solicit experts' opinions through discussions for deciding on the indicators required to measure the constructs. This has been discussed in details in the instrumentations sub – section.

1.7.2 Research approach

Following afore mentioned discussion, this study employed the quantitative research approach without ignoring the use of some aspects of qualitative approach where demand was aroused. For example, although qualitative data were not required to achieve the specific objectives of this study, it was necessary to make some discussions with experts (Key informants) in the field of agriculture and psychometric fields. This was important during the development of instruments measuring key variables of the study as explained in specific methodologies of the papers. In addition, consultations with agriculture officers were useful for pointing out the locations where useful information to address objectives of the study could be obtained. Awareness of the weaknesses of quantitative approach ere not concealed to researcher. Some scholars believe that quantitative research methods are inflexible because the instruments cannot be modified once the study begins (Ingham, 1993). Again, quantitative approach is accused for inaccuracy and

incompleteness of information due to non – interactive nature of the questionnaire (Ingham, 1993; Mertens, 1998; Johnson, 2014). In this study, these weaknesses were minimized by piloting the research instruments prior to their administration to a larger sample. This allowed the researcher to modify the items that were not easily understood or which seemed to be ambiguous to respondents. In addition, collection of data was done by researcher in person together with trained research assistants. This minimised the chances of receiving incomplete questionnaires while at the same time enabling the researcher to clarify any items which seemed to be ambiguous to respondents.

1.7.3 Research design

Under quantitative approach, data for cognitive and adoption variables were concurrently collected (cross – section). In its analytical design, the study was a correlational survey design. This was supplemented by consultation of key informants, an aspect of qualitative approach.

1.7.4 Areas of study

Research was conducted in Lake zone of Tanzania. The zone is comprised of Mara, Mwanza and Kagera regions. Selection of the zone was purposive given its early beneficiary status of hosting the first improved cassava processing units. Within the zone, the selection of the districts was influenced by presence of improved cassava processing units in operation, and the potential of the districts in cassava cultivation. Preliminary information (Grace *et al.,* 2018) mapped about 24 cassava processing units producing high quality cassava flour in the lake zone with an estimate of about 7150 farmers in the catchment areas of the processing units. Using information in Table 1.7.1, the districts were selected following their large unit – farmers' ratio relative to the rest of districts. Therefore, Biharamulo, Serengeti and Sengerema were selected.

Table 1.1*: Processing Units in the Lake Zone and Farmers Surrounding the Units*

Region	District	No. Cassava Processing Units (Outstanding)	Ownership Community Processing Group	SME	No. of Surrounding Villages	Est. No. of farmers Surrounding a Processing Unit	Unit-Farmers' Ratio
Mara	Serengeti	1	0	1	6	300	1:300
	Rorya	1	1	0	4	200	1:100
Kagera	Biharamulo	7	1	6	4	4000	1:500
	Ngara	4	0	4	7	500	1:125
Mwanza	Mwanza	1	0	1	5	100	1:100
	Kwimba	1	1	0	3	150	1:150
	Sengerema	3	3	0	6	900	1:300
	Ukerewe	8	8	0	24	1000	1:125
Total		**24**	**14**	**12**	**59**	**7,150**	**1:298**

Source: Modified from Grace *et al*. (2018)

1.7.5 Target population

Target population for this study was farmers growing cassava in the areas surrounding improved cassava processing units. They were of two categories: First, cassava growers who also processed their harvested cassava in the improved processing units; and second, cassava growers who processed their cassava traditionally. The number of these farmers could not be pre – estimated.

1.7.6 Sampling procedure and sample size

A sample is a subset of individuals selected from a larger population (Bordens and Abbott, 2011). Omari (2011) argues that by observing the characteristics of the sample, one can make certain inferences about the characteristics of the population from which it is carefully drawn. It is further argued that there is no clear-cut answer, for the correct sample size as this depends on the purpose of the study and the nature of the population under scrutiny (Cohen *et al.*, 2000). However, according to Cohen *et al*. (2000), in any research the essential requirement is that the sample must be representative of the population from which it is drawn. The researcher is aware that in quantitative studies,

samples are not selected haphazardly or carelessly. They are, instead, selected in a systematic or random way so that chancy errors are minimized and probabilistic reasoning involved in generalizations can be utilized (Omari, 2011). However, given the indefinite nature of the target population, randomization was ruled out in the sampling procedure of this study. Instead the characteristics of the target population were kept intact to include cassava growers in the catchment areas surrounding the processing units and to include farmers using improved processing methods and farmers using traditional processing methods. Therefore, farmers were selected purposively through invitation, so that the farmers consenting were included in the sample. The process resulted in obtaining 150 farmers from Buharamulo, 110 farmers from Serengeti and 100 farmers from Sengerema, making a total number of 360 respondents.

1.7.7 Instrumentation

To address the aforementioned gaps in literature using the psychological approach, some methodological challenges had to be addressed. Adoption studies in the field of rural development in Tanzania have sufficiently been done. Many of these studies, however, have assessed adoption in a discrete state, with binary response variables. Such an approach simply uses values zero and one for non-adopters and adopters, respectively (Udensi, Tarawali, Favour, Asumugha, Ezedinma, Okoye, Okarter, Ilona, Okechukwu and Dixon, 2011; Tarawali, Iyangbe, Udensi, Ilona, Osun, Okater and Asumugha, 2012; Nyanda, 2015; Mombo, Pieniak and Vandermeulen, 2016; Salum, 2016; Ntshangase, Muroyiwa and Sibanda, 2018). It is argued in this thesis that the dichotomous approach in measuring adoption is mainly suitable where the technology in question and the adoption assessment criteria are commonly known to, both, researcher and the farmers (Joshua, Massawe and Mwakalapuka, 2020a). In this study, consideration that the criteria

characterizing adoption of improved cassava processing technology were not commonly shared between the researcher and respondents was made.

So, based on that consideration, a set of defining criteria measuring adoption of improved cassava processing technology had to be put in place. The criteria were developed based on the tasks expected to characterize improved cassava processing technologies in place. The criteria were further established through discussions with senior agricultural officers experienced in cassava processing technologies. These criteria were such as practising cassava farming for business, planting improved varieties which are fast maturing and resistant to diseases, harvesting timely, processing timely, taking the harvested cassava to the processing units and buying cassava processed products. Other criteria for measuring adoption are detailed in the Cassava Processing Technology Adoption Scale (CPTA) available in appendix 1. The process for validation of the CPTA was further undertaken in a pilot study as detailed in paper one of this thesis. The paper discusses the introduction and application of the CPTA for addressing the adoption measurement issue.

With regard to self–efficacy, the need to have in place an instrument specifically designed to measure self–efficacy among cassava farmers was aroused. Dual issues are enlisted in the discussions surrounding self–efficacy in the available literature. The first issue is whether self-efficacy was a one-dimensional or multi–dimensional construct. While most literature originating from Western cultures (Scholz *et al.,* 2005; Luszczynska and Schwarzer, 2005; Teo and Kam, 2015) report the uni–dimensional nature of self–efficacy, most studies from non–western cultures, specifically from Asian countries support the multi–dimensional structure of self–efficacy (Chiu and Tsang, 2004; Zhou, 2015).

The second issue is on whether self-efficacy was a general trait that can be evidenced across domains or it should be conceptualized in a situation-specific manner. It was not clear as to what structure perceived self–efficacy would take among farmer populations in Tanzania and whether it would be a general trait across various domains of functioning, or task specific trait. Therefore, to address these uncertainties, it was necessary to adopt and validate the Perceived Self–efficacy Scale, which is the central discussion in paper four of this thesis.

Likewise, there was lack of an instrument readily designed to measure cognitive flexibility among farming populations. Available literature reports that cognitive flexibility lacked consensus in its definitions, which calls for re–conceptualization and development of an instrument measuring cognitive flexibility to capture the technology–enhanced contexts (Hamtiaux and Houssemand, 2012; Barak and Ziv, 2013; Plesch, Kaendler, Rummel, Wiedmann and Spada, 2013; Varanda and Fernandes, 2015). Development of an instrument measuring cognitive flexibility in the context of cassava farmers in Tanzania was thus, imperative. Paper five therefore, discusses the validation process of the Cognitive Flexibility Scale and its application in adoption of improved cassava technologies among cassava farmers in Tanzania.

Instruments for data collection

One questionnaire was administered to respondents. The questionnaire included instruments such as Cassava Processing Technology Adoption Scale (CPTA) for measuring dependent variable. Independent variables were measured using specific scale for each independent variable. Attitude was measured using Attitude towards Cassava processing technology scale (ACPT), self – efficacy was measured using Perceived Self–efficacy Scale (PSE), and cognitive flexibility was measured using Cognitive

Flexibility Scale (CFS). Further, the literature was thoroughly reviewed for post – reform developments in the commercialization of cassava sub – sector in Tanzania.

1.7.8 Ethical consideration

The ethical issues were adhered to. According to Creswell (2007), informed consent, confidentiality and benefits of research to respondents over risks are the crucial ethical issues to be taken into consideration in research. In the first place, research permit procedures were met from the SUA authorities prior to receiving a welcome to the offices of the Regional and Districts Administrative Secretaries of the relevant regions and districts. Second, informed consent of farmers was observed because farmers were invited and only those who consented to respond to the questionnaires were included in the sample. Lastly, confidentiality right of the respondents was taken into consideration since information provided by respondents was used solely for the purpose of this academic study.

1.8 Organization of the Thesis

This thesis is presented in three chapters. The first chapter introduces the overall theme of the study in the extended abstract and describes the commonality of the concepts presented in separate papers. Chapter two consists of a series of originally published papers in different journals. In chapter three, conclusions, recommendations and the implications of the study are presented.

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CHAPTER TWO

Manuscript one

Post-Reform Developments in the Commercialization of Cassava Sub-Sector

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Abstract

This chapter reviews post-reform developments in the commercialization of the cassava sub - sector in Tanzania. About 36 years after formal adoption of an economic recovery program in 1984, curiosity is raised on the legitimate quests, such as; what were the production, value addition and market opportunities of cassava during pre-reform period in the country? What are the production, value addition and market opportunities of cassava in the post-reform period in the country? What have been the challenges toward the achievement of the intended goal for the adoption of an economic recovery program? A critical review of literature addressing these questions leading to constructive arguments, conclusions and recommendations has been done. The review indicates that while during pre-reform period cassava was mainly grown by the rural household as a subsistence food crop, its importance increased due to its advantageous attributes such as natural ability to resist drought, thrive well in poor soils, and its long time underground storage attribute. Post-reform period has witnessed several policy changes incorporating more stakeholders in the sub-sector. This has resulted in increased production and market demand for the produced cassava. This chapter discusses all these changes and the challenges that have persisted since pre-reform and during post-reform period. The chapter further recommends the improvement in the strategies to improve production and create more potentially available markets for the commercialization of cassava.

Introduction

The term economic reforms refers to the measures taken by the country to set up a balance between foreign and local public policy structures to accelerate the economic development of the local country, especially where the disastrous state of the national economy is experienced (Ahmed and Lipton, 1997). The pre-reform context had to undergo the changes of socioeconomic policies following the compelling circumstances that led to the adoption of the economic reforms in the country. The years between 1961 and 1966 witnessed the economy of Tanzania operating under free-market conditions, guided by the World Bank's "transformation approach" to agricultural development in the government's first five-year plan (Wenzel and Wiedemann, 1989 as cited by Wobst, 2001). Though agriculture contributed more than 50 % of the gross national product (GNP), agricultural production was mainly meant to feed Europe's demand for raw materials and basic products such as sisal, cotton, coffee, and tea (Wobst, 2001).

Between 1967 and early 1980s, Tanzania adopted socialism and self-reliance policy to her socioeconomic development following the Arusha Declaration in 1967. According to the Declaration, the socialism and self-reliance policy was comprised of economic principles such as (1) public ownership of the major means of production, (2) preferences for cooperative ownership, (3) a "leadership code" to prevent officials from participating in private economic activities, (4) emphasis on self-reliance with diminishing dependency on foreign capital, (5) the establishment of Ujamaa villages, (6) emphasis on food crop agriculture and rural development, and (7) public provision of health care and education (Wenzel and Wiedemann 1989). Following this policy, the Ujamaa village was a productive and efficient unit of agricultural production. Economic infrastructure such as transport systems, water and energy supply, and health and education facilities was improved to increase the availability of productive inputs, the capacity of human capital,

and the sales prospects for agricultural production (Wobst, 2001). According to Ndulu (1994), the period between 1967 and 1980 was the first periodic thrust in economic development policy after independence that emphasized state-controlled modernization and structural transformation to reduce reliance on the external economy. Following the costly Kagera war of 1978/79, the prolonged drought and the collapsing world market prices in the early 1980s, Tanzania's economic performance deteriorated continuously and remained highly inefficient. Also, Tanzania's terms of trade deteriorated severely resulting in the increased trade deficit, decreased foreign capital inflows, and overall indebtedness exceeded critical levels (Wobst, 2001).This situation forced the government to launch its first significant economic reform aimed at liberalizing the economy in the 1984/85 fiscal year. The reforms involved measures such as raising agricultural producer prices by 46 - 55%, currency devaluation, the reintroduction of cooperation unions for crop marketing, and raising the government wages by an average of 30%. Other measures were liberalization of domestic food products trade, elimination of consumer price subsidies for maize, and the initiation of the own-fund import scheme. Following this self-reform adoption, the international organizations increased their pressure on the Tanzanian government to take further action and pursue stricter coordination of its economic policies, which were adopted in 1986.

