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Towards Evidence-Informed Agriculture Policy Making: Investigating the Knowledge Translation Practices of Researchers in the National Agriculture Research Institutes in Nigeria

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Abstract

This study investigated the knowledge translation practices of researchers in the National Agriculture Research Institutes of Nigeria and the utilization of research knowledge by policy actors in the Federal Ministry of Agriculture and Rural Development in Nigeria. Data for the study was obtained from agriculture researchers and the policy actors through questionnaires and interviews. In addition, bibliometric and content analysis were carried out on documents from the research institutes and the Federal Ministry of Agriculture and Rural Development to gauge the transfer and use of knowledge by the researchers and policy actors respectively. Out of about six hundred questionnaires that were distributed to the researchers in fifteen agricultural research institutes, four hundred and forty-eight usable questionnaires were analysed. Twenty-two researchers were interviewed about their knowledge translation practices and fourteen senior members of the Federal Ministry of Agriculture and Rural Development were interviewed regarding their use of research knowledge generated at the agriculture research institutes. Majority of the agriculture researchers reported that they occasionally carried out knowledge translation activities targeted at policy actors in the Federal Ministry of Agriculture and Rural Development, with the most common knowledge translation method being the sending of annual reports to the ministry. However, the policy actors hardly made use of such reports in policy making either due to lack of emphasis on the part of the researchers on policy implications of their research or non-relevance of the research to policy making. Similarly, content analysis of the ministry's documents showed that policy actors rarely made references to findings from the agriculture research institutes. Interestingly, journal articles from two of the research institutes seemed to have received

a lot of citations from other authors affiliated with educational institutions in Nigeria. The most prominent barrier for knowledge translation noted by researchers was the high cost of translating research knowledge. Hence, this study recommends: provision of adequate budget, incentives and time to Nigerian agriculture researchers to enable them to do KT; and capacity building trainings / workshops for both researchers and policy actors to boost knowledge translation for agriculture policy making in Nigeria.

Keywords – Knowledge translation, Agriculture research, Nigeria, Policy actor, Bibliometrics, Knowledge use, Research transfer, Evidence informed policy, Developing countries.

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List of Abbreviations

ADP - Agricultural Development Programme

AI - Avian Influenza

ARCN - Agriculture Research Council of Nigeria

CGIAR - Consultative Group for International Agricultural Research

CHSRF - Canadian Health Services Research Foundation

CIHR - Canadian Institutes of Health Research

CRIN - Cocoa Research Institute of Nigeria

EVIPNet - Evidence-Informed Policy Network

FAO - Food and Agriculture Organization

FGN - Federal Government of Nigeria

FIMS - Faculty of Information and Media Studies

FMARD - Federal Ministry of Agriculture and Rural Development

FMAWR - Federal Ministry of Agriculture and Water Resources

FRCN - Federal Radio Corporation of Nigeria

GDP - Gross Domestic Product

IAR - Institute for Agricultural Research

IAR&T - Institute of Agricultural Research & Training

IAR4D - Integrated Agricultural Research for Development

IFAD - International Fund for Agricultural Development

IFPRI - International Food Policy Research Institute

IITA - International Institute of Tropical Agriculture

IKT - Integrated knowledge translation

KB - Knowledge broker

KT - Knowledge translation

KTA - Knowledge to Action

LCRI - Lake Chad Research Institute

LIS - library and information science

LMICs - low- and middle-income countries

MaSSP - Malawi Strategy Support Program

MoAFS - Ministry of Agriculture and Food Security

NAERLS - National Agricultural Extension and Research Liaison Services

NAPRI - National Animal Production Research Institute

NARI - National Agriculture Research Institute

NCRI - National Cereals Research Institute

NIFFR - National Institute for Freshwater Fisheries Research

NIFOR - Nigerian Institute for Oil Palm Research

NIHORT - National Horticultural Research Institute

NIOMR - Nigerian Institute for Oceanography and Marine Research

NISER - Nigeria Institution of Social and Economic Research

NPC - National Population Council

NRCRI - National Root Crops Research Institute

NSPRI - Nigerian Stored Products Research Institute

NVRI - National Veterinary Research Institute

OMAFRA - Ontario Ministry of Agriculture, Food and Rural Affairs

PARiHS - Promoting Action on Research Implementation in Health Services

REACH - Regional East African Community Health

REFILS - Research Extension Farmer Input Linkage System

RRIN - Rubber Research Institute of Nigeria

SEBAP - Supporting Evidence-based Agriculture Policy

UNDP - United Nations Development Programme

USAID - United States Agency for International Development

WAAPP - West Africa Agricultural Productivity Programme

WHO - World Health Organization

WoS - Web of Science

Chapter 1

1 Introduction

1.1 Background

Knowledge translation (KT) is a term used to describe the set of activities involved in advancing knowledge generated from research into effective changes in policy, practice and products (Barwick et al., 2005). KT usually involves the processes of transferring research knowledge from researchers or others involved in the production of research to stakeholders who need insights for better practice (e.g., policy makers, practitioners, general public, or other researchers). Studying KT is therefore key to ensuring that the most appropriate strategies are used to communicate suitable research-based evidence to the right target audience through the most appropriate and effective means. Although, suggesting that knowledge can be more than what is derived from research, the World Health Organization (WHO) expressed that KT can harness the power of science to inform and transform policy and practice (WHO, 2006). However, Cherney and McGee (2011) argued that when it comes to the uptake of research knowledge, the assumption is that policy makers rarely use it, asserting that academically produced research knowledge has a marginal impact on policy making. Similarly, Corluka (2011) observed that research that can potentially produce knowledge relevant to policy remains underused, especially in developing countries. Furthermore, Ongolo-Zogo, Lavis, Tomson and Sewankambo (2014) identified deficiencies in research use by policy makers in low and middle income countries.

Knowledge translation (and its synonymous terms, for example knowledge mobilization or knowledge transfer) has been suggested to be the 'remedy' to what is

often referred to as the ‘know-do gap’ or ‘knowledge-to-action gap’ (Azimi, Fattahi & Asadi-Lari, 2015; Grimshaw, Eccles, Lavis, Hill & Squires, 2012). This gap describes the disparity between what research studies propose to be solutions to problems, and what is actually practiced or implemented as policy in relation to the same problems (Spedding, 2015). In recent years, KT has received substantial attention in health research, with researchers focusing on how health systems and policy research knowledge is transferred and received by end users in developed countries (e.g. Belkhodja, Amara, Landry & Ouimet, 2007; Kothari, McLean & Edwards, 2009; Tetroe et al., 2008). However, Huzair et al. (2103) noted that KT is an interdisciplinary construct, crossing the traditional boundaries of academic fields. As such, there are, although few, current KT related studies being carried out in the context of environmental management (Fazey et al., 2012; Reed et al., 2014). Education is another field in which a number of studies have been carried out in knowledge mobilization, as it is popularly called in the education field (Biddle & Saha, 2002; Cooper, 2012; Coburn & Stein, 2010; Cooper, Levin & Campbell, 2009; Levin, 2004, 2011; Levin, Cooper, Arjomand & Thompson, 2010; Qi & Levin, 2013; Timperley, 2010). Studies on KT with a focus on agriculture research knowledge to policy makers have received negligible attention. Likewise, KT in the context of developing countries remains an under-explored research area. Although some selected studies have focused on KT related to health systems research in developing countries (Bergstrom, Peterson, Namusoko Waiswa & Wallin, 2012; Cameron et al., 2010; Guindon et al., 2010; Hoffman et al., 2011; Huzair, Borda-Rodriguez, Upton & Mugwawa, 2013; Lavis et al., 2010; Langlois et al., 2016; Moat et al., 2015; Neves, Lavis, Panisset & Klint, 2014; Onwujekwe et al., 2015; Pablos-Mendes & Shademani,

2006; Santesso & Tugwell, 2006; Scroff et al., 2015; Simpson et al., 2007; Uneke et al., 2015), very few KT studies have been carried out with respect to agriculture research knowledge. This is nonetheless important because agriculture is considered to be the backbone of the economies of many nations (Izuchukwu, 2011; Omorogiuwa, Zivkovic & Ademoh, 2014). Most of the studies focusing on KT in health in developing countries (Cameron et al., 2010; Ellen, Lavis, Sharon & Shemer, 2014; El-Jardali, Ataya, Jamal & Jaafar, 2012; Langlois et al., 2016) explored the growing demands internationally for health practice and policies to be based on research evidence, stressing the need to strengthen mechanisms that promote and increase the uptake of research findings by health practitioners and policy makers. Nevertheless, in Nigeria and many developing world contexts, the advancement of agriculture is equally important, and good agricultural policies and implementation is the key to the health and well-being of citizens. Yet, the extant literature is silent on KT from the perspective of agriculture research knowledge in developing countries. And no study has yet investigated agriculture researchers' practices in transferring agriculture research knowledge to policy makers in Nigeria. This is the mandate of the current study.