Pre-reform Production of Cassava

During the pre-reform, cassava was mainly grown by the rural household as a subsistence food crop. Its importance increased due to the emphasis by the government to rural households on the need to cultivate cassava (Laswai, 2006) and the crop's advantageous attributes such as the natural ability to resist drought, thus, requiring relatively little rainfall for maturity. It was also believed that cassava grew well in poor soils. Further, cassava could be stored underground for a long time before it was harvested when needed

for food. These attributes made cassava popular as it was the most depended on food crops when cereals failed to sustain life during hunger periods. According to TISCO Consultants and Associates (2009), cassava production consistently increased from 1 244 000 tons in 1972 to 1 330 000 tons in 1977, to 1 420 000 tons in 1982, and the main producing areas were Mtwara, Mwanza, Coast, Tanga, Lindi, Rukwa, Shinyanga, Tabora and Kagera regions. Relative to other crops cassava followed after maize and paddy both in terms of importance and production. During this period, however, cassava production faced agronomic challenges such as planting cassava in the exhausted soils, late planting of cassava, and late or not weeding cassava crop and use of local seeds varieties with low genetic potential leading to low productivity.

Post-reform Production of Cassava

Post-reform production of cassava may better be understood in the context of the reform policies related to agriculture. The reform policies not only paved the way for several stakeholders in the agriculture sector to join forces for the development of sustainable agriculture but also bound Tanzania's agriculture in the global economy. For instance, the Local Government Reform Policy of 1998 aimed at devolving responsibility for socio-economic development and public service provision in the jurisdiction of the Local Government Authorities; including functions such as facilitation and maintenance of law and order on agricultural development. On the other hand, there exists global level policy development like the Millennium Development Goals (MDG's) to which Tanzania has to abide to fit in the global economy. In this context, the national policy framework had to change to implement the Tanzania Development Vision (TDV – 2025), the Poverty Reduction Strategy Paper (PRSP) and the National Strategy for Growth and Reduction of Poverty (NSGRP I and NSGRP II). As such, the macro policy framework focuses on developing an efficient, modern, commercial, competitive and profitable agricultural

industry that contributes to the improvement of the livelihoods of Tanzanians and the attainment of broad-based economic growth and poverty alleviation (Ministry of agriculture food security and cooperatives, 2013). These developments put Tanzania at the regional ties as a member of both East African Community (EAC) and the Southern Africa Development Community (SADC). In the International arena, Tanzania is an economic partner of Europe, Asia, and American economies.

All these ties have been potentially beneficial to the cassava sub-sector than ever before. However, at the policy level cassava has not received specific attention as other crops such as cashew nuts, cotton, coffee, and tea. Discussing the production of cassava between the years 1985 and 1995, Kapinga *et al.* (2015) report a fluctuating trend of the production over time with a decline in 1985 to 1989 in almost all zones with exception of the Eastern zone where cassava production increased in the same period. They further report an increase of cassava production in almost all zones in the season of 1989/90 with exception of the Eastern zone, but reporting the highest production in the southern zone in the season of 1991/92, which reached 750 000 tons of dried cassava chips. Generally, Kapinga *et al.* (2015) reports a yield of 4.5/ha in Eastern zone recorded in 1985/86 and 1989/90, which is still below National yield average of 10.5/ha (COSCA Tanzania, 1996). Nevertheless, the following decade witnessed the intervention through policy statements that could not leave things the way they were. For example, the 1995 national agricultural research policy, having recognized the importance of drought-tolerant crops such as cassava, sorghum, and millet, for assurance of basic food security, income generation and employment growth; stated the following objects:

i. The Government will take steps to ensure that support services are concentrated on drought-prone areas to stimulate the production of these crops. Distribution of

seeds, control of pests and extension services to promote the use of available technologies will be given special attention.

ii. The Government will assist the private sector to develop a strong marketing system for these crops. Collection and dissemination of information on availability, demand, prices and quality requirements will be a key responsibility of the Government;

iii. The Government will encourage the private sector to install processing facilities in both production and consumption areas to promote commercial consumption of these crops;

iv. The Government will ensure that when famine relief is required in drought-prone areas, as far as possible, only drought-resistant crops will be delivered to the victims to encourage the production and utilization of these crops in these areas;

v. The Government will assume the role of providing farmers and traders with export marketing intelligence to promote the export of these crops when surpluses are available; and

vi. Research into more processed products and their utilization will be initiated to promote domestic consumption of these crops thus expanding demand.

Implementation of this policy has been evident through intervention projects by the government in collaboration with some international stakeholders such as Mennonite Economic Development Associates (MEDA), International Initiatives for Tropical Agriculture (IITA) and Cassava Adding Value for Africa (CAVAI & II). These projects have improved the status of cassava production in the country. For example, between the years 2012 – 2015 MEDA, with funding from the Bill and Melinda Gates Foundation and MEDA members, has been undertaking an initiative officially named commercially sustainable, Quality-assured Cassava Seed Distribution System in Tanzania: Pilot Innovation Project, known locally as *Muhogo Mbegu Bingwa* (MMB). Through this project, an attempt has been made to bridge the gap between the research laboratories

developing new varieties of disease – resistant cassava and farmers looking for clean planting material. The initiative has inflicted in the minds of farmers the commercialization of the cassava seeds, the practice that was not traditionally common as farmers used to borrow seeds from their neighbouring farmers (MEDA, 2016). Another example of one ongoing project supported by IITA is ‘Building an Economically – Sustainable Seed System in Tanzania for Cassava (BEST Cassava)’ with the overall objective of enabling the commercial cassava seed system in Tanzania, whereby farmers are expected to timely access quality-declared, disease – resistant and disease – tolerant varieties in the right quantities and at a price they can afford. This might help farmers to produce high – yielding cassava despite the increasing disease pressure. However, these projects are very short – lived in terms of time and small scale in nature so that as they come to end the seeds problem remains unsolved. Actually what these projects do is to experimentally show what needs to be done to address the problem. There should be planned efforts in the government’s annual budgets to upscale the production of the improved seeds to the production level to meet the needs of the farmers if the reliable commercialization of cassava is to be realized.

Pre-reform Value Addition and Market Opportunities of Cassava

During the pre-reform period, Tanzania was experiencing a pricing system whereby the Government assumed an active role in the determination of producer prices of all food crops, a system that resulted in a fierce struggle for marketing margins between cooperative unions and National Milling Corporative (NMC). Little is reported in the literature about cassava value addition. Cassava was mainly for food and was not mentioned among the cash crops (Laswai, 2006). However, both local and export trading of cassava were taking place. Exports of cassava significantly reached the levels mounting to about 108.7 metric tons between the early 1980s and 1990s before the

significant decline of the volume of export up to 3.4 metric tons due to failure of cereals' price within the European Community between 1999 and 2001 (Economic and Social Research Foundation, 2011; Abass, 2013). For example, it is reported that in the late 1980s Chisegu area in Masasi district, which is located 600 km south of Dar es Salaam, was exporting cassava chips to the EU market through the southern port of Mtwara (Abass *et al.*, 2013). The decline of export is attributed to challenges such as lack of consumers' confidence in the quality and safety of products; cultural perceptions of cassava being the food of the poor and displaced; lack of appropriate marketing channels; poor transport infrastructure; poor market information; low and fluctuating volumes of marketable cassava; variable quality; and uncompetitive prices of cassava-based primary and consumer products (CfC, 2002). Lack of reliable markets and marketing information also led to post harvest loss due to poor processing technology and lack of storage facilities.

Post-Reform Cassava Value Addition and Market Opportunities

Open market pricing policy system, whereby the principles of demand and supply control the price in the market has characterized cassava marketing after policy reforms just like any other products in the country. With these changes, the Ministry of Agriculture through the Marketing Development Bureau (MDB) has been providing market information on the producer and consumer prices on a regional basis through the radio and market bulletins issued every three months to guide farmers and traders in the price negotiation process (Kapinga *et al.*, 2015). Though earlier practice shows that cassava in Tanzania is largely used for food, the crop has been shifting its status from subsistence to commercial crop such that it has started competing with the traditional cereal crops in the market. Although it seems in terms of price that paddy and maize are sold higher than cassava, a study in the Coast region has shown that cassava is advantageous over cereal production

due to its low cost of production. For example, in the Coast region of Tanzania, the cost of production for cassava was about 62% less than that for paddy and that the returns to cassava production were 22% higher than that for rice (TARP II-SUA, 2002).

This shift has been an outcome of the policy reform whereby the emphasis has been on developing an efficient, modern, commercial, competitive and profitable agricultural industry that contributes to the improvement of the livelihoods of Tanzanians and attainment of broad – based economic growth and poverty alleviation (Ministry of agriculture food security and cooperatives, 2013). The policy opportunity that has allowed the private sector and the government to work together for economic development seems to have boosted the efforts to open up the potential value of cassava. There are potential market opportunities for cassava as its demand is increasing with the diversification of the use of the crop. However, these market opportunities are directly linked with value addition because of the perishable nature of cassava and its diversified use. One good example that can be sited on the potential market is Chinese market. The open doors for this market was marked by the signing of a protocol on phytosanitary requirements for the export of dry cassava from Tanzania to China on 16th May, 2017. The protocol has opened the way for the registered companies from Tanzania to export the dry cassava to China. The main condition in the protocol is to ensure the quality of cassava from the production stage to the harvesting and exportation (Ministry of Agriculture, 2019). Following the signed protocol, up to January 2019 three companies had achieved full registration but only one company had started exporting cassava. The other two companies were on the final accomplishment processes. Added to that, in the year 2017/18, Tanzania had managed to export about 471 tonnes to the Chinese market (Ministry of Agriculture, 2019). To date, Tanzania is reported to rank 8th in Africa with a

cassava production worth USD 369 000 representing 0.63% of the total world exported from Africa (IPP Media, 2016).

The Chinese market, however, is not the only solution for the cassava market in Tanzania. This is because there are other competitors for the Chinese cassava market. For example, in 2017, Thailand exported about 75% of her harvested cassava to China. In addition, the need for cassava from Tanzania by the Chinese is not permanent. The signed protocol exists for only 5 years though it is open for the renewal upon the will of the two parties. Exploration of other markets both international and local is still of a pivotal role. The work by Grace *et al.* (2018) has indicated other potential local markets in Tanzania which have not been utilized. Figure 1 indicates the existence of high potential opportunities for cassava given several demands such as animal feed using improved traditionally processed cassava (known as *makopa* in Kiswahili), biscuit manufacturing using high – quality cassava flour (HQCF), bakery industry using HQCF, and traditional beer manufacturing using improved *makopa*. An analysis of the potential profitability of few small processing enterprises carried out using data from the pilot processing plants with 1 t/day capacity (Abass *et al.,* 2013) in Tanzania found that at the Chisegu HQCF site, profitability level of US$1,876 and the internal rate of return (IRR1) was 77%. At the Bungu, chip site, which was operating at 59% capacity utilization, the profitability was US$2,126 while the IRR was 135%. Although starch production is the most labour and capital intensive, of the three technologies studied in Tanzania, the starch site at Mtimbwani had a total profit level of US$4,482, with an IRR of 91%.