Agriculture has wide-ranging global impacts, which extend to economic growth, poverty reduction, food security, livelihoods, rural development and the environment (Waddington et al 2012). It is also the main source of income for more than 2.5 billion people in developing countries (Food and Agriculture Organization [FAO], 2003). Research in agriculture is widely recognized as one of the most significant tools for sustainability of agricultural productivity and economic development in developing countries (Uganneya, Ape & Ugbagir, 2012), including Nigeria. Although research

knowledge has become increasingly recognized in the agriculture sector (Klerkx et al., 2012), especially for policy decision making, Isoe and Nakatani (2011) suggested that the transfer of knowledge is a problem in the agriculture sector. Even though the idea of knowledge dissemination has its roots in agriculture research (Blake &Ottoson, 2009; Curran, Grimshaw, Hayden & Campbell, 2011; Rogers, 2003), in recent times more knowledge transfer research has been conducted in the area of public health. Virgona and Daniel (2011) however suggested that as with health, there is a clear need to ensure that research is central in the policy decision making process in agriculture. Garnett (2011) also noted that the underlying concepts of knowledge translation are salient for other disciplines outside health, and that library and information science (LIS) is an ideally situated research community to address the KT schism and it should be able to understand the meta-scientific processes that influence the uptake of research. Information studies related to agriculture have continued to be important for LIS researchers in Nigeria as exemplified in the work of Aina (1991), who studied the importance of agriculture in Africa by outlining the information needs of agriculture research scientists, farmers and agricultural extension workers. A number of other LIS studies have also been carried out related to agriculture in Nigeria (e.g. Chikonzo & Aina, 2001; Dulle & Aina, 1999; Ezeala & Yusuf, 2011; Hamman & Nansoh, 2014; Mohammed & Ozioko, 2015; Okocha, 1995; Oladele, 2010; Opara, 2010; Sheba, 1997; Uganneya et al., 2012; Uganneya, Ape & Ugbagir, 2013). Some of these studies investigated the information services provision and user satisfaction with library resources and services in research libraries in the Nigerian Agricultural Research Institutes.

Nigeria is a developing country as well as an agrarian nation, thus the importance of agriculture to her economy and to the general well-being of the populace cannot be overemphasized. Agriculture is extremely important for producing food for the nation, raw materials for industries and as a generator of foreign exchange. It also contributes 40% of the country's Gross Domestic Product (GDP) (Mukata, 2014). In terms of employment, agriculture is by far the most important sector of Nigeria's economy, engaging about 70% of the labor force (Chauvin, Mulangu & Porto, 2012). In Nigeria, agricultural research is carried out in various institutions such as universities, colleges, and dedicated agriculture research institutes. The Federal Ministry of Agriculture and Rural Development (FMARD) is a ministry of the Nigerian government that regulates agricultural and veterinary research throughout Nigeria. Fifteen agriculture research institutions function under the purview of the FMARD. These institutions conduct research into different agricultural commodities and services with some claims to success. For instance, researchers at one of the agriculture research institutes, National Root Crops Research Institute (NRCRI), asserted that their research findings were commendable, having helped make Nigeria the world's leading producer of cassava and yam, which contributed immensely to its economic development (NRCRI, 2014). However, there has been no known investigation into how the research knowledge from that institute was transferred to potential users, especially policy makers. Given the importance placed on research evidence-informed policymaking and in light of the role of agriculture research in the growth and development of Nigeria, the lack of investigation into the KT practices of researchers in the agriculture research institutes (for policy making) represents a key knowledge gap which the current study seeks to fill.

1.2 Problem statement

Agriculture is the principal source of food and livelihood in Nigeria and employs nearly three-quarters of Nigeria's work force (Chauvin et al., 2012; Omorogiuwa et al., 2014). Without a doubt, agricultural research is a critical component, and is crucial to the economic growth and development of Nigeria. In acknowledging the value of agriculture, many countries have made attempts to sustain it by formulating pragmatic agricultural policies. One of these policies in Nigeria is the establishment of specialized institutions known as National Agriculture Research Institutes (NARIs). The goal of the NARIs is to carry out research in agriculture and consequently help boost socio-economic development in Nigeria through improvements in agriculture (Ezeala & Yusuff, 2011). The objectives of agricultural research in Nigeria are to increase farm productivity and smallholder incomes within the context of environmental sustainability, as well as improve food security, overall standard of living, and macroeconomic stability (Agriculture Research Council of Nigeria [ARCN], 2006). In this regard, research outputs are measured in terms of the generation of new or improved crop varieties or new livestock breeds, and availability of information, such as agronomic recommendations (ARCN, 2006). However, there is no mention of the relevance of agriculture research findings in policy making. The national institutes for agricultural research, as recognized bodies, are tasked with providing recommendations that feed into agricultural practice and policy. Over their years of existence, there have been reports of agricultural technologies that have been generated and disseminated to crop and livestock farmers as well as processors of agricultural produce (ARCN, 2006). However, there has been no systematic investigation of knowledge transfer practices between the researchers in the

agriculture research institutes and individuals in policy making capacities. This becomes necessary in view of the need to make research more receptive to the needs of the policy actors.

1.3 Objectives of the study

The goal of this study is to understand the knowledge translation practices of the researchers in the agriculture research institutes in Nigeria as well as research knowledge use by the public policy actors in the Federal Ministry of Agriculture and Rural Development (FMARD). Hence, it seeks to investigate KT practices in the agricultural sector of Nigeria. As noted in previous sections, the study will also contribute to research on KT in a developing country's context. The main objectives of this research are:

1. To examine how knowledge is being translated between the researchers in the agricultural research institutes and the policy actors in the FMARD.

2. To investigate the manner and degree to which policy actors in the FMARD use research knowledge produced by the agricultural institutes in their policy actions.

3. To evaluate researchers knowledge dissemination practices through publications using bibliometric analysis.

1.4 Research questions

The research questions for the study are:

1) What efforts do researchers in the agriculture research institutes make to translate their research findings to potential users, especially policy actors in the FMARD?

2) What factors enable the translation of research knowledge by researchers in agricultural research institutes in Nigeria?

3) What barriers inhibit the translation of research knowledge by researchers in agricultural research institutes in Nigeria?

4) How do policy actors in the FMARD in Nigeria use research knowledge generated at the National Agriculture Research Institutes (NARIs) in their decision making process?

5) What factors enable the use of research knowledge by policy actors in the FMARD in Nigeria?

6) What barriers inhibit the use of research knowledge by policy actors in the FMARD in Nigeria?

7) Who are the intermediaries for the translation of research knowledge between the agriculture research institutes and the policy actors in the FMARD in Nigeria?

8) What is the influence/reach/spread of researchers' knowledge in the form of publications?

1.5 Study hypotheses

Studies have shown that there can be differences in the frequency of KT activities carried out by researchers based on researchers' demographics (Landry, Amara & Rherrad, 2006; Landry, Saïhi, Amara & Ouimet, 2010). And as such, the following are the hypotheses tested in this present study concerning the Nigerian agriculture researchers' KT:

1. There is no significant difference in the frequency of KT activities undertaken by the male and female researchers.

2. There is no significant difference in the frequency of KT activities undertaken by the researchers in the different age groups.

3. There is no significant difference in the frequency of KT activities undertaken by the researchers with different highest academic degrees.

4. There is no significant difference in the frequency of KT activities undertaken by researchers in different positions in the research institutes.

5. There is no significant difference in the frequency of KT activities by researchers with different lengths of service.

6. There is no significant difference in the frequency of KT activities carried out by the researchers in the different agriculture research institutes.

1.6 Scope of study

The study participants included the researchers in the National Agriculture Research Institutes of Nigeria as well as the directors of the different technical departments in the Nigerian Federal Ministry of Agriculture and Rural Development.

1.7 Significance of the study

Knowledge translation (KT) is the attempt to integrate research evidence into policy and practice. In addition, KT research is about understanding how research knowledge is disseminated and used in ways that result in changes in ideas, policies and practices (Bhattacharyya, 2007). It is important to study KT, bearing in mind that if research knowledge is not translated, it cannot be utilized, and considering that if research knowledge is not used, decision makers may not be taking advantage of useful findings. Woolfrey (2009) noted that there is a need to investigate knowledge utilization by African governments, including the attitudes of African policy-makers to the use of research results to improve the quality of their decisions, and the level of skills among government planners in Africa to undertake this task. This study satisfies the need to move towards a more robust understanding of the role of actors involved in KT activities. This involves gathering data both from the knowledge producers and from the knowledge users on the KT activities specific to agriculture research knowledge in Nigeria.

At the basic level, the results of this study are most beneficial to the researchers in the agriculture research institutes, as it evaluates their KT efforts and suggests areas for improvement. The findings are also useful for policy actors in the Federal Ministry of

Agriculture and Rural Development in Nigeria to learn about ways to improve their research uptake to inform policy making. It may also be useful to the other parastatals of the agriculture ministry and stakeholders in the agriculture sector in Nigeria, such as the Federal Colleges of Agricultural Education and agencies, and academics interested in agrarian issues in Nigeria. Given that Nigeria is a developing country, the findings from this study may also apply to other developing countries, especially those in Africa, in their efforts to translate agricultural research knowledge.

1.8 Structure and organization of the thesis report

The rest of the thesis is organized into eight chapters. Chapter one is an introduction which gives the background information and the objectives of the study. Chapter two presents the review of the relevant literature. Chapter three presents the study design, describing the study area, the study population, sampling techniques, data collection and data analysis methods. Chapter four presents the findings from the questionnaire distributed to the researchers in the National Agriculture Research Institutes while chapter five presents the findings from the interviews with the agriculture researchers in Nigeria. Chapter 6 presents the findings from the interviews with the policy actors in the Federal Ministry of Agriculture and Rural Development in Nigeria and chapter seven presents the findings from the bibliometric and web content analysis. Chapter eight is a discussion of all the findings from the study, ordered according to the research questions. Finally, chapter nine concludes the report with a summary, some recommendations, limitations of the study, and areas for future research.

Chapter 2

2 Literature review

2.1 Perspectives of knowledge translation

The core idea behind the concept of knowledge translation (KT) is in the ways knowledge (typically knowledge generated as findings from research studies) is communicated to prospective users to whom it may be useful, for example for making practice or policy decisions, and generally in an effort to bring about improvement. The gap between research knowledge and policy and practice decisions is often lamented, and KT in its variant terminologies is a process for making decisions about a practice or policy that is grounded in the best available research evidence (Amara, Ouimet & Landry, 2004; Beyer, 2011; Boaz, Baeza & Fraser, 2011; Bowen & Graham, 2013; Brownson, Gurney & Land, 1999; Estabrooks et al., 2003; Grimshaw, Walker, Johnson & Pittus, 2004; Grimshaw et al., 2012; Hanney et al., 2004; Landry, Lamari & Amara, 2003; Lapaige, 2010; Lomas, 2000; Oborn, 2012; Schryer-Roy, 2005).

Despite the fact that much of the available recent literature in KT is in the healthcare context, the knowledge to action gap is not unique to health (Oborn, Barrett & Racko, 2013). It is noted that the concept of "knowledge translation" can be traced to the field of agriculture at the beginning of the 20th century (The University of Texas School of Public Health Institute for Health Policy, 2012). These first waves of KT related studies reportedly began with diffusion studies of agricultural innovations to farmers (Blake & Ottoson, 2009; Jacobson, 2007; Leeuwis & van den Ban, 2004; Rogers, 2003), whereby face-to-face communication was used to disseminate agricultural research for the benefit of farmers. In recent years, interest in KT and its allied subject areas has

spread into various other disciplines, including education, health care, political science, social work, sociology, psychology, and engineering management (Blake & Ottoson, 2009)

Different terms are used to refer to the process of using research knowledge to inform policy and practice decisions (Bowen & Graham, 2013; Ciliska, 2012; Grimshaw et al., 2012; Ward, House & Hamer, 2009). Common terms that have been used independently and interchangeably to describe the process of using research evidence in decision making include: knowledge utilization, research use, research dissemination, implementation research, research translation, knowledge dissemination, knowledge mobilization, evidence translation, research uptake, evidence uptake, research utilization, implementation, diffusion and dissemination, research transfer, knowledge transfer, knowledge translation, knowledge exchange, research transfer, technology transfer, knowledge transformation, etc. In fact, 100 different terms were found to describe KT (Oborn et al, 2013) and Graham et al. (2006) identified 29 terms used to refer to the concept of moving knowledge into action. The terms are often used synonymously, but a specific term may be used because it highlights a particular component of the knowledge flow process. For example, knowledge exchange implies sharing of information between equal partners and focuses on the movement of knowledge between them (Fredericks, Martorella & Catallo, 2015), whereas research utilization implies the transformation of research results into usable knowledge and focuses on embedding the usable knowledge in practice (Groeneboer & Whitney, 2009; Nunnelee & Spaner, 2002). Ottoson (2009) also inferred possible differences in the meaning of terms used to describe KT: knowledge transfer describes when learning moves as intended from a training site to the

community context, or when knowledge morphs into alternate, adapted skills; implementation theory describes when the intended beneficiaries of knowledge have the authority or opportunity to use a new skill; knowledge translation describes when ideas are translated into actionable messages for intended beneficiaries; while the diffusion of knowledge describes when intended beneficiaries share but do not necessarily use their programme experience, i.e. the spread of knowledge irrespective of use or non-use. Knowledge mobilization, on the other hand, is an attempt to integrate research evidence, and use research more to improve policy and practice, e.g., in education (Cooper et al., 2009; Nutley, Walter & Davies, 2007).

According to Levin (2011), terminology for KT may vary across sectors and disciplines. But, regardless of the term, the underlying spirit is the same, which is trying to make research matter more in policy and practice for organizational and system improvement (Levin et al., 2010). This point is echoed by Blake and Ottoson (2009), who noted that the goal of KT is to ensure that results of scientific research are used to directly benefit humans. Although the KT literature presents challenges to reviewers because of the different names used to describe the generation, sharing and application of knowledge (Greenhalgh & Wieringa, 2011), for this thesis, this process shall be referred to as knowledge translation (KT).