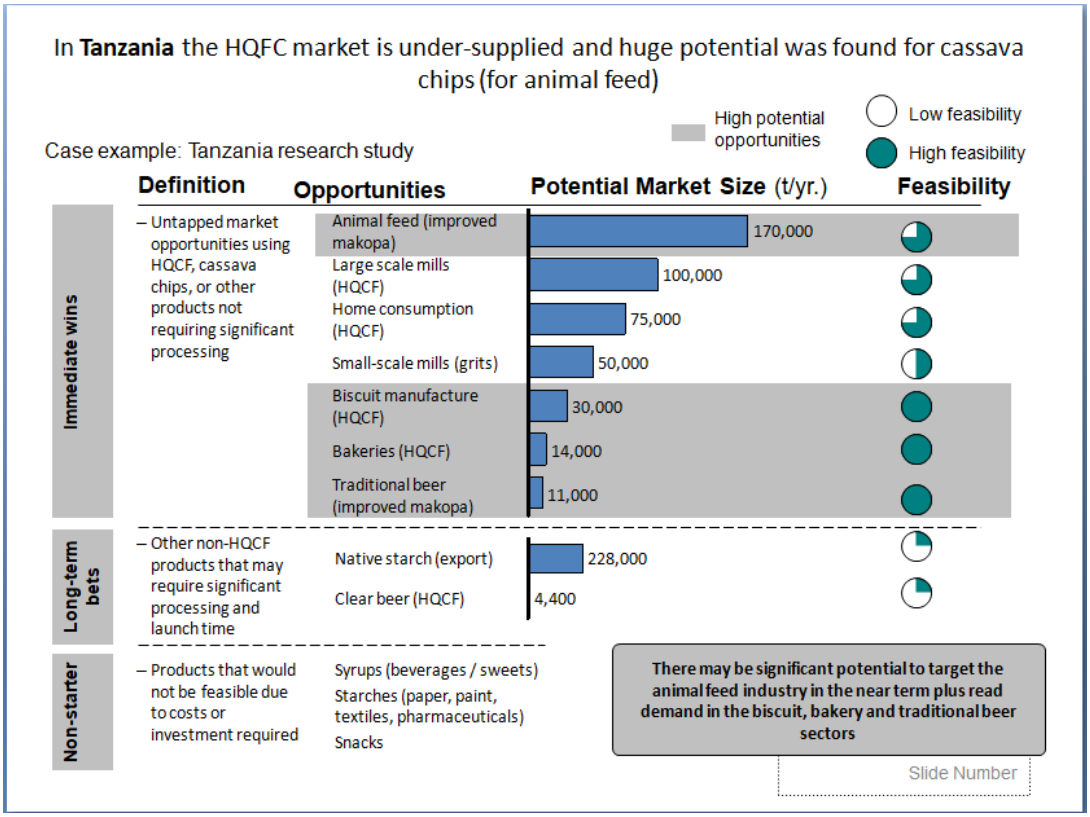

Figure 2.1: Potential Market for Cassava Products
Source: Grace, Loyce, Rhoda, Beatus and Tito (2018)

Other potential local market opportunities for cassava may be created by the Government through the Presidential Cassava Transformation Initiative (PCTI). This is a conscious step taken by the Governments through policy and regulations to promote the use of the processed High – Quality Cassava Flour (HQCF) as a partial substitute for the use of wheat flour in the bakery industry. For example, the Federal Government of Nigeria embarked on an intensive drive for increasing cassava yield to support the import substitution programme through legislation for use of 10-20 percent of cassava flour in baking bread and other products (Okelele, 2010). Following the initiative, farmers in Nigeria had increased access to improved cassava varieties, strengthened the Nigerian cassava industry and generated a chain of progressive activities on the nation's economy which has helped many cassava farmers to alleviate poverty (Onwudiwe *et al.*, 2015).

Okhankhuelel *et al.* (2017) appraised the effects of the initiative on the level of efficiency of the micro–scale cassava processing enterprises in South–West Nigeria before and after participating in the initiative and found that the average scale efficiency for all the states increased from 69.4 % before the initiative to 88.5% after the initiative. Unfortunately in Tanzania, there is no specific explicit policy of the nature of the presidential initiative aimed at promoting cassava and its products to enable the crop to gain such a high status as in Nigeria and Ghana. From Nigerian experience, the adoption of the PCTI would have diversified the uses of cassava and thus increased the crop's local market.

Challenges Facing Cassava Sub–Sector

To date, 35 years after the reform, reviewed literature (Kapinga *et al*., 2015; MEDA, 2016; Grace *et al.*, 2018) still outlines the same challenges faced by cassava sub-sector during the pre-reform period. These challenges are described below:

1. Pests and diseases such as cassava green mites (Mononychellus sp.), Cassava mealybug, Cassava Mosaic Disease (CMD), and Cassava Bacterial Blight (CBB). The spread of these diseases in the Lake and Coastal zones has been speedily spreading by the tendencies by farmers to plant unapproved cassava seeds or shifting the approved seeds in one zone to another where the seeds have not been approved. The diseases have led to discouragement of cassava farming by farmers and hence, low production and productivity.
2. Agronomic problems such as planting cassava into the exhausted soils, late planting of cassava, and late or not weeding cassava crop. Most farmers usually plant cassava without appropriate spacing during April and May when the rainy seasons are about to end. This is usually after planting other crops such as maize, beans, potatoes, etc. Cassava is also planted at the least fertile soils as most farmers believe that cassava does not require any fertilizer or manure.

Also, among most farmers, weeding of cassava is not a priority because it is usually done later when weeding of all other crops is over. Such a delay to weed cassava or no weeding at all makes the crop too weak to compete with weeds for a small amount of nutrients available in the already infertile soils. Due to these tendencies, cassava lacks sufficient water and nutrients in its early growth stage, thus reducing the expected yields.

3. Shortage of planting materials and continuous use of low genetic potential cassava varieties. Following the problem of pests and diseases, the emphasis has been to stop using traditional seeds that have already been affected by the diseases and shift to the use of the improved quality – declared, disease – resistant and disease – tolerant varieties by farmers. Such seeds are found through a systematic chain from pre – basic seeds prepared by the researchers, basic seeds usually owned by researchers or certified companies for multiplication, certified I and certified II which are then given to the Quality Declared Seeds (QDS) producers. Farmers are then allowed to buy the seeds from these QDS producers. According to the Ministry of Agriculture (2019), so far in Tanzania, there are only 20 approved seeds varieties in the entire country. In the Lake zone, the approved seeds varieties are *Mkombozi, Kyaka, Meremeta, Rangimbili, Belinde, Kasala, Nyakafulo*, and *Suma*. In the Central zone, four varieties approved are *Mumba, Hombolo 95/005, Dodoma*, and *Makutupora*. In the East and Southern zone, about eight seeds varieties have been approved. These are such as *Kiroba, Kibaha, Mkumba, Pwani, Mkuranga 1*, *Kipusa, Chereko,*and*Kizimbani*. However, at the QDS level, where farmers are supposed to access the improved seeds varieties, the QDS registered farms are only about 366 hectors in the entire country (Ministry of Agriculture, 2019). This implies that the target to enable every farmer to access the improved seeds varieties for the improved yields is still very far.
4. Inadequate extension services to farmers

Harris-Coble (2016) reports the average ratio of agricultural extension officers to farming families of 1: 630 in Tanzania, although this ratio varies considerably by regions. Such a ratio is too big to enable farmers to gain the necessary required skills from extension officers to improve cassava productivity in the country. Kapinga *et al.* (2015) reports that even the few extension officers available in the country cannot adequately fulfil their duties because they have no transport facilities to attend the farmers in rural areas.

5. Poor access to the market due to limited transport and storage facilities. Most of the cassava is produced by smallholder farmers in rural areas where there are no reliable transport means. These areas are sometimes connected to the towns in the headquarters of the districts by rough roads which are hardly passable during the rainy seasons. At the same time, given the perishable nature of cassava, one needs to process it within 24 hours and access the market. Where the market for raw cassava is not readily available, one needs to store it in a processed form for about a maximum of nine months before expiry. Given the fact that smallholder farmers are economically unstable to manage appropriate storage, they usually leave cassava in their farms as a means of storage. However, it is impossible to continue with this practice since most of the improved seeds varieties have short lifespan usually between 9 months and one year, hence leading to post–harvest loss. Under these circumstances surrounding a smallholder cassava farmer, reliable transportation infrastructure could enable them to sell their cassava in either raw or processed form, timely.

   On the other hand, with the increasing international demand for cassava, access to the market is connected to yet another systemic challenge that needs to be critically sorted out. For example, International markets such as the Chinese require the cassava chips to reach particular standards as outlined in the protocol

on phytosanitary requirements for the export of dry cassava from Tanzania to China. These requirements can be very difficult to meet by individual smallholder farmers, who are currently the big workforce in the cassava sub-sector. This is because article 5 of the protocol, for example, requires The United Republic of Tanzania to “register the companies for production, processing and/or storage to ensure that they meet the relevant quarantine conditions and implement such measures as disinfecting and cleaning.” This condition automatically rules out individual smallholder farmers who are not formerly registered despite their long time contribution to the farming of the cassava sub-sector. Unless they form companies, smallholder farmers in Tanzania will remain watching the companies such as Dar Canton Investment, Jielong Holdings (T) Company and other foreign investors enjoying these International cassava marketing opportunities.

6. Rudimentary cassava processing technology leading to a lack of diversified cassava products and declining expansion cassava land area. So far processing technology is still using grater and press machines in the small processing units, which have been established in rural areas where cassava is cultivated. Most of the grater machines are thus, using petrol engines and the press machines using manual cranes (jacks) in pressing for dewatering. Sun-drying is still the main drying technology. Very few (about two) processing units are currently using flash dryers and the other two use solar houses for drying the cassava granules. Under these rudimentary techniques, it is very difficult to maintain quality, especially with HQCF because of the changing weather such as abrupt rainfall, wind; and contamination possibilities associated with the sun – drying methods. Also, these technologies can hardly meet the demand of the mass production of cassava products that might be required in the world market economies.
7. The slow rate of investment in cassava processing, which has been facilitated by limited access to clean and safe water as well as electricity for processing.

Cassava processing requires clean and safe water for washing the cassava roots before crashing and for washing the machines. They also require reliable power if mass production and processing are to be achieved. Most of the rural areas, where cassava is cultivated and where the processing units should be established given the perishable nature of cassava, are not equipped with both electricity and water services, thus retarding the speed of investing in the cassava processing units.

8. Despite having the policy statements on the drought–resistant crops cassava inclusive, the Policy and regulations on cassava, cassava has not received so much specific policy attention as it has been done in other African countries that have comparatively achieved much in cassava subsectors such as Nigeria and Ghana. In these countries, the adoption of the Presidential cassava transformation initiative (PCTI) has contributed much to the success and growth of the cassava subsector.

Conclusion

During the pre-reform period, production of cassava was mainly for subsistence, dominated by poor agronomic practices such as farming in exhausted soils, use of unimproved seeds varieties, poor spacing and delayed or no weeding. Although cassava was produced in such poor practices it served as a rescue for hunger when all other cereals had failed. Regarding value addition and marketing, cassava was sold in the raw form and the markets were mainly local and found in the neighbouring urban areas where buyers could manage to access cassava in its fresh form. It was also sold in a dry form as chips or ‘makopa’ in the same local markets. In addition, cassava was exported in the European markets though the reliability of the European markets disappointed farmers due to factors such as lack of consumers’ confidence in the quality and safety of products; cultural perceptions of cassava being the food of the poor and displaced; lack of appropriate marketing channels; poor transport infrastructure; poor market information;

low and fluctuating volumes of marketable cassava; variable quality; and uncompetitive prices of cassava-based primary and consumer products due to the centralized pricing system.

The policies' reforms among other things decentralized the pricing system and allowed the private sector to develop a strong marketing system for cassava, whereby the private sector has been working in collaboration with the Government to research on and commercialization of the improved diseases resistant and fast-maturing seeds varieties, educating farmers on the agronomic issues related to cassava farming, and cassava value addition. The government has also encouraged the private sector to engage in the commercialization of cassava through the collection and dissemination of information on availability, demand, prices and quality requirements for cassava. Following the reforms, the production of cassava has been increasing in terms of the increased farming areas and production output. However, yields, which is a measure of cassava productivity has remained below an average of 10.5 tons per hector in most parts of the country. Efforts concerning value addition and marketing have been evident and potential cassava markets have been identified and partly utilized. However, 35 years after the reforms, the cassava subsector is still facing the same challenges experienced by pre-reforms cassava farmers. These are such as pests and diseases, agronomic problems, inadequate extension services to farmers, shortage of the improved disease resistant and fast-maturing seeds, poor access to market due to limited transport and storage facilities, and continued use of rudimentary cassava processing technology. Therefore, one can fairly conclude that the reforms have been successful in improving the status of the cassava sub-sector in Tanzania despite the remaining challenges calling for the cassava stakeholders' attention.

Recommendations

From the reviewed challenges facing the commercialization of cassava subsector the following are recommended:

1. The Government through the Ministry of Agriculture needs to invest much in research to combat Pests and diseases such as cassava green mites (Mononychellus sp.), Cassava mealybug,Cassava Mosaic Disease (CMD), and Cassava Bacterial Blight (CBB). While this is important, the investment should go together with much focus in up scaling the production of and make readily available the improved, disease-resistant and fast-maturing cassava seeds to farmers.
2. Agronomic education should be given a priority among farmers if an increased cassava production and productivity is to be realized. Specifically, a planned and consistent program by extension officers should guide farmers' attention on appropriate kinds of fertilizers matching cassava, timely planting and weeding of cassava, and appropriate application of weeding chemicals or mechanization for large scale cassava farming.
3. Smallholder farmers should be assisted on how to form companies that can meet International agribusiness standards.
4. The government should set apart sufficient budget to provide extension officers with transport facilities such as motor vehicles to enable them to attend the farmers in the rural areas. Yet, the need to recruit more extension officers to attend the farmers should not be ignored to enable farmers to receive adequate education and practical guidance on how to improve cassava production and productivity in the country.
5. The government should invest in the establishment of economic infrastructures such as roads, electricity, storage facilities, and clean and safe water in the areas potential for large scale cassava farming and processing.
6. The government needs to adopt explicit policies and regulations on cassava and specifically the Presidential cassava transformation initiative (PCTI), which has

been found to contribute much to the success and growth of the cassava sub-sector in other African countries such as Nigeria and Ghana.

7. The government should put much focus in strengthening the local in addition to international market by inviting the investors to build small cassava processing units in the rural areas where smallholder farmers are, and by diversifying the local uses of cassava products.