Curran, Grimshaw, Hayden and Campbell (2011) and Kerner (2008) posited that the existing literature on KT is distributed across different disciplines, with roots that can be traced back to the field of agriculture. KT is both an art, as well as a science (Rycroft-Malone, 2007), such that the field is quickly accumulating a number of theories dispersed across a range of disciplines. Although KT is the process of moving from what has been

learnt through research to application in different decision-making contexts (Curran et al., 2011), KT research is that which empirically examines the relative value and effectiveness of alternative KT approaches, models and strategies (Rychetnik et al., 2012). KT research investigates whether and how evidence informs policy and practice, what and how research is used and by whom. KT research also deliberates factors that support or hinder the use of research knowledge. Curran et al. (2011) noted that the goal of KT research is to develop a generalizable empirical and theoretical basis to optimize KT activities. Concerning the actors involved in the KT process, Campbell (2011) proposed a simplistic conception of 'producers' and 'users', while acknowledging the rise of the role of intermediaries. Producers are researchers and people involved in carrying out research (generating knowledge), while users are those who are expected to act with the results of research findings (using/applying knowledge).

2.1.1 Knowledge for knowledge translation

According to Buckland (1991), information is situational; determining that anything is information depends on a fusion of subjective judgements, on agreement, or at least some consensus. Buckland (1991) also noted that because these decisions are based on a compounding of different judgements, there would be disagreements. Olatokun and Tiamiyu (2005) recognized knowledge as the accumulation of information that has been assimilated over time by, and into, a human mind. Knowledge constitutes an intangible resource that takes multivariate forms, such that sound decisions and professional practices must be based on multiple types and pieces of knowledge that bring complementary contributions to problem solving (Landry et al., 2006).

Dobbins, DeCorby and Twiddy (2004) expressed that multiple forms of knowledge impact decision making process and decisions. In the KT literature, however, knowledge usually implies research findings, systematic reviews and any form of information that is a product of primary research (Grimshaw, 2012). Research is an original investigation undertaken in order to gain knowledge and understanding (Hemsley-Brown, 2004). Although one of the goals of research is to generate new knowledge and establish the evidence base within professions (Hemsley-Brown, 2004), Beyer (2011) argued that science is not an efficient process in the sense that every piece of research is usable by somebody, and research is only one out of many sources of knowledge that can inform practice and policy decisions (Nolan et al., 2007). Nonetheless, proponents of KT maintain that using a scientific approach to investigate all available evidence can lead to decisions that are more effective in achieving desired outcomes, since the knowledge for decision making is evidence developed through systematic and methodologically rigorous research that emphasizes the use of science. However, Bowen and Graham (2013) suggested that there is often an incomplete research base to inform decisions, much research is contradictory and non-research forms of evidence are legitimately used in policy and practice decision making. Furthermore, Kothari, Bickford, Edwards, Dobbins and Meyer (2011) called for a need to broaden the scope of knowledge for KT to include other forms of knowledge beyond formal, explicit knowledge acquired through research, i.e., tacit or experiential knowledge. Nevertheless, the primary focus for KT is on knowledge that is derived from methodical research and analysis.

Acknowledging that there are different kinds of knowledge indicated in written works, this study focuses on knowledge that is generated from scientific research. This type of knowledge is created not from an individual's personal experiences, but predominantly by using a systematic and methodological approach, based upon the principles of repeatability to answer questions and solve problems through the planned and systematic collection, analysis and interpretation of data (Mouly (1978). Like Ottoson (2009) noted, and this study upholds, research knowledge is what is translated in KT.

2.1.2 Individual level knowledge translation

Jacobson, Butterill and Goering (2003) suggested that researchers may translate their research results to potential user groups by increasing their familiarity with the intended user groups, and by understanding the user context. They proposed an individual level KT framework consisting of five domains: the user group, the issue, the research, the KT relationship, and dissemination strategies. The framework includes a series of questions within each domain, which provide the researcher with a way of organizing what they already know about the user group, and the KT project; of identifying what still is unknown, and flagging what is important to learn. Jacobson et al. (2003) described a hypothetical scenario in which a single researcher identifies a single user group to engage in KT. Similarly, Beyer (2011) noted that for researchers to sell their research, they must know their customers. Researchers who want their research to be used need to have meaningful contact with the community they seek to inform. Beyer (2011) recommended that the only one thing that researchers should not do in an effort to increase the uptake

and use of their research findings is nothing. Bowen and Graham (2013) interpreted the knowledge translation gap as a knowledge production gap that resulted from researchers failing to address the most important problems facing practitioners and decision makers, suggesting that individual researchers must make an effort to carry out relevant studies, so as to ensure that findings from research studies make a difference in the practice or policy decisions of potential users. Bowen and Graham (2013) encouraged individual researchers to endeavor to seek out audiences who are most likely to benefit from the findings of research studies, and properly convey the best results to them.

2.1.3 Organizational level knowledge translation

The organizational perspective to KT is based on the idea that organizational structures, tasks, roles, procedures and routines are essential elements in understanding KT. Studies that discuss organizational level KT emphasize how research knowledge informs an organization's practice. This viewpoint takes into account the variables that influence decision making at the organizational level, and its capacity to assimilate new knowledge. Knowledge translation is done at the organizational level, whereby members of an organization are responsible for transferring knowledge within their organization, or externally. These may be research intensive organizations such as universities or research institutes, government offices or community organizations. Kothari and Armstrong (2011) noted that organizational based KT processes capture the connection between evidence, decision makers, practitioners, and the organizations they serve, whereby decisions are based on relevant research and organizational requirements. Duguid's (2005) theory of organizational learning, interpreted in the context of KT, suggests that

organizations must provide support that corresponds to their needs. Dobbins et al (2009b) also showed that there is a need to match organizational research culture to KT strategy, emphasizing the identification of organizational characteristics so as to recognize and implement an optimal array of KT methods. Majdzadeh et al (2008) described programmes and strategies needed for KT at an organizational level.

2.1.4 Policy level knowledge translation

Policy level KT is when research knowledge is transferred with the intention of bringing about changes in an institution's policies. In the work of Elliot and Popay (2000), policy level KT was exemplified when research was used to fill an identified knowledge gap in the policy process such that a policy problem was identified, and the solution sought through existing research, research in progress or new research. It might also be a case whereby research is one of several knowledge sources on which policy actors draw in. Hanney and Gonzalez-Block (2011) noted that there have been major long-standing attempts within some health research systems to develop approaches in which policymakers and researchers work together to identify priorities for research that will meet the needs of policymakers. These could be integrated knowledge translation approaches, whereby policy makers and researchers partner on research studies.

2.1.5 Integrated knowledge translation

Integrated knowledge translation (IKT) describes the efforts and activities that bring researchers and knowledge users working together throughout the research process, ultimately to increase the chances of knowledge being taken up by users. According to

Graham and Tetroe (2009) and Fredericks, Martorella and Catallo (2015), IKT involves collaboration between researchers and the knowledge users in the majority of stages of the research process, including the shaping of the research questions, deciding the methodology, involvement in the data collection and tools development, interpreting the findings and helping disseminating the research results. IKT focuses on researcher-knowledge user partnership (Wathen & MacMillan, 2015). Studies that have discussed IKT portray it to be an effective form of KT. For instance, Kothari and Wathen (2013) suggested that IKT is being aggressively positioned as an essential strategy to address the problem of underutilization of research-derived knowledge. IKT approaches can take the form of mandated or voluntary partnerships that involve information sharing, frequent meetings and working together to: generate and refine research questions; develop feasible research designs and data collection procedures; collect and analyze data; interpret data for practice and/or policy recommendations; and identify an action plan to support the integration of recommendations (Kothari & Wathen, 2013. However, Wathen and MacMillan (2015) pointed out that effective IKT requires work and resources. It is advised that decisions to undertake IKT should be entered into by researchers and research users with a full understanding of the potential costs, as well as benefits to all groups/stakeholders involved (Wathen & MacMillan, 2015).

2.1.6 Context for knowledge translation

Dobrow et al. (2004) documented that two fundamental components of KT are the research evidence and context. Landry et al. (2006) noted that KT is a complex interactive process that depends on human beings and their context, and Huzair et al.