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Paper One

Introduction of the cassava processing technology adoption scale (CPTA) as a measurement tool for adoption of improved cassava processing technology

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Paper Two

The relationship between farmers' attitude towards the improved cassava processing technology and adoption

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Paper Three

Validation of the perceived self-efficacy scale (PSE) among cassava farmers in Tanzania

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Paper Four

The relationship between farmers' perceived self–efficacy and adoption of the improved cassava processing technology

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Abstract

Low acceptance and adoption of farming technologies has been reported from both developed and developing countries. Addressing low acceptance of the cassava processing technology, previous works have placed less emphasis on cognitive variables in their conceptual models. This paper presents the study whose general objective was to examine the relationship between perceived self–efficacy and adoption of improved cassava processing technology among farmers. This was achieved through three specific objectives which were: first, to explore the association between farmers' ability to deal with difficulties and adoption of improved cassava processing technology; second, to explore the association between farmers' ability to cope with difficulties and adoption of improved cassava processing technology; and lastly, to predict adoption of improved cassava processing technology from perceived self–efficacy. A total of 360 respondents including 181 (50.3%) males and 179 (49.7%) females were purposively selected from Mara, Mwanza and Kagera regions in Tanzania. A questionnaire with instruments measuring perceived self–efficacy (PSE) and adoption of improved cassava processing technology was administered. The questionnaire was also comprised of other personal variables such as age, sex, education level, training on cassava processing technology, participation in other economic activities and intention to adopt. Binary logistic regression analysis revealed that attendance to training on improved cassava processing technology, perceived ability to deal with difficulties and ability to cope with difficulties explained farmers' involvement in pre-processing technology. It was further found that training on improved cassava processing technology and perceived ability to deal with difficulties explained farmers' involvement in processing tasks. Lastly, results indicate that only attendance to training on improved cassava processing technology explained utilization of the processed cassava products. The paper discusses practical and theoretical implications of the findings and recommends that farmers should be encouraged to attend in trainings related to farming technology to be introduced; and the technology exposure trainings should contain topics that are capable of building farmers' self–efficacy such as mastery experience, vicarious experience, psychosocial state, and social persuasions.

Keywords: Self–efficacy scale, self-efficacy measures, self–efficacy and adoption, adoption.

Introduction

Perceived self-efficacy is the construct in the Social Cognitive Theory (SCT) (Bandura, 1997). The term means one's judgment on one's capabilities to organize and execute a task to attain an expected outcome. It does not refer to the skills one has, but with judgments on what one can do with whatever skills one possesses (Ajzen, 1991; Bandura, 1997). In this paper the term refers to how easy or difficult it is for a farmer to deal with unexpected problems, implement the planned activities, keep trying until they achieve the planned task, cope with difficulties, resist challenges, undertake new activities, deal with novel problems, and adopt new technologies such as the improved cassava processing technology.

On the other hand, 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). Adoption is also described as 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). Despite the relevance of the latter definition of adoption in farming technologies, this paper cautiously notes that given uncertain and unspecific nature of the future, farmers need to put into practice the innovations from the onset of an innovation introduction before the technology expires. Throughout this paper therefore, the term adoption refers to whether or not the farmer engages in the tasks related to the improved cassava processing technology, which are categorized into three. First, the involvement in the pre-processing tasks, which refer to the activities that usually, accompany the improved cassava processing technology and that need to be accomplished before cassava is sent to the processing units. Second component is farmers' involvement in the processing tasks. This refers to immediately

washing after peeling and taking the washed cassava to the cassava processing unit to obtain High Quality Cassava Flour (HQCF). Lastly, utilisation of the processed cassava products, which refers to the use of the products made of cassava such as HQCF, biscuits, burns (Maandazi in Kiswahili) and bread.

Existence of relationship between self-efficacy and human behaviour has been documented in studies which found such a relationship in behaviours such as dental flossing, seat belt use, physical activity, dust mask wearing and dietary behaviours (Schwarzer, Schüz and Ziegelmann *et al.*, 2007; Schwarzer, 2016). Other studies have reported that self–efficacy influenced self-examination (Luszczynska and Schwarzer, 2003) and physical exercise (Scholz, Sniehotta and Schwarzer, 2005). Self-efficacy has also been found to influence training proficiency, human health, behavioural therapy, academic achievement, job performance and learning (Martocchio and Judge, 1997; Stajkovic and Luthans 1998; Jerome and McAuley, 2013; Gallagher *et al*., 2013; Parker *et al*., 2014). According to Kyaruzi (2019), student's mathematics self–efficacy and perceptions of feedback use together accounted for a statistically significant portion of variance in students' mathematics performance in Tanzania.

Studies on correlates of adoption of farming technologies (Abel *et al*., 1998; Mwangi and Kariuki, 2015; Olaniyi, 2015) have found relationship between self–efficacy and such variables as access to financial institutions, age, sex, marital status, household size, religiosity, education level, membership of the association and attitude (Mwangi and Kariuki, 2015). According to Abel *et al*. (1998) farmers' reluctance to adopt new practices is mainly due to their lack the perceived need for change, the sub-culture they live in does not allow them to change, they do not know the risky returns, and the benefits expected of their adoption are not made clear to them. In addition, Felicia and Olaniyi (2015) points out that membership to association, costs of the improved cassava processing technology,

access to credit, access to extension services, firm size, and access to market are also correlated to farmers' adoption of technologies. Other correlates further highlighted are uncertainty of being beneficiary of the technology, lack of assets, insufficient labour or capital to manage the new practice or technology, inappropriateness of the technology; and processing, marketing and transport constraints to motivate the rigid nature of farmers (Abel *et al.*, 1998). According to the Social Cognitive Theory (SCT; Bandura, 1997; 2001), self–efficacy is the key determinant of human motivation and behaviour. However, little is known as to whether or not perceived self-efficacy could determine adoption of improved cassava processing technology among farmers in Tanzania, and which component of self-efficacy could influence which implementation stage of adoption.

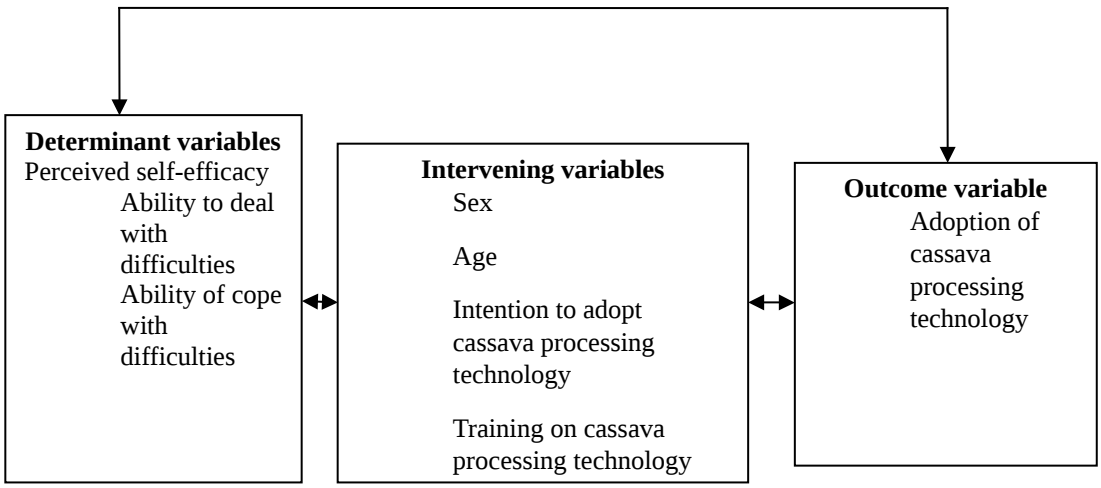
While this study was guided by the SCT in determining the relationship between self-efficacy and adoption of improved cassava processing technology, it also took into account other variables that have been emphasized in the past researches. For example, Cramb (2005) argues that the intention to implement farming operations is central to farmers' behaviour to the extent that it might determine the adoption of farming technology. This argument concurs with the postulate by the theory of planned behaviour that behavioural intention is a key to behavioural adoption (Ajzen and Madden, 1986; Ajzen, 1986; 1991). Thus, the blueprint for this study was the assumption that there would be a relationship between farmers' self–efficacy and adoption of improved cassava processing technology. It was further assumed that other variables such as age, sex, intention to adopt, education level, loans support, and farmers' attendance to trainings on improved cassava processing technology would act as the intervening variables, and thus, interfere with the relationship between self–efficacy and adoption of improved cassava processing technology.

Conceptual Framework

Formation of the assumptions in this study has been informed to the large extent by the social cognitive theory (SCT; Bandura, 1997, 2001). The main postulate presented in this work was that there would be a relationship between farmers' perceived self-efficacy and adoption of improved cassava processing technology. The term self–efficacy as measured in this study involved farmers' ability to deal and cope with difficulties toward the achievement of the planned goal (Gangloff and Mazilescu, 2017). A similar construct, which is conceptually related to self –efficacy is perceived behavioural control in the Theory of Planned Behaviour (TPB; Ajzen, 1986; 1991). While in SCT self–efficacy is a key construct directly interrelated to behavioural change, in the TPB the perceived behavioural control can influence intention to adopt a behaviour, which then exerts an influence on behavioural change. At the same time in TPB, perceived behavioural control can directly influence behavioural change even without intention. The review of these social cognitive theories reveals the role of studying cognitive variables in an attempt to discover their potential ability to explain adoption of improved cassava processing technology. Besides, cognitive variables are malleable to change subject to interventions; and have for a long time been recognized as causes of behaviours and for their mediating roles (Msuya and Duvel, 2007; Annor-Frempong and Düvel, 2009; Mlyuka, 2011).

The crucial role of self-efficacy in influencing adoption of cassava processing technology might thus, be assumed. Before adoption of improved cassava processing technology, a farmer makes assessment of difficulties associated with the technology. The farmer assesses their ability to deal and cope with the difficulties given their beliefs on ease or difficulty of the technology. When the farmer is confident on the beliefs regarding the new framing technology, the farmer is likely to step into the improved cassava processing technology.

Some environmental and other personal variables might act as the intervening variables in the presumed relationship between self-efficacy 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 (Honogbode, 2001; Okpukpara, 2010; Sewando, Mdoe and Mutabazi, 2011; Amaza *et al.*, 2016). The relationship between cognitive flexibility was thus, studied using the blueprint illustrated in Figure 2.1, with double arrows indicating the interrelationship among variables.



Conceptual Framework on the Relationship between self-efficacy
Source: Adoption developed by researcher from Social Cognitive Theory

Methodology

Study design, area and sampling

This cross-sectional study was carried out among cassava farmers in Serengeti, Sengerema, and Biharamulo Districts in Mara, Mwanza and Kagera regions respectively. The regions are located in the Lake zone of Tanzania. The districts were selected given their cassava cultivation potential and presence of the cassava processing units in operation, which is a potential drive for adoption of the improved cassava processing

technology. The key target population for this study was farmers growing cassava in the catchment areas where cassava processing units in the areas were introduced and installed, whether still in operation or not. This population frame was not definite in terms of numbers. The sampling technique was purposive to include farmers who grow cassava and process their cassava in the existing processing units and farmers who grow cassava but process their cassava using traditional methods. The owners of the processing units were of great help to identify both farmers who process in their processing units and the rest of cassava growers in their catchment areas. Given such nature of the population, the invitation was made to the identified farmers and farmers consenting to participate in the study were sought.

A total of 360 participants including 181 (50.3%) males and 179 (49.7%) females responded to the questionnaire comprised of questions on perceived self–efficacy, cassava processing technology adoption, age, sex, education level, receiving loan support, attendance to training on cassava processing technology and intention to adopt. The respondents had a mixed nature in terms of age groups 174 (48.3%) young age group (<= 35 years), 84 (23.3%) middle age group (36 – 44 years), and 102 (28.3%) old age group (45+)]. Their education levels included 70 (19.4%) with no formal education, 138 (38.3%) with primary education, and 152 (42.2%) with secondary education level or above. In terms of economic activities, 183 (50.8%) engaged in only farming, 36 (10%) farming and business and 141 (39.2%) other economic activities. ‘Other economic activities’ mentioned were such as rearing cattle, poultry, casual labour in other farmers’ farms, driving motor cycles, carpentry, selling charcoal and firewood, and bull-cart driving/dragging.

Instruments for Data Collection

One general questionnaire was used to collect data for this study the questionnaire was composed of questions inquiring respondents' information on sex, age, intention to adopt cassava processing technology and attendance in training on cassava processing technology. In addition, two scales, namely; perceived self–efficacy scale (PSE) and cassava processing technology adoption scale (CPTA were part of the questionnaire. Prior to the use of the instruments in this survey, the instruments were pilot tested among 200 participants for reliability and validity. Perceived self–efficacy was measured using the perceived self–efficacy scale (PSE). PSE was adopted from the 13 items perceived self-efficacy scale (Gangloff and Mazilescu, 2017) to measure farmers' perceived self-efficacy in Tanzania for dual reasons. First, tool's items are relevant to general domains and its application to the population composed of more than one group (executives, employees and students). This criterion led to the assumption that it 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), making 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 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 and Mazilescu, 2017).

Following the pilot study, the Principle Component Analysis found only 11 items relevant in the farmers' context. The 11 items of PSE were further found to be a two factors scale (subscales) measured in a five point continuum from never to always. The first subscale measures farmers' ability to deal with difficulties and the second subscale measures farmers' ability to cope with difficulties. The sample items measuring farmers' ability to

deal with difficulties were such as '*When unexpected problems arise, I am well able to deal with them,' and 'I feel able to deal with most of the problems that occur in my life.'* The sample items measuring farmers' ability to cope with difficulties were *'I avoid coping with difficulties' and 'If something seems too complicated, I don't even bother trying.'*

The same structure of the instrument was found in the present study whereby in PCA analysis the initial loadings indicated two factor solutions and were in agreement with the scree plot, whose elbow point was similarly at the second point. Similarly, a systematic comparison between the criterion values from the Monte Carlo Parallel analysis and the actual PCA values indicated similar results because 2 components from PCA indicated eigenvalues greater than the corresponding criterion values for a randomly generated data matrix of the same size (11 variables × 360 respondents). With regard to reliability, Gangloff and Mazilescu (2017) report adequacy of internal consistency (α = 0.86) for their 13 items perceived self-efficacy scale. Reliability for the PSE during the pilot study indicated good internal consistency of α = 0.74 for ability to deal with difficulty subscale, α = 0.77 for ability to cope with difficulty subscale and α = 0.81 for the total PSE. In the present study, the internal consistencies for PSE were improved so that ability to deal with difficulty sub – scale reached good internal consistency of α = 0.79, perceived ability to cope with difficulty subscale was α = 0.79 and the reliability for the total PSE was good with internal consistency of α = 0.85.

Cassava processing technology adoption scale (CPTA) was used to measure adoption of the improved cassava processing technology. CPTA is a three factor measurement scale comprising of 18 items intended to measure three stages or components of adoption improved cassava processing technology. The three components are involvement in the

pre-processing tasks, involvement in processing tasks, and utilization of the processed cassava products. The reliability of both subscales and the entire scale reached an acceptable reliability indices (greater or equal to 0.7, Tabachnick and Fidel, 2007; Field, 2009; Pallant, 2011). These were $\alpha = 0.86$. $\alpha = 0.71$, $\alpha = 0.79$, and $\alpha = 0.93$ for involvement in the pre-processing tasks, involvement in the processing tasks, utilization of the processed products and total adoption scale respectively. With regard to validity, there were low to moderate correlations among subscales. The correlations were $r = -0.32$ between involvement in the pre-processing tasks and involvement in the processing tasks subscales; $r = -0.23$ between involvement in the pre-processing tasks and utilization of the processed products; and $r = 0.27$, between involvement in the pre-processing tasks and utilization of the processed products. These correlations imply that the subscales measure the common trait of adoption and at the same time each subscale can be used as a measure of an independent subtheme.

Data Analysis

Items in the scales were entered in the statistical package for social sciences (SPSS) version 21 for analysis. Having screened the data, negatively worded items in all scales were reversed so that high scores in the PSE represented perceived high self–efficacy while low score represented perceived low self–efficacy. Similarly, high scores in the CPTA scale represented a high level of adoption while low scores in the CPTA represented low level of adoption of the improved cassava processing technology. Principle component analysis (PCA) confirmed the two factor nature of the PSE and the three factor nature of the CPTA. The scores in items forming the subscales in both scales were then summed up for each participant and arranged in descending order. Then the median score for each subscale (factor) was treated as a cut-off point separating the high from low scores in each of the sub-scales.

Such a categorization led to labelling whereby respondents whose scores fell below the median score in the PSE subscales were labelled as low self-efficacy category while those scoring above the median were labelled as high self–efficacy category. The same procedure was applied to label adopters from non-adopters in the subscale of the CPTA. In addition, it led to the choice of two statistical tools of analysis. Chi-square (χ^2) analysis was performed to explore the magnitude of the association in farmers' perceived self–efficacy with the three components of adoption of the cassava processing technology, which are; involvement in pre-processing tasks, involvement in the processing tasks and utilization of the cassava processed products. Chi-square analysis was further supplemented by binary logistic regression analysis to explain adoption of the improved cassava processing technology from perceived self–efficacy upon controlling for all other variables in the conceptual framework.

Results

Relationship between farmers' adoption of improved cassava processing technology and perceived self -efficacy

The relationship between farmers' perceived self–efficacy and adoption of improved cassava processing technology was explored by analysing the magnitude of association between the two variables using a chi-square test for independence. This was done by assessing how each component of perceived self–efficacy (Beliefs on ability to deal with difficulty and Beliefs on ability to cope with difficulty) was associated with each implementation stage of adoption of improved cassava processing technology (involvement in the pre–processing technology, involvement in processing technology and utilisation of the processed cassava products). Table 3.1 shows the results.

The Association between perceived self-efficacy and Farmers' involvement in the pre-processing tasks

Data in Table 1, show a significant difference, [χ^2 (1, n = 360) = 4.304, p = 0.04, phi = - 12] in adoption of the pre-processing tasks with farmers' beliefs on their ability to deal with difficulties. The magnitude of association was just small as signified by the phi = 0.12. This assessment was based on Cohen's criteria whereby a phi value of .10 is considered small association, 0.30 is moderate and 0.50 is high association (Field, 2009; Pallant, 2011). Similarly, there was a slight significant difference, χ^2 (1, n = 360) = 3.196, p = 0.07 in involvement in pre-processing tasks with farmers' beliefs on their ability to cope with difficulties with small magnitude of association (Phi = 0.10). These results mean that farmers with perceived high self–efficacy were more likely to report involvement in the pre-processing tasks than farmers with perceived low self–efficacy.

The Association between perceived self-efficacy and farmers' involvement in the improved processing tasks

Information in Table 2 reveals no significant differences, χ^2 (1, n = 360) = 2.075, p = 0.150 between farmers who reported low perceived ability to deal with difficulty and their counterparts who reported high perceived ability to deal with difficulty in involvement in the processing tasks. Similarly, there was no significant difference, χ^2 (1, n = 360) = 0.061, p = 0.805 in involvement in the processing tasks with farmers' perceived ability to cope with difficulties.

The association between perceived self-efficacy and farmers' and utilisation of the cassava processed products

Data in Table 1, indicates no significant difference, χ^2 (1, n = 360) = 0.283, p = 0.595 between farmers with perceived high beliefs on ability to deal with difficulties and farmers with perceived low beliefs on ability to deal with difficulties in reporting utilization of the processed cassava products. Results further show no difference, χ^2 (1, n = 360) = 0.106, p = 0.745 utilization of the processed cassava products with farmers' perceived ability to cope with difficulties.

Table 1: The Association between Farmers' Perceived Self-efficacy and adoption of the improved cassava processing technology

Self-efficacy	Level	Adoption: Involvement in the Pre-processing tasks: Not adopted F	Not adopted %	Adopted F	Adopted %	Chi-square test: χ^2	df	p	phi
Ability to deal with difficulty	High	52	45.2	63	54.8	4.304	1	.04	.12
	Low	141	57.6	104	42.4				
Ability to cope with difficulty	High	66	47.5	73	52.5	3.196	1	.074	.10
	Low	124	56.4	96	43.6				
Involvement in the Processing tasks									
Ability to deal with difficulty	High	147	60.0	98	40.0				
	Low	59	51.3	56	48.7				
Ability to cope with difficulty	High	124	56.4	96	43.6	.061	1	.805	.02
	Low	81	58.3	58	41.7				
Utilization of the processed cassava products									
Ability to deal with difficulty	High	136	55.5	109	44.5	.283	1	.595	.034
	Low	68	59.1	47	40.9				
Ability to cope with difficulty	High	127	57.7	93	42.3	.106	1	.745	.023
	Low	77	55.4	62	44.6				

The Likelihood of adoption of improved cassava processing technology from perceived self–efficacy

Further analysis was performed using direct logistic regression models for the purpose of explaining adoption of improved cassava processing technology from both independent

and intervening variables in the conceptual framework. Variables such as age, sex, training on cassava processing, intention to adopt, loan support, farmers' beliefs to deal with difficulties, and farmers' beliefs to cope with difficulties were assessed for their influence on the likelihood that respondents would report adoption. This was so done for involvement in pre-processing tasks, involvement in processing tasks and utilization of the processed cassava products.

Predicting the likelihood of involvement in pre-processing tasks from perceived self-efficacy

The model for explaining involvement in pre-processing tasks as a whole was statistically significant, [$\chi 2$ (8, n = 360) = 16.52, $p < .04$], indicating that the model was capable of distinguishing respondents who reported from those who did not report adoption of improved cassava pre-processing tasks. The model explained between 7.8% (Cox and Snell R square) and 10.4% (Nagelkerke R squared) of the variance in involvement in pre-processing tasks, and was able to categorise 61% of non-adopters. As Table 2 indicates, only three variables, (farmers' attendance to the training on improved cassava processing technology, farmers' ability to deal with difficulties and farmers' ability to cope with difficulties) uniquely explained farmers' involvement in pre-processing tasks. The strongest variable in explaining involvement in pre-processing tasks was farmers' attendance to training on improved cassava processing technology, which recorded an odds ratio of 5.32. This meant that farmers, who had attended training on the improved cassava processing technology before, were five times more likely to report involvement in the pre-processing tasks than their counterpart farmers who had not attended any training on the improved cassava processing technology.

Farmers' ability to deal with difficulties followed, with odds ratio of 1.909, implying that farmers' with high ability to deal with difficulties were twice more likely to report involvement in the pre-processing tasks than farmers with perceived low ability to deal with difficulties. Lastly, farmers' ability to cope with difficulties was the third variable in explaining involvement in pre-processing tasks by recording an odds ratio of 1.585. This meant that farmers who reported perceived high ability to cope with difficulties were one and a half times more likely to report involvement in the improved pre-processing tasks. Other variables such as age, sex, education level, intention to adopt and loan access did not uniquely explain adoption of the pre-processing tasks.

Predicting the likelihood of involvement in processing tasks from perceived self-efficacy

The model for explaining involvement in processing tasks was statistically significant, [$\chi 2$ (8, n = 360) = 16.52, $p < .04$]. This means that the model was able to categorise respondents who reported engaging in involvement of processing tasks from those who reported non-involvement in processing tasks. The model explained between 4.5% (Cox and Snell R square) and 6.0% (Nagelkerke R squared) of the variance in involvement in processing tasks, and correctly categorised 61.6% of non-adopters. Findings in Table 2 shows that only two variables (attending training on improved cassava processing technology and ability to deal with difficulties) uniquely explained farmers' involvement in processing tasks.

The strongest variable in explaining farmers' involvement in processing tasks was attendance to training on improved cassava processing technology (Odds Ratio = 3.12). This meant that farmers who had attended training on cassava processing technology were three times more likely to report involvement in processing tasks than farmers who had not attended any training on the same. Perceived ability to deal with difficulty

followed (Odds Ratio = 1.70), implying that farmers with perceived high ability to deal with difficulty were about two times more likely to report involvement in processing tasks relative to their counterpart farmers with perceived low ability to deal with difficulty. Age, sex, education level, intention to adopt loan access and perceived ability to cope with difficulties did not uniquely explain involvement in processing tasks.

Predicting the likelihood of utilization of the processed cassava processed products from perceived self-efficacy

The model for explaining utilization of the processed cassava products as a whole was statistically insignificant, [$\chi 2$ (8, n = 360) = 11.29, p < .19]. The model explained between 3.1% (Cox and Snell R square) and 4.2% (Nagelkerke R squared) of the variance in utilization of the processed cassava products, and correctly categorised 57.4% of non – adoption. Information from Table 2 reveals that only one variable, which is farmers' attendance to training on improved cassava processing technology, uniquely explained farmers' utilization of the processed cassava products when all other variables in the conceptual framework were put under control. The variable recorded Odds Ratio of .36, indicating that farmers who had not attended any training on improved cassava processing technology were .36 times less likely to report utilization of processed cassava products than farmers who had attended trainings on improved cassava processing technology.

Table 2: Likelihood of adoption of improved cassava processing technology

	B	S.E.	Wald	df	Sig.	Odds Ratio	95% C.I. for Odds Ratio	
Involvement in Pre-processing Tasks								
Age	-.030	.016	3.503	1	.061	.970	.940	1.001
Sex(1)	-.028	.223	.016	1	.900	.972	.629	1.504
Ednlevel(1)	-.281	.330	.722	1	.396	.755	.395	1.443
Ednlevel(2)	.174	.319	.296	1	.586	1.190	.636	2.224
Everattend(1)	1.672	.411	16.504	1	.000	5.320	2.375	11.917
Intendprocess(1)	-.479	.272	3.089	1	.079	.620	.363	1.057
BTDeal(1)	.647	.247	6.856	1	.009	1.909	1.177	3.097
BTCop(1)	.461	.227	4.105	1	.043	1.585	1.015	2.476
Constant	.564	.680	.687	1	.407	1.758		
Involvement in Processing Tasks								
Age	.002	.016	.019	1	.890	1.002	.972	1.033
Sex(1)	.141	.220	.414	1	.520	1.152	.749	1.773
Ednlevel(1)	.134	.332	.164	1	.686	1.144	.596	2.194
Ednlevel(2)	.572	.323	3.142	1	.076	1.771	.941	3.334
Everattend(1)	1.138	.389	8.558	1	.003	3.119	1.456	6.684
Intendprocess(1)	.166	.264	.394	1	.530	1.180	.704	1.979
BTDeal(1)	.530	.243	4.757	1	.029	1.699	1.055	2.735
BTCop(1)	-.050	.225	.050	1	.824	.951	.611	1.479
Constant	-1.075	.673	2.553	1	.110	.341		
Utilization of the Processed Cassava Products								
Age	.017	.016	1.212	1	.271	1.018	.987	1.049
Sex(1)	-.291	.218	1.787	1	.181	.747	.488	1.145
Ednlevel(1)	-.068	.321	.045	1	.833	.935	.499	1.752
Ednlevel(2)	-.343	.312	1.211	1	.271	.710	.385	1.307
Everattend(1)	-1.017	.406	6.265	1	.012	.362	.163	.802
Intendprocess(1)	.177	.261	.461	1	.497	1.194	.716	1.992
BTDeal(1)	-.234	.242	.934	1	.334	.792	.493	1.271
BTCop(1)	.071	.223	.103	1	.748	1.074	.694	1.662
Constant	-.494	.665	.552	1	.457	.610		

Discussion

The study findings show the relationship between perceived self–efficacy and adoption of improved cassava processing technology. This has just added to the list of human behaviours which are influenced by self–efficacy as it had been put forward by other researchers in the field and physical exercise (Luszczynska and Schwarzer, 2003; Scholz, Sniehotta and Schwarzer, 2005; Schwarzer, Schüz and Ziegelmann *et al.*, 2007; Schwarzer, 2016). Self-efficacy has also been found to determine training proficiency, human health, behavioural therapy, academic achievement and job performance (Martocchio and Judge, 1997; Stajkovic and Luthans 1998; Jerome and McAuley, 2013; Gallagher *et al*., 2013; Parker *et al*., 2014; Kyaruzi, 2019).