(2013) recorded that KT happens in practice and therefore in context. It is clear that context plays a key role in affecting KT. Nutley, Walter and Davies (2003) posited that although different sectors (health care, education, social care, criminal justice system, and agriculture) have a particular context that may influence the process of KT, they also have many areas of commonalities. Context is not bounded by the actors that directly engage in the KT process, it also reflects a wider socio-economic, political and geographical identity of each investigated case, which might affect the KT process. Poor funding, a lack of political will, and geographical location that complicate the physical meeting of actors that engage in KT, undermines KT (Huzair et al., 2013; Van Eerd et al., 2011). Dobrow et al. (2004) defined context for KT to include all factors within an environment where the knowledge is to be transferred and used for decision making. Context is often characterized by complexities, comprising both the known and the unknown, the certain and the uncertain. Power, politics and resources are contextual examples at the heart of KT difficulties in developing countries (Huzair et al., 2013).

2.1.7 The science of knowledge translation

The science of KT, differentiated from practicing KT, is about studying knowledge translation. Knowledge translation research has come a long way from its roots in agriculture and diffusion theory. A variety of questions have been (and are still being) addressed in KT studies. Questions in KT studies range from a focus on the translated knowledge, to the actors involved in KT, and to facilitators/barriers to KT. Knowledge translation studies have investigated the characteristics of the knowledge producers, knowledge users and intermediaries involved in KT. Other studies have also been

conducted with the aim of developing models to describe and aid effective KT in different context, to bring about improvement in practice and policy decisions. For example, Majdzadeh et al (2008) generated a KT model for Iranian health care from a literature review of existing KT models, in addition to findings from a focus group with researchers and decision makers. The resulting model described programmes and strategies for KT in an Iranian health care organization.

Knowledge translation research empirically examines the relative value and effectiveness of alternative KT approaches, models and strategies (Rychetnik et al., 2012), probing whether and how research knowledge informs policy and practice. KT research also deliberates factors that support or hinder the use of research knowledge. Oborn (2012) postulated that research in KT can be usefully organized into three overlapping perspectives: a linear transfer of knowledge, a social interaction perspective, or a multilevel implementation perspective that incorporates contextual factors. Curran et al (2011) noted that the goal of KT research is to develop generalizable empirical and theoretical bases to optimize KT activities. While it has also been noted that the KT field is quickly accumulating many theories dispersed across a range of disciplines, some KT studies (e.g. Adelle, 2015; Barer, 2005) have taken a critical stance and exposed some flaws in the ideas of knowledge translation.

2.1.8 The practice of knowledge translation

The practice of KT simply means doing KT. It includes the efforts put in by individuals involved in disseminating and using research knowledge. For instance, Bishop, Bingley and Matthews (2011) noted that the knowledge translation strategy implemented for

capacity building with the Kenyan horticulture sector was partnership, where the horticultural researchers in the university collaborated with a commercial organization to decide which knowledge was going to be used to benefit their business. This can also be regarded as an example of IKT. In addition, different KT methods such as the use of databases with reviews on selected topics (e.g. healthevidence.ca), targeted messages and knowledge brokers were implemented and then evaluated (Dobbins et al., 2009b). Levin (2011) also described three interventions implemented to increase research use in schools: systems to share research articles; study groups around research issues; and districts conducting research. To properly do KT, the right approach that is suitable for the target audience has to be chosen. These could include printed materials, meetings, outreach, local opinion leaders, audit and feedback, computerized reminders and tailored interventions or multifaceted interventions, electronic newsletters, bulletins, listserv, reminders, discussion forums, tailored messaging/products, knowledge brokers, research exchange officers, roundtables, networks, briefs/reports/summaries, media advisories, conferences/workshops/ presentations/symposiums, meetings, websites, training sessions, journal publications. Langlois et al. (2016) emphasized that in developing KT strategies, due consideration must be given to fit-for-purpose approaches, as different needs require adapted processes and knowledge. Similarly, Dobbins et al. (2004) found that in addition to providing knowledge users with relevant and timely research evidence, a KT strategy must also provide the information in a reliable and consistent way, and must give users options for customizing how the knowledge will be received.

2.1.9 Knowledge brokering

There is no simple direct line between knowledge production and utilization, and knowledge users respond differently to varying types of transfer strategies. As such, knowledge brokering is a popular KT approach (Tran, Hyder, Kulanthayan, Singh & Umar, 2009). Knowledge brokering, as defined by the Canadian Health Services Research Foundation (CHSRF), is about bringing people together to build relationships, uncover needs, share ideas and evidence with the aim of improving the use of research knowledge (CHSRF, 2003). Klerkx et al. (2012) described knowledge brokering as an approach to enhance the uptake and use of research, moving beyond mere diffusion of research results through reviews, leaflets and summaries. Knowledge brokering involves activities that connect research users to researchers, facilitating their interaction to forge new partnerships, enabling a better understanding of each other's goals and professional cultures, and promoting the use of research knowledge in decision-making. Knowledge brokering most often involves a third party that acts as a mediator between researchers and policy makers (Tran et al., 2009), and supports evidence-based decision-making by encouraging the connections that ease knowledge transfer (CHSRF, 2003).

A knowledge broker (KB) (intermediary or translator) may be an individual, a team or an organization that operates in the capacity of aiding the transfer of knowledge. Meyer (2010) noted that KBs are people or organizations that move knowledge around and create connections between researchers and their various audiences. He further suggested that it is the responsibility of the knowledge broker to translate research findings (Meyer, 2010). Curie and White (2012) posited types of knowledge brokering roles as liaison, representative, gate-keeper, coordinator, consultant, and found that most

participants in their study played liaison roles. Michaels (2009) examined how different knowledge brokering strategies - informing, consulting, match making, collaborating, and capacity building - were employed in responding to different types of policy problems. It was found that knowledge brokering was a means to an end with the goal of improving decision making (Michaels, 2009). Alternatively, Meyer (2010) maintained that knowledge brokers act in three main capacities as knowledge managers, linkage agents, or capacity builders, and are involved in activities such as articulation work, communication work, identification work, mediation work, and educational work. Although, the Dobbins et al. (2009b) randomized control trials found no real difference between KB and other (less costly and time-consuming) KT strategies, a review of studies on knowledge brokering in health research found that knowledge brokering is effective as a knowledge translation activity in communicating research knowledge to users (Bournaris et al., 2016; Elueze, 2015). This shows that the right KT strategy really depends on the context and user needs. Nevertheless, in the agriculture sector, there is an emergence of the complementary role of knowledge broker as systemic facilitator, innovation intermediary, or innovation broker (Klerkx et al., 2012). Knowledge brokers undertake different activities (Turnhout, 2013), and are called agricultural extension agents in the agricultural sector (Klerkx et al., 2012).

2.2 Knowledge translation in developing countries

The WHO (2006) noted, concerning KT in developing countries, the absence of essential qualities of knowledge for policy-making. WHO (2006) equally noted that available research may not be credible, accessible or affordable in developing countries, or may be

irrelevant to the needs of specific countries and hence not applicable. However, the WHO recognized that experiences from developing countries demonstrate innovations in push, pull and exchange systems to address gaps in research-policy-practice in a variety of settings. Huzair, Broda-Rodriguez, Upton and Mugwagwa (2013) highlighted particular problems for KT in developing countries, noting that context-specific and dynamic capabilities and capacities are required for effective KT in developing countries. Also, Santesso and Tugwell (2006) posited that research is not consistently used to make health care decisions in developing countries, and that the evidence base for the effectiveness of strategies to ensure knowledge is used or translated into policy, practice and improved health is relatively sparse in developing countries. In East Africa, the Regional East African Community Health (REACH) Policy initiative, designed by EVIPNet (Evidence-Informed Policy Network) Africa - a network of WHO, sponsored KT platforms in seven sub-Saharan African countries to access, synthesize, package and communicate evidence for policy and practice and for policy-relevant research agenda. Lavis and Panniset (2010) reported that EVIPNet policy brief directly informed Burkina Faso's successful application to the 7th round of the Global Fund to Fight AIDS, Tuberculosis, and Malaria. An institutional mechanism for KT through knowledge brokering was developed through country-wide and regional consultations and workshops. Similarly, Langlois et al. (2016) implemented two IKT interventions between researchers and policy makers in Mexico, Nicaragua, South Africa and Cameroon. The first approach focused on KT facilitated by communities of practice and the second approach was called the Policy BUilding Demand for evidence in Decision making through Interaction and Enhancing Skills (Policy BUDDIES). The authors found that both KT approaches improved policy

makers' capacities to identify and use evidence in solving maternal health issues, as the policy makers in the study reported enhanced recognition of the value of research and greater demand for policy-relevant knowledge (Langlois et al., 2016).