In addition to the knowledge highlighted by past research (Martocchio and Judge, 1997; Stajkovic and Luthans 1998; Luszczynska and Schwarzer, 2003; Scholz, Sniehotta and Schwarzer, 2005; Schwarzer, Schüz and Ziegelmann *et al.*, 2007; Jerome and McAuley, 2013; Gallagher *et al*., 2013; Parker *et al*., 2014; Schwarzer, 2016; Kyaruzi, 2019), this study brings to light that perceived self–efficacy on adoption varies with the component of self-efficacy measured and the stage of technology adoption. While both perceived ability to deal with difficulties and ability to cope with difficulties explained farmers' involvement in the pre–processing tasks, only ability to deal with difficulties could explain farmers' involvement in the processing tasks. On the other hand, both ability to deal with difficulties and ability to cope with difficulties did not uniquely explain utilization of the processed cassava products. While other intervening variable in the conceptual framework did not interfere with the relationship between perceived self –efficacy and adoption, attendance to the training on the improved cassava processing technology did. It was even the strongest predictor of adoption of improved cassava processing technology in some implementation stages of adoption. This might support the emphasis that for more successful adoption, training on farming technology needs to be introduced in pair with introduction of the farming technologies. In these trainings the contents might include practical exhibition on both expected advantages and disadvantages, as a means to motivate the development of self-efficacy.

The fact that self–efficacy explained farmers' involvement in pre-processing tasks and processing tasks but not utilization of the processed cassava products might lead to some assumptions. First, farmers might require self–efficacy in the early stages of adoption, and specifically, beliefs in both one's ability to deal with difficulties and one's ability to cope with difficulties because the early stages are still unknown to farmers. Hence, given inexperience farmers have in involvement in these initial implementation stages of the

technology, self–efficacy is more crucial. In addition, one might assume that farmers don't need self–efficacy for them to utilize the products since they have participated in their preparations, so probably they are confident enough to use them. On the other way around, farmers might participate in processing cassava for business purposes and not for their own domestic consumption given the fact that consumption of the technology might depend on perceived usefulness of the technology itself (Lin, Fofanah and Liang, 2011; Muk and Chung, 2015). Second, it might also signify that provided one has knowledge gained from training on cassava processing technology, one is able to utilize the products regardless of whether or not one is self–efficacious.

The role of attendance to training on improved cassava processing technology has been also observed. Training might contribute in the development of self–efficacy if it includes the topics that develop self–efficacy. It might also develop farmers' intention to adopt improved cassava processing technology. According to Ajzen (2001) perceived social norms which shares conceptual Operationalization with training on socially acceptable practices influences one's behavioural intention. It is not surprising that the level of formal education could not explain adoption of improved cassava processing technology but rather attendance to training on improved cassava processing technology did. This may be because while formal education does not have any content regarding processing, cassava training seminars have. This might quickly influence an individual exposed to the training of improved cassava processing technology regardless of whether or not such an individual has formal education.

These results add this paper to the list of literature supporting the postulates by the Social cognitive Theory (Bandura, 1997). In the first place, attendance to training by farmers and self-efficacy explained adoption of improved cassava processing technology. This implies

that as long as farmers attend (Personal factor) the trainings (environmental factor) they develop self-efficacy that enables them to adopt improved cassava processing technology (Behavioural factor). In addition, the theory argues that behaviour change is a function of exposure whereby when the role model is rewarded; the likelihood of imitation (adoption) is greater than when the role model is punished. Since self–efficacy influences adoption, fostering self–efficacy among farmers is one of the practical tasks that need to be undertaken before or hand in hand with the introduction of any farming technology. To develop self–efficacy, Usher and Pajares (2009) propose some skills that if taught, might act as feeders of self–efficacy among farmers. These are mastery experience, vicarious experience, psychosocial state, and social persuasions. All these activities can be embraced in planned practical training accompanied by exhibitions of successful famers, who can demonstrate their ways to success.

Conclusions

The general purpose of this paper was to present the study whose general objective was to examine the relationship between perceived self–efficacy and adoption of improved cassava processing technology among farmers. This was achieved through three specific objectives which were: first, to explore the association between farmers' ability to deal with difficulties and adoption of improved cassava processing technology; to explore the association between farmers' ability to cope with difficulties and adoption of improved cassava processing technology; and to predict adoption of improved cassava processing technology from farmers' perceived self–efficacy. Results have indicated that while both perceived ability to deal with difficulties and ability to cope with difficulties explained farmers' involvement in the pre–processing tasks, it is ability to deal with difficulties which explained involvement in the processing tasks.

Results have further indicated that while the components of perceived self–efficacy predicted early implementation stages of adoption of improved cassava processing technology, attendance to training on the improved cassava processing technology the later stage of the same technology, namely utilization of the processed cassava products. Based on the study's findings therefore, three conclusions are hereby drawn. First, the ability of perceived self–efficacy to explain adoption of improved cassava processing technologies varies with the components of self–efficacy measured and the implementation stage of adoption of the technology in reference. Second, both ability to deal with difficulties and ability to cope with difficulties are important in the early implementation stages of adoption of non – incremental technologies, which require farmers' decision making to participate in the tasks demanded by the introduced technologies. Lastly, farmers' perceived self–efficacy explains adoption despite the fact that it is not the only and sufficient factor explaining adoption of cassava processing technologies.

Recommendations

Based on the study's findings and conclusions, the following are recommended:

i. Promotion agents such Extension officers should place much effort to encourage farmers' attendance to trainings on cassava processing technologies. The contents of the training, among others, should include pairing farming technology with practical training such as exhibitions of the successful adopters.

ii. The trainings need to accommodate the contents exposing farmers to expected advantages and disadvantages of the technology to be adopted.

iii. Attendance to training should continuously be encouraged from early stages and even in the later implementation stages of adoption of improved cassava

processing technology (involvement in pre–processing tasks, involvement in processing tasks and utilization of the processed cassava products).

iv. For future researchers, this study provokes the need to investigate the duration required for farmers to develop into self–efficacious individuals through teaching mastery experience, vicarious experience, psychosocial state, and social persuasions. This might successfully be achieved by conducting quasi experimental design studies among farmers.

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Paper Five

Validation of the cognitive flexibility scale (CFS) and its application in adoption of improved cassava technologies among cassava growers in Tanzania

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Paper Six

The relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology

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Paper Seven

Cognitive predictors of the likelihood of adoption of improved cassava processing technology

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CHAPTER THREE

3.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

3.1 Summary and Conclusions

This section presents a summary of the major findings of this study, from which the conclusions and recommendations are made. It summarises the work covered in the specific objectives of the thesis, which have been addressed in the journal articles enlisted in the previous chapter. Each subsection below addresses one specific objective presented in the themes or titles of the same.

3.1.1 The relationship between farmers' attitudes and adoption of improved cassava processing technology

The first specific objective of this study examined the relationship between farmers' attitudes and adoption of improved cassava processing technology. Analysis and results for this objective are covered in paper two of this thesis. The paper discusses the relationship between farmers' attitude towards improved cassava processing technology and its adoption. Results in the paper indicate significant associations between farmers' instrumental attitude and involvement in pre-processing tasks ($p < 0.001$); and between cognitive attitude and involvement in pre-processing tasks ($p < 0.01$).

Significant associations were also found between farmers' instrumental attitude and involvement in the processing tasks ($p < .001$); and between farmers' cognitive attitude and involvement in the improved processing tasks ($p < 0.01$). Further, significant associations were found between farmers' instrumental attitude and utilization of the cassava processed products ($p < 0.01$); and between farmers' cognitive attitude and utilization of the cassava processed products ($p < 0.001$). Binary regression analysis found that predictors of reporting adoption of improved cassava processing technology

were attendance to training on improved cassava processing technology, Intention to engage in improved cassava processing technology, instrumental attitude and Cognitive attitude. The paper argues that, while instrumental attitude is more likely to explain adoption of the improved cassava processing technology in specific pre-processing tasks, cognitive attitude is more likely to explain utilisation of the processed cassava products than it is likely to explain involvement in the pre-processing and processing tasks. The paper concludes that attitude towards improved cassava processing technology partly explains adoption of the improved cassava processing technology and that the influence of attitude on adoption of the improved cassava processing technology is not the same across the components of adoption of the improved cassava processing technology.

3.1.2 The relationship between farmers' perceived self-efficacy and adoption of improved cassava processing technology

The second specific objective of this study examined the relationship between farmers' perceived self-efficacy and adoption of improved cassava processing technology. Perceived self-efficacy was an independent variable in the second objective of this study. It required a relevant instrument which could capture this cognitive trait among farmers. Though self–efficacy had been measured in so many studies previously; three main issues had to be addressed. These concerned the structure of the PSE as to whether it is a uni-dimensional or multi-dimensional construct; second, whether self-efficacy is task-specific or domain-specific; and third, there was a lack of in instrument measuring self–efficacy in the context of cassava farming and processing technology in particular. Hence, the study validated the tool to measure self – efficacy among farmers (Joshua, MAssawe and Mwakalapuka, 2020c). In the validation process, Principle Component Analysis (PCA) supplemented by the Monte Carlo Parallel analysis is performed. Results indicate that 11 items of the PSE ere relevant in measuring farmers' self-efficacy.

Results further indicate the moderate discriminant validity (r = 0.48), and good internal consistency (α = 0.85) of the adopted PSE. The paper concludes that PSE is an effective instrument in assessing individual differences in perceived self-efficacy. Having put an instrument to measure self – efficacy in place,

The relationship between farmers' perceived self-efficacy and adoption of improved cassava processing technology was addressed in paper four of this thesis. In the paper, self–efficacy, which is an independent variable, is categorized into two sub–scales measuring farmer's ability to deal with difficulties and their ability to cope with difficulties. The paper addresses three specific objectives, namely; explore the association between farmers' ability to deal with difficulties and adoption of improved cassava processing technology; second, to explore the association between farmers' ability to cope with difficulties and adoption of improved cassava processing technology; and lastly, to predict adoption of improved cassava processing technology from perceived self–efficacy. On the other hand, adoption of cassava processing technology, which is an outcome variable, is measured using cassava processing technology adoption scale (CPTA), which is composed of three – subscales (involvement in the pre-processing tasks, involvement in processing tasks, and utilization of the processed cassava products). Other personal variables such as age, sex, education level, training on cassava processing technology, participation in other economic activities and intention to adopt are also measured as intervening variables.

Data was analysed using chi – square for independence supplemented by binary logistic regression analytical tool. Results in the paper indicate significant association between farmers' farmers' beliefs on their ability to deal with difficulties and involvement in pre-processing tasks ($p < 0.04$); but a slight significant association between farmers' beliefs on their ability to cope with difficulties and involvement in pre-processing tasks ($p < 0.07$).

Regarding association between perceived self–efficacy and farmer's involvement in processing tasks, results in the paper indicates no significant associations between perceived ability to deal with difficulty and involvement in the processing tasks and between ability to cope with difficulties and involvement in processing tasks. Similarly, results indicate no significant associations between perceived ability to deal with difficulties and utilization of the processed cassava products and between ability to cope with difficulties and utilization of the processed cassava products. Binary logistic regression analysis revealed that attendance to training on improved cassava processing technology, perceived ability to deal with difficulties and ability to cope with difficulties explained farmers' involvement in pre-processing technology. It was further found that training on improved cassava processing technology and perceived ability to deal with difficulties explained farmers' involvement in processing tasks. Lastly, results indicate that only attendance to training on improved cassava processing technology explained utilization of the processed cassava products.

Basing on the results, the paper argues that perceived self–efficacy on adoption varies with the component of self-efficacy measured and the stage of technology adoption. The paper concludes that paired with attendance to training on improved cassava processing technology, perceived self–efficacy partly explains adoption of improved cassava processing technologies. Perceived self–efficacy in terms of ability to deal and cope with difficulties is important in the early implementation stages of adoption of non – incremental technologies, which require farmers' decision making to participate in the tasks demanded by the introduced technologies.

3.1.3 The relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology

The third specific objective of this thesis examined the relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology. Cognitive flexibility was a key independent variable in the second objective of this study. To measure cognitive flexibility, it was necessary to have in place an effective tool which is both reliable and valid. This important role is addressed in paper three of this thesis. The paper discusses the validation process of the cognitive flexibility scale (CFS) as a measurement instrument for farmers' cognitive flexibility (CF). The study is carried out with three specific objectives which are to assess the instrument's component structure including validity and reliability, to examine whether CFS could categorise farmers' performance in cognitive flexibility by farmers' demographics; and whether or not could cognitive flexibility have an influence on farmers' adoption of cassava farming technologies. Results indicate that CFS is a three factor scale reaching an internal consistency of $\alpha = 0.85$. The three subscales are reported to be adapting to new farming technologies ($\alpha = 0.88$), acceptance of new farming technologies ($\alpha = 0.86$), and open mindedness to other people's ideas ($\alpha = 0.80$). The findings further indicate low correlations among the subscales, implying discriminant validity of the scale. It is also indicated that CFS is able to categorise farmers' performance in cognitive flexibility by their demographics such as sex, age groups and levels of formal education and that cognitive flexibility as measured by CFS is potentially associated with farmers' adoption of cassava farming practices and technologies. The paper concludes that CFS is effective and potentially applicable in the field of rural development and with specific focus to adoption of farming technologies.

The relationship between farmers' cognitive flexibility and adoption of improved cassava processing technology is addressed in paper four composing this thesis. In the paper,

discussion is centered on the assumption that cognitive flexibility would explain farmer's adoption of cassava processing technology. The study is guided by the conceptual framework deduced from the Social Cognitive theory. The framework makes cognitive flexibility as the main independent variable of the study. Three subscales (tendencies to adaptation to new technologies, technology acceptance, and open mindedness) to mean cognitive flexibility. While adoption of cassava processing technology is treated as dependent variable in the paper, specific sub–scales (involvement in pre–processing tasks, involvement in the processing tasks and utilization of the cassava processed products) are measured to represent the construct. The study further assumes that other non – cognitive variables such as sex, age, intention to adopt cassava processing technology and attendance to training on cassava processing technology would confound the relationship between cognitive flexibility and adoption.

Both Chi–square for independence and Binary logistic regression analytical tools are used to analyse data. Concerning the association between farmers' cognitive flexibility and involvement in the pre-processing tasks, the paper reports significant association between farmers' adaptation to new farming technologies and involvement in pre-processing tasks ($p < 0.03$). On the other hand, neither does the paper reports significant associations between farmers' involvement in pre-processing tasks with technology acceptance (TA) nor with open mindedness (OM) to other peoples' ideas. The paper also reports that no significant associations between farmers' adaptation to new farming technology and their involvement in the processing tasks; and between farmers' technology acceptance and their involvement in the processing tasks. However, significant association is reported between farmers' open mindedness and involvement in the improved processing tasks ($p < .001$). Regarding utilization of the processed cassava products, the paper reports significant associations between farmers' technology acceptance and utilisation of the cassava processed products ($p < .04$); and between farmers' open mindedness and

utilization of the processed cassava products ($p < 0.03$). Binary logistic regression analysis indicates that attendance to the training on improved cassava processing technology, adaptation to farming technologies, open mindedness to other people's, age and intention to adopt processing explained adoption of improved cassava processing technology. The paper argues that the influence of cognitive flexibility on cassava processing technology is not uniform across the three implementation stages of adoption of the technology but rather differs depending with the implementation stage of adoption and concludes that cognitive flexibility partly explains adoption of improved cassava processing technology.

3.1.4 Explain adoption of the improved cassava processing technology from cognitive variables when other personal and environmental variables are held constant

The fourth specific objective of this study intended to explain the adoption of the improved cassava processing technology from cognitive variables when other personal and environmental variables are put under control. The seventh paper of this thesis presents how this objective was addressed. The paper purports to predict the likelihood of adoption of improved cassava processing technology from cognitive traits in Tanzania. 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. On the other hand, the cassava processing technology adoption (CPTA) scale is used to measure respondents' adoption of improved cassava processing technology. The paper is guided by a blueprint which factorizes these cognitive traits as correlates of adoption of improved cassava processing technology. The blueprint also places other non – cognitive variables such as level and type of technology, training on cassava processing technology, education level, participation in other economic activities,

sex, age and intention to adopt cassava processing technology as intervening variables. However, the paper assumes that cognitive variables would explain adoption of improved cassava processing technology upon controlling for other non – cognitive variables in the conceptual blueprint.

Data in the paper are analysed using Pearson product–moment correlation coefficient to assess the relationships among the key variables of the study. This is supplemented by binary logistic regression analytical tool 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. The paper reports between low positive and moderate positive correlations among the variables ($p < 0.001$), and low negative insignificant 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. Binary logistic regression analysis revealed that attendance to training on improved cassava processing technology, perceived self–efficacy, cognitive flexibility, age, attitude, explained farmers' adoption of improved cassava processing technology.

Basing on the results, the paper argues that cognitive flexibility and perceived self–efficacy explains the first stages of adoption of the newly introduced farming technologies such as the improved cassava processing technology. It is further argued in the paper that adaptation to and acceptance tendencies might be achieved when one is efficacious enough to accept and adapt to new technologies. The paper concludes that cognitive traits such as attitude, self–efficacy and cognitive flexibility paired with attendances to the training in improved cassava processing technology and age partly explain adoption of improved cassava processing technologies. In addition, different implementation stages of adoption require different cognitive variables and even different components of the same cognitive variables.

3.2 Contributions to the Body of Knowledge

While past research in Tanzania has been attributing low adoption of improved cassava processing technology to factors eternal to farmers; this thesis has brought into light the contribution of inherent cognitive variables in explaining adoption of the same. This implies to its uniqueness in an appeal to psychological approach in addressing adoption of cassava processing technology. Added to that, three new research instruments have been put in place. These instruments are potential for future studies in the field of agriculture, rural development and behavioural studies. The instruments are cassava processing technology adoption scale (CPTA) (Joshua, Massawe and Mwakalapuka, 2020a), Perceived Self-Efficacy Scale (PSE) (Joshua, Massawe and Mwakalapuka, 2020b) and cognitive flexibility scale (CFS) (Joshua, Massawe and Mwakalapuka, 2020c).

In addition, unlike most previous studies which measured adoption as a uni – dimension variable with dichotomously expected response, this thesis adds into literature a unique approach of measuring adoption of improved cassava processing technology by structuring adoption into three implementation stages (involvement in pre – processing tasks, involvement in processing tasks and utilization of the processed cassava products) measured in a continuum five point scale (Joshua, Massawe and Mwakalapuka, 2020a).

3.3 Theoretical Implications of the Findings

Selection of the variables formulating the conceptual framework, specific objectives and the research hypotheses guiding this study was informed by the Social Cognitive Theory (Bandura, 1977). The framework assumed that the reciprocal relationship would exist between cognitive variables (attitudes, perceived self–efficacy and cognitive flexibility) and adoption of improved cassava processing technology. Other non – cognitive variables

such as level and type of technology, training on cassava processing technology, education level, participation in other economic activities, sex, age and intention to adopt cassava processing technology could act as intervening variables. Despite the possibility of these variables to interfere with the relationship between cognitive variables and adoption of cassava processing technology, it was assumed that cognitive variables would explain adoption of improved cassava processing technology upon controlling for other non – cognitive variables in the conceptual blueprint.

The findings in this study are partly in support of the arguments of the theory. In Joshua, Massawe and Mwakalapuka (2020d) for example, it is reported in line with SCT that attendance in the training uniquely explained adoption in pre-processing and processing stages but did not uniquely explain utilization of the processed cassava products. According to SCT, 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. In the same paper, attitude has partly explained adoption of improved cassava processing technology just as the theory informs: ‘acquisition of the behaviour undergoes evaluation of positive and negative outcomes because people are more likely to engage in a modelled behaviour if the behaviour brings valued outcomes than if it has unrewarding or punishing outcomes to the role model (Joshua, Massawe and Mwakalapuka, 2020a; Joshua, Massawe and Mwakalapuka, 2020d).

Although it was expected that cognitive variables (attitudes, perceived self–efficacy, and cognitive flexibility) would lead in explaining adoption, attendance to training in cassava processing technology became the strongest predictor of adoption (Joshua, Massawe and Mwakalapuka, 2020d; Joshua, Massawe and Mwakalapuka, 2020e; Joshua, Massawe and Mwakalapuka, 2020f). This is in line with the main postulate of the SCT that a reciprocal relationship exists between environmental factors, personal factors, and behaviour.

3.4 Recommendations

As far as the results of this study are concerned, this thesis provides two types of recommendations. The first type is a set of recommendations for practice by the stakeholders of cassava subsector, and the second type is a set of recommendations for future research.

3.4.1 Recommendations for Practice

(i) Development of positive attitude towards improved cassava processing technology

Instrumental attitude explained adoption of improved cassava processing technology in this study. In measuring instrumental attitude specific focus was placed on aspects such as palatability, accessing the products, market for the products, preparation time and safety in terms of consumer's health. This information motivates the recommendation on the need to develop attitude toward improved cassava processing technology by first, processors should ensure that the quality of HQCF in terms of preparation conditions is maintained. Second, processors should make arrangements with their supply agents to make sure that HQCF and its accompanying products such biscuits, breads, and burns (*maandazi* in Kiswahili) are available at the reach of customers. Third, The Government through the Ministry of Agriculture in collaboration with Tantrade should assist farmers to search of reliable markets for the processed cassava products. Fourth the Government should adopt the Presidential cassava transformation initiative (PCTI) policy, which has been found to contribute much to the success and growth of the improved cassava processing technology in other African countries such as Nigeria and Ghana.

(ii) Encouraging attendance to training in improved cassava processing technology

Results in this study indicate that attendance to training in improved cassava processing technology explained farmers' adoption. This compels recommendation to promoters of improved cassava processing technology to encourage farmers to attend to the training since trainings are the agent of attitude development. Trainings should also be designed to include topics exposing farmers to the benefits related to processing tasks. Farmers should also respond to the calls for these trainings as much possible whenever training opportunities arise.

(iii) Development of farmers' self-efficacy

In this study, self–efficacy has been found to partly explain adoption of improved cassava processing technology specifically, in the early stages of adoption. This finding motivates recommendations to cassava promotion agents such as extension officers to develop farmers' self–efficacy. To successfully do this, the promotion agents should expose farmers to the contents capable of building farmers' self–efficacy such as mastery experience, vicarious experience, psychosocial state, and social persuasions.

(iv) Development of farmers' cognitive flexibility

Findings of this thesis indicate that cognitive flexibility explains adoption of improved cassava processing technology. Given the fact that innovations associated with cassava processing methods are many and progressive, it is recommended that promotion agent of cassava processing technology such as NGOs and extension officers should adopt approaches for promoting cassava processing intervention which are flexible enough to develop flexibility in accepting new technologies by farmers.

3.4.2 Recommendations for Future Research

(i) Improvement of research instruments

Future research in this area in Tanzania may investigate on how to improve the instruments on measuring cognitive thinking. The instruments used in this thesis have been introduced, validated and used in the single farming zone in the country. Future research might find its way in validating and improve these instruments to make them more suitable in other locations within and outside Tanzania. In addition the instruments are in form of self-report scales. Future research might also think of improving the instruments to be in a form of tests or tasks instead of the use of self-report inventories.

(ii) The role of cognitive variables in predicting subsequent adoption

In this thesis data were concurrently collected. Future research may investigate the impact of these cognitive variables in subsequent adoption.

(iii) Farmers' past experience

Future studies might also find their investigation path in whether or not farmers' past experience in dealing with challenging tasks and cultural beliefs might interfere with their reporting self–efficacy in adoption of new technologies.

(iv) Causal relationships

The practice of research in this area in Tanzania has been that of prediction of adoption from theoretical constructs rather than causal relationship existing between these variables. I provoke the avenue for conducting experimental studies to examine whether or not these cognitive variables can cause adoption.

3.5 References

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APPENDICES

Appendix 1: Data Collection Instruments for the Study

Title: Cognitive Correlates of Adoption of Improved Cassava Processing Technology among Farmers in Tanzania

Introduction

I am **Joel Matiku Joshua**, a PhD student of the Sokoine University of Agriculture. I am conducting a study about your experiences in cassava farming and processing. The findings of this study will enable me to recommend some improvement to policy makers, on how to ease your farming and processing conditions. I am requesting your willingness to fill in the following survey forms and answering the questions honestly. I assure you that the information you provide will remain confidential and will be used only for the purpose of this study. Should you agree to willingly participate in this study, please continue answering the following questions:

1. Name of your village: …….District…….
2. Date ……
3. Your age: ……..….in years
4. Sex: You are: Male Female (Check one relevant to you).
5. What is the size your cass farm? Size: …… in acres.
6. What kind of cassava variety have you planted in your cassava farms? Mention the varieties
   i. ……
   ii. ……
   iii. ……
7. After how many months do you start harvesting your cassava? ……. Months.
8. Have you ever borrowed money from any financial institution to improve your cassava farming? Yes No (Check one relevant to you).
9. Are you a member ny SAC DS? Yes No (Check one relevant to you).
10. Did you borrow money from your SACCOS to support your cassava project? Yes No (Check one relevant to you).
11. Have ever attended any training on cassava processing using improved methods? Yes No (Check one relevant to you).
12. How many times ave you attended the training on cassava processing? ..... times.