In Bangladesh, an effort to translate development knowledge to programmes and action revealed that development knowledge could be successfully shared, adapted and scaled up using village organization as the nucleus of the intervention (WHO, 2006). Panadés Rubió and Panisset (2006) discussed the experiences and lessons learned in managing and utilizing local knowledge through social participation in Brazil. It was noted that local decision-makers had no experience in working with research and technical information. However, an interactive process for learning was developed involving decision-makers, health practitioners, the communities as well as federal, local and state funders. Information technology resources were deemed to be essential tools, in addition to human resources for social production, sharing and use of knowledge (WHO, 2006). The experience of the rural internship on collective health in Brazil, in an attempt to integrate scientific evidence, local knowledge and the capacity to implement policies through social participation in health systems, showed that dissemination and sharing of user-friendly information and knowledge promoted social participation in local health systems planning and management. Likewise, Nafo-Traoré in WHO (2006) elucidated a policy maker's view of the role of research in the health sector reform movement in Mali. It was recorded that although in the initial stages, policy formulation for health reform was mainly based on experiential knowledge of the factors contributing to the crisis in Mali, there was increasing use of research during the scale up of health programmes, particularly on health service delivery models, simulation models for sustainability,

systematic documentation of process and outputs and systematic exchange of experiences.

It is reported that much has been done in China with respect to health management information systems and information technology. The Chinese Ministry of Health expressed the need for an efficient capture and synthesis of research evidence that could be used for policy in a timely manner. WHO (2006) reported that capacity building of all stakeholders on knowledge sharing is recognized as a major challenge, in order to establish efficient systems for the capture and use of research for health policy making in China. Strategies described for knowledge management to improve health policy making in China were: improving access to health information; sharing and applying experiential knowledge; creating an enabling environment for knowledge management; and using KT strategies.

In Nigeria, training programs and mentorship resulted in a better appreciation of research, and built capacities among individual health policy makers to acquire, assess, adapt and apply research evidence (Uneke et al., 2012). Uneke et al. (2015b) also reported that the creation of a Health Policy Advisory Committee comprising of policy maker and researchers served as an excellent mechanism to bridge the divide between researchers and policy makers, and boost the Ministry of Health's effort to apply evidence informed strategies in health policy making in Nigeria. It was suggested that a evidence-to-policy workshop organized for health policy makers improved policy makers' capacity for evidence informed policy making, by developing evidence-informed policy briefs on infectious diseases of poverty in Nigeria (Uneke et al., 2015c; Uzochukwu et al., 2016). Likewise, a mentorship programme established one-to-one

contacts between senior researchers and policy makers, and increased the skill, knowledge and capacity of health policy makers in Nigeria to use evidence in policy making processes (Uneke et al., 2015d). In addition, Onwujekwe et al (2015) noted that policy dialogues allowed research evidence to be considered together with views, experiences and tacit knowledge of health policy makers, which enhanced evidence to policy link in Nigeria and four other low-and middle-income countries.

2.3 Knowledge translation in agriculture

In agriculture, like in many other sectors, knowledge is the most important factor of production, relevant to the creation and utilization of material capital (Florianczyk et al., 2012). Florianczyk et al. (2012) noted that knowledge in agriculture, as in all sectors of any economy, is a key factor stimulating increases in productivity through better utilization of resources. In the Polish experience, knowledge was transferred as codified knowledge, and extension workers (i.e. personnel that advocate for the application of scientific research and knowledge to agricultural practices through farmer education) were recognized as a main channel for the provision of agricultural knowledge. This was corroborated by Manning et al. (2013) who noted that one of the main aims of agricultural extension was to effect behaviour change in the target audience. Models have been designed and implemented to assess extension programmes and their impact, but not the KT efforts of the agriculture research producers themselves. Asselin, MacLeoad and Dosman (2009) reported that at a national consultation on KT in agriculture sector in Canada, participants identified priorities for KT to be to develop a model to facilitate KT between researchers and end users, with an intermediary that is credible among

producers, close to producers and respected by them, and with means of communication adapted to the realities of the environment. They also noted that agricultural producers should be involved in the process of establishing priorities of research and involved in the process of knowledge creation in order that the needs of end users are understood and incorporated into the development of relevant, reality-based research knowledge. This approach described by these authors would be an example of IKT. The authors also noted that a KT process could significantly enhance the positive outcomes from current investments in agricultural research in Canada. Similarly, in England, Smallshire, Robertson and Thompson (2004) described the significant progress in translating the knowledge gained from farmland bird research into mechanisms which deliver sympathetic farm management. They noted that it focused on the development, targeting and delivery of agri-environment schemes, and supporting advisory materials and services. Smallshire, Robertson and Thompson (2004) also noted that knowledge transfer mechanisms have evolved and great progress has been made in the production of advisory information by various bodies involved in the agri-environment schemes. In Mexico's agricultural sector, Rivera-Huerta, Dutrénit, Ekboir, Sampedro, and Vera-Cruz (2011) reported that agricultural research is conducted in three types of institutions in Mexico: general universities; sectoral universities; and other local organizations such as technological universities and institutes that also researched non-agricultural topics or conducted other types of activities. The institutes were mandated to generate research results that could contribute to poverty alleviation in Mexico. They found that the impact of the nature of interactions on research productivity differed according to the type of research output. They noted that researchers in the agricultural sector in Mexico produced

three main types of outputs: only papers; only new recommendations and techniques; and papers and other outputs. They also found a positive relationship between researchers' interaction with farmers and publishing of papers, when interactions are carried out through the research and development modality (Rivera-Huerta et al., 2011).

In sub-Saharan Africa, knowledge management was proposed by the Integrated Agricultural Research for Development (IAR4D) as a means to ensure that agricultural research outputs are taken up across sub-saharan Africa. It entailed synthesis and dissemination of experiences and outcomes with information exchange and knowledge management for rapidly sharing methods between teams (von Kaufmann, 2007). Popescu et al. (2013) reported that in Romania, the objective of the transfer of agriculture knowledge was to increase the income and living standards for all rural people, among other reasons. They identified research institutes and university centres as research knowledge producers, farmers as the knowledge consumers, and the agricultural cooperatives as the knowledge disseminators, who ensure that the farmers access the knowledge (Popescu et al., 2013).

In Ontario, Canada, KT is strongly associated with the field of agriculture. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) has KT as a core activity. This is evident on OMAFRA website, where it publicly asks researchers to apply an information exchange process called knowledge translation and transfer (KTT) to their results in practical ways that benefit Ontario. OMAFRA defines KT as the transformation of knowledge into use through synthesis, exchange, dissemination, dialogue, collaboration and brokering among researchers and research users. Two main objectives and intended impacts of KT for the OMAFRA are that research be developed using a

needs-based approach also known as demand-driven research or integrated knowledge translation, and that knowledge produced by research is used in a timely manner. In addition OMAFRA urges agriculture researchers to build their own individual KT plans, by giving the researchers reasons to develop a KT plan, steps on how to build a successful KT plan, and a template and checklist for a KT plan with a downloadable toolkit. The OMAFRA asserts that their KT activities have impact on three main levels: programmes, policy and commercialization. The three streams have characteristically different target audiences, each with different needs and undertaking different KT approaches (http://www.omafra.gov.on.ca/english/research/ktt/kttdefined.htm). Similarly, the Faculty of Agriculture at Dalhousie University in Canada, recognizing the essence of KT, hosted a two day practice-oriented KT training workshop in Halifax, in collaboration with The Nova Scotia Health Research Foundation (NSHRF) in December 2013. The workshop was aimed at helping agriculture researchers develop fundamental skills and competencies around creating and implementing a KT plan that will improve research impact, promote research utilization and ensure that research findings reach the appropriate audiences (http://www.dal.ca/faculty/agriculture/news-events/news/2013/05/31/science_knowledge_translation__sktt__workshop.html).

2.4 Knowledge utilization

Knowledge is a multifaceted concept with multilayered meanings (Nonaka, 1994). However, as has been noted in the introduction of this thesis, knowledge for KT usually implies, and will be operationalized to mean, findings and results generated from research studies. Knowledge use means different things to different people (Nutley et al., 2007),

and has different descriptions. Dobrow et al. (2004) described knowledge utilization with a restricted focus on the use of scientifically produced research. Similarly, Estabrook and Wallin (2004) considered research utilization to be a subset of knowledge use. However, Jacobson et al (2003) argued that research utilization is a synonym for knowledge utilization. Research knowledge use is central to KT (Johnson, 2005; Cherney, 2012).

Although Webber (1986) pointed out that knowledge use has proven quite difficult to conceptualize completely and measure accurately, Chung and Galleta (2012) noted that knowledge use can be conceptualized and measured along several different dimensions. Birdsell, Thornley, Landry, Estabrooks and Mayan (2005) suggested science-push, demand-pull, dissemination and interaction as alternative ways to describe knowledge use, while Chung and Galleta (2012) identified innovative use, conceptual use and effective use as three dimensions of knowledge use constructs. Likewise, knowledge use could be instrumental, conceptual or strategic (Amara et al., 2004). Instrumental use is when research knowledge feeds directly into decision-making for policy and practice (Amara et al., 2004). Nutley et al. (2007) referred to this as direct use of research. Even when practitioners are not able to use research knowledge directly, it may be used conceptually to change their understanding of a situation, provide new ways of thinking, and offer insights into the strengths and weaknesses of particular courses of action (Nutley et al., 2007). Strategic use is when research is used as mobilization of support for a decision, practice or policy and becomes a tool of persuasion. Nutley et al (2007) listed seven different meanings of knowledge use – the knowledge-driven model, the problem-solving model, the interactive model, the political model, the tactical model, the enlightenment model, and research as part of the intellectual enterprise of society. In

addition, Nutley et al. (2007) pointed out that the use of research knowledge is a subtle and complex process, which is difficult to trace, and often results in equally subtle and complex outcomes.

2.4.1 Policy actors' use of research knowledge for decision making

According to Hanney et al (2003), a positive case can be set out for the contribution research can make to policy-making. The basic assumption of knowledge utilisation related to policy-making is that policies that are research informed will be better than those uninformed by relevant research. It is assumed that research exposes policy-making to a wider range of validated concepts and experiences than those that can be drawn from the normal time-limited and politically constrained processes of policy deliberation. Research often enables policies to be generated upon technically well-informed bases, allowing a broader choice of policy options to emerge. An analysis of research utilisation for policy-making identified three broad areas of activity: policy agenda setting; policy formulation; and policy implementation, and research could potentially be used in all three areas (Choi, 2005). Weiss (1979) also suggested that there are three main forms in which research might appear and be utilised in policy-making: as data and findings; as ideas and criticism in the enlightenment mode; or as briefs and arguments for action. Nutley et al. (2007) posited that research can enter policy through diverse channels and forms, and some understanding of these routes offers a first step to understanding the process of research use for policy making.

Amara et al. (2004) found that instrumental use of research knowledge is rare in public policy; conceptual use of research knowledge is more frequent than instrumental

use for policy making. Similarly, Cherney and McGee (2011) reported that research knowledge is more often used conceptually by policy actors. Although the main purpose of knowledge utilization is to bring about change in policy (Kiresuk, 1993), Belkhodja et al (2007) pointed out that government administrators rarely use knowledge to which they potentially have access, and use it less often if the knowledge is counter intuitive. Furthermore, Birdsell et al (2005) reported that policy actors' average score on their extent of research utilization hovered between sometimes and often. A study conducted in 2004 in Cameroon revealed that Cameroonian policy-makers did not make substantial use of research even when the research was commissioned by them (Wolley, 2009).

2.4.2 Contextual factors influencing knowledge use for policy making

The goal of applied research is to generate new knowledge and establish an evidence base for use, but there is no simple direct line between knowledge production and utilization (Hemsley-Brown, 2004). Factors presumed to be determinants of research utilization are equivocal (Estabrooks, Floyd, Scott-Findlay, O'Leary & Gustha, 2003), and context is key to using research knowledge (Nutley et al., 2007). Courtright (2007) suggested that knowledge use takes place within specified situations and context. Context can be complex and dynamic, and it includes consideration of resources and power relations (Fisher & Julien, 2009); it is emergent, fluid, and changes over time due to temporality (Cross & Sproull, 2004).

Policy making attends to different interest at the same time (Beyer, 2011), and the context for policy making is dispersed, non-hierarchical and sensitive to the characteristics of individual policy actors (Webber, 1986). Policy decisions are

influenced by numerous factors such as institutions, interests and ideas (Ouimet, Landry, Ziam & Bédard, 2009). Although it has been put forward that the use of research in policy making is most influenced by interactions between policy actors and researchers (Kothari et al., 2011), Ouimet et al. (2009) found that policy actors' use of research knowledge during policy decision making was generally moderated by power relationships. Some political, sociological, and psychological traits of policy actors are also related to their knowledge use, as well as party identification, ideological persuasion and length of legislative service (Webber, 1986).

2.5 Facilitators and barriers of knowledge translation

Jacobson et al. (2004) noted that although KT has become a priority for universities and other publicly funded research institutions, there are certain barriers to engaging in KT activities. Successful KT is said to require understanding and attending to the multidimensional barriers and facilitators that influence the knowledge decision-making gap (Curran et al., 2011). Although few studies have reported some level of success in KT (Amara et al., 2004; Bishop, Bingley & Matthews, 2011; Canadian Institutes of Health Research [CIHR], 2006; 2008; Landry, Amara & Lamari, 2001), some did not note any great outcome (Dobbin et al., 2009; Driedger et al., 2010). Barriers identified to KT are: time, inability to access research, inability to understand the language of research, lack of critical appraisal skills, lack of confidence in making change based on research evidence, resistance to change, decisions based on history, lack of organizational valuing of or support for evidence-based practice, lack of consensus on what constitutes evidence, absence of personal contact between researchers and users, lack of timeliness

or relevance of research, mutual mistrust, political naivety of scientists, scientific naivety of research users, power and budget struggles (Ciliska, 2010; Estabrooks, Floyd, Scott-Findlay, O'Leary & Gustha, 2003; Funk et al., 1991; Hemsley-Brown, 2004; Innvaer et al., 2002). Based on a systematic review by Innvaer et al (2002) on the use of research evidence in health policy decision making, the most commonly mentioned facilitators were: personal contact between researchers and policymakers; timeliness and relevance of the research; research that included a summary with clear recommendations; good quality research; research that confirmed current policy or endorsed self-interest; community pressure or client demand for research; and research that included effectiveness data. Landry et al. (2001) however found, contrary to their expectations, that projects focused on users' needs did not significantly affect use of knowledge. However, funding sources encourage KT (El-Jardali et al., 2014). Nutley et al. (2007) noted that the size of a nation, the degree of economic development and the scale and scope of their governmental apparatus are likely to matter for KT and research uptake. Wolley (2009) noted that the mode of communication was a factor that contributed to the non-utilization of commissioned research between researchers and government practitioners in Cameroon. Time constraints on policymakers meant policymakers were unable to read the academic publications produced from research findings, which were written up by academics who were more interested in publishing results in peer-reviewed journals than convincing government agencies to adopt new policies (Wolley, 2009). In addition, van Kammen et al. (2006) noted that urgent health policy decisions were driven by political opinions, crisis, paradigms, ideologies and funders in east Africa.