13. Do you process your cassava in the nearby processing unit?

    ☐ Yes ☐ No (Check one relevant to you).

14. Do you intend to process your cassava in the processing unit in the next harvest? ☐ Yes ☐ No (Check one relevant to you)
15. **Attitude scale** (ACPT)**:** In the scale provided below, read the statements about what most people think about cassava processing. After reading each statement, **check under the response** (1, 2, 3, or 4) to indicate your level of agreement with the statement. 1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree. Please note that there are no Right or wrong answers to the statements in this task but be very sincere to yourself in responding to a statement.

Statement		Responses			
		Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)
	Instrumental Attitude				
1	HQCF is more delicious than 'Makopa' flour				
2	Using HQCF has made my eating ugali a better experience than I would have when I used other types of cassava flour				
3	I can quickly and easily buy HQCF than I can buy makopa flour				
4	It takes short time to prepare HQCF than it takes to prepare Makopa flour				
5	HQCF is better than using Makopa flour for healthy foods like ugali				
6	I know where to get HQCF				
	Cognitive Attitude				
7	I know how to wash cassava immediately after pealing to remove impurities				
8	I have seen how cassava is processed in the machines to obtain HQCF				

9	I know how HQCF is prepared				
10	I like eating the products of HQCF such as ugali, cakes, biscuits and burns.				

16. **Perceived Self-efficacy (PSE) Scale:** In the scale provided below, read the statements about what most people do experience across different life situations. After reading each statement, **check under the response** (1, 2, 3, or 4) to indicate your level of agreement with the statement describing your personal life experience. 1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree. Please note that there are no Right or wrong answers to the statements in this scale but be very sincere to yourself in responding to a statement.

Statement		Responses			
		Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)
	Ability to deal with difficulty				
1	When unexpected problems arise in cassava farming, I am well able to deal with them				
2	When I decide to cultivate cassava, I immediately dedicate myself to it				
3	I feel able to deal with most of the problems related to cassava farming and processing				
4	I give up easily when I face difficulties in cassava farming				
5	I abandon farming tasks such as cassava weeding before completing them				
6	When I set farming objectives that are important to me, I rarely reach them.				
7	If I don't manage to implement cassava farming instructions given to me by extension officers the first time, I keep trying until I achieve them				
	Ability to cope with difficulty				
8	One of my problems is that I cannot get to work when I should				
9	I put myself to cassava farming until I completely harvest despite arising unpleasant challenges				

10	I avoid coping with difficulties related to cassava farming				
11	If cassava farming instructions seems too complicated, I don't even bother trying				

17. **Cognitive Flexibility Scale (CFS):** In the scale provided below, read the statements about what most people do when they come across different farming situations. After reading each statement, **check under the response** (1, 2, 3, or 4) to indicate your level of agreement with the statement. 1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree. Please note that there are no Right or wrong answers to the statements in this task but be very sincere to yourself in responding to a statement.

Statement		**Responses**			
		Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)
	Adapting to New Farming Technologies (AFT)				
1	I am open to updates in new farming tools that can help me improve farming				
2	I adjust myself to changes in farming conditions without difficulty				
3	I adjust easily when ways of farming change				
4	I do not have trouble getting used to new farming techniques				
5	It is important that different farming techniques will be expressed in the farming practice				
6	I adjust easily to technological changes in farming such as using new seeds varieties				
7	I adjust quickly to new farming technologies				
	Acceptance of New Farming Technology (TA)				
8	I accept to experience new farming technologies				
9	When learning new farming experiences I accept to listen to various opinions even if they contradict my opinion				

10	I do accept to use various farming tools for farming and frequently change between them				
	Open Mindedness to Other People's Ideas (OM)				
11	Even when I am convinced I am right I listen to other farmers' opinion				
12	For successful farming, I tend to try diverse farming techniques				
13	In farming, I tend to consider cultivating various crops with changing seasons				
14	When learning new farming experiences , I observe things from different perspectives				
15	In practicing farming activities, I am open to feedback and criticism				

18. **Cassava Processing Technology Adoption Scale** (CPTA)**:**
Instructions

In the scale provided below, read the statements about your experience with cassava processing. After reading each statement, **check under the response** (1, 2, 3, 4 or 5) to indicate your level of agreement with the statement that describes your personal experience and beliefs. **Key:** `5 = Always involved, 4 = Usually Involved, 3 = Sometimes involved, 2 = Rarely involved and 1 = Not at all involved`

Statement		**Responses**				
		1	**2**	**3**	**4**	**5**
1	I carry out cassava farming more for business than food crop					
2	I do plant new cassava varieties which are fast maturing and resistant to diseases					
3	I do harvest cassava immediately within the harvesting time as instructed by extension officers					
4	I process my cassava within 24 hours from harvesting to packaging of HQCF					
5	I wash my cassava immediately after pealing to remove impurities					
6	I take my washed cassava to the nearby cassava processing unit to obtain HQCF					
7	When I don't have my own cassava I do buy HQCF from the processors					
8	I use traditionally processed cassava flour only when I can't find HQCF					
9	I do mix HQCF with other cereals for the delicious ugali					
10	I started to process cassava using new methods very late					

11	I was one of the last people to process cassava using the machines					
12	I was one of the first people to use the machines to process cassava immediately after their introduction					
13	I have not yet started but I expect to use the machines when I am sure that everyone else uses the machines					
14	I am suspicious of agents of change (people who like change, speak with you about change, try to promote change, etc.).					
15	I must be certain that a new technology does not fail before I start using it.					
16	I do resist innovations until I become sure of their advantages					
17	I approach innovations with a skeptical and cautious air.					
18	I often fear using new technology a little bit.					

Appendix 2: Letter of Acceptance for Paper Five

SOKOINE UNIVERSITY OF AGRICULTURE
COLLEGE OF SOCIAL SCIENCES AND HUMANITIES (CSSH)
THE EAST AFRICAN JOURNAL OF SOCIAL SCIENCES & HUMANITIES
P. O. BOX 3035 CHUO KIKUU, MOROGORO, TANZANIA
TEL/FAX: +255 023-264360, +255 023 2604279, 4758, Ext. 4404, 4405
Email: csshcollege@suanct.ac.tz; website: http://www.sua.ac.tz

Our Ref: Your Ref: Date: 9th May 2020

Mr. Joel M. Joshua, Dr. Fatihiya A. Massawe, and Amani A. Mwakalapuka

RE: STATUS OF YOUR MANUSCRIPT

This is to inform you that your paper titled "*The Relationship between Farmers' Perceived Self – Efficacy and Adoption of Improved Cassava Processing Technology*" has gone through typesetting and will be published in Vol.2 Issue 1 of our journal.

Thank you for making the East African Journal of Social Sciences and Humanities a vehicle for your research interests.

Best wishes,

M. Muhanga (Phd)
Associate Editor-in-Chief

Appendix 3: Research Permission and Clearances

SOKOINE UNIVERSITY OF AGRICULTURE
DIRECTORATE OF POSTGRADUATE STUDIES, RESEARCH, TECHNOLOGY TRANSFER AND CONSULTANCY
P.O. Box 3151, MOROGORO, Tanzania,
TEL: +255 23 264 0013, 023 264006-9, E-mail Address: *drpgs@suanet.ac.tz*

Our Ref:	PDS/D/2018/0009	**Our Date**	25th February 2019

Mr. Joshua Joel Matiku
Department of Development Studies,
SUA - Morogoro.

Dear Mr. Matiku,

RE: APPROVAL OF YOUR PhD. RESEARCH PROPOSAL

Please refer to the above mentioned subject.

I am writing to inform you that the Chairman of SPGSC has noted the approval made by the Board of College of Social Science and Humanities for your PhD Research Proposal. This means you are now allowed to embark on your research work.

Wishing you all the best for studies.

Sincerely,

Mr. D. L. Malack
For **DIRECTOR**

Director
Postgraduate studies, Research,
Technology Transfer and Consultancy
Sokoine University of Agriculture
P. O. Box 3151, Morogoro
TANZANIA

c.c. Principal, College of Social Science and Humanities
c.c. Chairman College Postgraduate Studies Committee
cc: Supervisors, Dr. F. A. Massawe and Dr. A. A. Mwakalapuka

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000 CHUO KIKUU, MOROGORO, TANZANIA
Phone: 255-023-2640006/7/8/9, Direct VC: 2640015; Fax: 2640021;
Email: vc@suanet.ac.tz;

Our Ref. SUA/ADM/R.1/8/359 **Date:** 25th February, 2019

The Regional Administrative Secretary,
Kagera Region,
KAGERA.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by University Act No. 7 of 2005 and SUA Charter, 2007 which became operational on 1st January 2007 repealing Act No. 6 of 1984. One of the mission objectives of the university is to generate and apply knowledge through research. For this reason the staff and researchers undertake research activities from time to time.

To facilitate the research function, the Vice Chancellor of the Sokoine University of Agriculture (SUA) is empowered to issue research clearance to staff, students, research associate and researchers of SUA on behalf of the Tanzania Commission for Science and Technology.

The purpose of this letter is to introduce to you **Mr. Joshua Joel Matiku** a bonafide **PhD (Rural Development)** student with registration number **PDS/E/2018/0009** of SUA. By this letter **Mr. Joshua Joel Matiku** has been granted clearance to conduct research in the country. The title of the research in question is **"COGNITIVE CORRELATES OF ADOPTION OF THE IMPROVED CASSAVA PROCESSING TECHNOLOGY AMONG SMALLHOLDER FARMERS IN TANZANIA".**

The period for which this permission has been granted is from **March, 2019** to **March, 2021**. The research will be conducted in **Kagera Region.**

Should some of these areas/institutions/offices be restricted, you are requested to kindly advice the researcher(s) on alternative areas/institutions/ offices which could be visited. In case you may require further information on the researcher please contact me.

We thank you in advance for your cooperation and facilitation of this research activity.

Yours sincerely,

Prof. Peter R. Gillah
FOR: VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Researcher/Student – **Mr. Joshua Joel Matiku**

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000 CHUO KIKUU, MOROGORO, TANZANIA
Phone: 255-023-2640006/7/8/9, Direct VC: 2640015; Fax: 2640021;
Email: vc@suanet.ac.tz;

Our Ref. SUA/ADM/R.1/8/358 **Date:** 25th February, 2019

The Regional Administrative Secretary,
Mara Region,
MARA.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by University Act No. 7 of 2005 and SUA Charter, 2007 which became operational on 1st January 2007 repealing Act No. 6 of 1984. One of the mission objectives of the university is to generate and apply knowledge through research. For this reason the staff and researchers undertake research activities from time to time.

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The period for which this permission has been granted is from **March, 2019** to **March, 2021**. The research will be conducted in **Mara Region.**

Should some of these areas/institutions/offices be restricted, you are requested to kindly advice the researcher(s) on alternative areas/institutions/ offices which could be visited. In case you may require further information on the researcher please contact me.

We thank you in advance for your cooperation and facilitation of this research activity.

Yours sincerely,

Prof. Peter R. Gillah
FOR: VICE-CHANCELLOR

VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Researcher/Student – **Mr. Joshua Joel Matiku**

CLEARANCE PERMIT FOR CONDUCTING RESEARCH IN TANZANIA

SOKOINE UNIVERSITY OF AGRICULTURE
OFFICE OF THE VICE-CHANCELLOR
P.O. Box 3000 CHUO KIKUU, MOROGORO, TANZANIA
Phone: 255-023-2640006/7/8/9, Direct VC: 2640015; Fax: 2640021;
Email: vc@suanet.ac.tz;

Our Ref. SUA/ADM/R.1/8/360 **Date:** 25th February, 2019

The Regional Administrative Secretary,
Mwanza Region,
P.O. Box 119
MWANZA.

Re: UNIVERSITY STAFF, STUDENTS AND RESEARCHERS CLEARANCE

The Sokoine University of Agriculture was established by University Act No. 7 of 2005 and SUA Charter, 2007 which became operational on 1st January 2007 repealing Act No. 6 of 1984. One of the mission objectives of the university is to generate and apply knowledge through research. For this reason the staff and researchers undertake research activities from time to time.

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The period for which this permission has been granted is from **March, 2019** to **March, 2021**. The research will be conducted in **Mwanza Region.**

Should some of these areas/institutions/offices be restricted, you are requested to kindly advice the researcher(s) on alternative areas/institutions/ offices which could be visited. In case you may require further information on the researcher please contact me.

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Yours sincerely,

Prof. Peter R. Gillah
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VICE CHANCELLOR
SOKOINE UNIVERSITY OF AGRICULTURE
P. O. Box 3000
MOROGORO, TANZANIA

Copy to: Researcher/Student – **Mr. Joshua Joel Matiku**