2.5.1 Other factors that enable or constrain KT

Some other factors that have been noted to affect KT positively or negatively include: interpretation; time constraints; skills to convey research findings in plain language; motivation to carry out KT, rewards system and incentives; research focus and relevance for policy; proximity of actors involved; leadership; funding issues; availability of knowledge brokers (intermediaries); research partnerships; and culture.

In the light of research knowledge for KT, it has been discovered that the interpretation of the research knowledge by the prospective users of the knowledge has an effect on what is translated. Wathen, Macgregor, Sibbald and MacMillan (2013) found that findings from a research study were not interpreted consistently in subsequent works, including major practice and public policy documents. In some instances, the research finding was noted to be interpreted contradictorily (Wathen et al., 2013). This implies that potential research users will often interpret research knowledge as it suits them, regardless of the KT efforts of the researchers. This constitutes a problem for the KT field, and for this reason it is important to consider the malleability of research evidence and its potential for both intended and unintended uses (Wathen et al., 2013). A similar complication for KT arises when research findings are quite different from, or contradict, what users want to hear. This was manifest in a study by Wathen, Sibbald, Jack and MacMillan (2011), where some respondents expressed that because the research results contradicted their practices, it was not going be used, or it was going to be used selectively. Even selective use may be perceived as a hurdle to effective KT, for instance when government administrators did not use research knowledge that was counter intuitive to what they already knew (Belkhodja et al., 2007). It has been put forward in

critique of KT that research evidence can be used by decision makers to serve many purposes (Almeida & Báscolo, 2006). It is only reasonable that KT will always be challenged as long as there are multiple players with different interests vying for the attention of research users (Barer, 2005), which may influence the users' interpretation of research knowledge, and thus determine if and how it is used.

Time may be a factor for KT if researchers do not have time allotted for transmitting their research results to the policy actors, in addition to carrying out their research studies. KT is a complex and lengthy process (Majdzadeh, Sadighi, Nejat, Mahani & Gholami, 2008), and time required for KT is significant. Time constraints may also manifest in the form of time for research to reach a conclusive end. This has to do with the concern of whether research is complete enough for the researchers to feel confident to communicate the findings, considering that if the findings are used to inform public policies for a country, it will have far reaching effects. Sometimes, this along with the costly and slow process of knowledge production and synthesis may also have an impact on when and how researchers disseminate their findings. The KT literature suggests that research organizations should transfer actionable messages from a body of research knowledge, not simply a single research report or the results of a single study (Lavis, Robertson, Woodside, McLeod & Abelson, 2003). Also, as new knowledge is always forthcoming from research, KT must be continuous (McWilliam, Kothari, Kloseck, Ward-Griffin & Forbes, 2008).

Skills to convey research results may also influence the communication of research findings to the policy maker. The KT literature expresses that researchers and policy actors operate using different language and, especially, field-specific jargon. It is

important that research is transferred to policy actors in a language and format that the policy actors can interpret and understand. It has also been observed that sometimes researchers feel little or no motivation to communicate their findings to policy actors even when they know that it will be useful in informing policy decisions. This may be because they have not received any incentives to do this work, which is time-consuming and resource-intensive. In Mexico, Rivera-Huerta et al. (2011) found that incentives offered to researchers were based mostly on the number of papers published in ISI-indexed journals. While this may foster an increase in researchers KT effort through publications (relatively low-impact KT activity), it does speak to whether these kinds of incentives will encourage researchers to carry out other forms of KT activities. Additionally, funding may constrain KT if researchers do not receive special funding, either from the country's national purse, their own research institute, or any other funding agencies, to translate their research knowledge.

The focus of research may influence its translation, if the researchers are convinced that the research findings are relevant for policy making. Production of good relevant research knowledge will influence the KT efforts. As Kothari, MacLean, Edwards & Hobbs (2011) noted, not all research is useful for policy decisions. In addition, science is not such an efficient process that every piece of research is usable by somebody (Beyer, 2011), even if it was intended for application in its design. Further, proximity of researchers to policy actors - for example research institutes located in national or state capitals - may also influence the efforts they put into conveying their research findings to policy actors to be considered for policy decision making

(Brousselle, Contandriopoulos & Lemire, 2009; Kothari et al., 2009). This speaks to the importance of social networks in KT.

The administrators or leadership of research organizations may also play a part in influencing the KT efforts of the researchers (Landry et al., 2006). Leaders can encourage KT, or otherwise could be a determining factor for the researchers' efforts towards translating their research findings to potential users in the policy making circles (i.e., acknowledging KT in performance metrics and evaluations). Knowledge brokers may equally influence KT endeavors. Knowledge brokers act as intermediaries between researcher and the policy makers (Meyer, 2010). Having researchers working with and through trusted knowledge brokers may constitute a way around the time constraints faced by individual researchers to translate knowledge (Lavis et al., 2003).

Partnering with, or engaging policy actors in the research process, also called IKT, may influence the efforts researchers put into translating the final results to the policy actors, as has been suggested that user involvement in research increases the likelihood of the research knowledge use (Szmukler, Staley & Kabir, 2011). It has been noted that agriculture researchers have experience in engaging users in various stages of research (Talwar, Wiek & Robinson, 2011). Furthermore, a research organization's culture, which is the organization's specific set of standards, values, attitudes, beliefs, traditions, language, and ways of doing things (Belkhodja et al., 2007), may also influence the researchers attempt at KT.

2.6 Measuring knowledge translation

So far, the evaluation of KT efforts, practices, activities and strategies is the least developed part of the KT literature as only a few studies have reported on the evaluation of KT. Estabrooks and Wallin (2004) noted that despite the gains in the theoretical base of KT, measuring KT validly and reliably has not been adequately addressed, and remains a persistent and unresolved problem in the field. While the measurements of the impact of KT activities are not altogether impossible, they have been noted to be difficult to define and to measure (Amara et al., 2004). This observation is corroborated by Reardon et al. (2006), who noted that very few well-developed instruments are available to evaluate the implementation and impact of KT practices. It is not surprising given the difficulties in defining KT let alone measuring it. Lavis et al. (2003) argued that measures for KT need to reflect the target audience and the objectives appropriately while Boyko (2010) posited that evaluating policy implications are important areas for future development of KT.

Van Eerd et al. (2011), in a synthesis of 54 quantitative studies discovered a variety of instruments used to evaluate KT applications. Van Eerd et al. (2011) found that many of the instruments described were developed by the authors/researchers for the specific context of their studies, thereby advocating for research that develops newer ways of evaluating KT. Although surveys lead to the observation of a large number of individuals (Landry et al., 2001), Estabrooks, Floyd, Scott-Findlay, O'Leary & Gustha (2003) complained about the use of self-reports in KT studies, when KT involves multiple communication activities such as documents (Brousselle et al., 2009). Thus bibliometric techniques are an approach noted to evaluate KT.

2.6.1 Bibliometrics

Publishing is a core activity in research-focused institutions (Lee, 2010) because the results of scientific research are mainly disseminated through the publication of peer-reviewed papers in scholarly journals (Campbell et al., 2010). Consequently, the analysis of publications is considered to be an important objective measure that provides key insights into science and research activities (Lewison, Purushotham, Mason, McVie & Sullivan, 2010). Bibliometrics is a method used in library and information science that utilizes quantitative analysis and statistics to describe patterns of publication within a given field or body of literature. Bibliometric indicators are noted to be an objective, reliable and cost efficient measure of research outputs in the form of publications (Campbell et al., 2010; Diem & Wolter, 2012; van Leeuwen, 2007). Abramo and D'Angelo (2011) showed that bibliometric methodology is by far preferable to peer-review in conducting research assessments based on robustness, validity, functionality, time and costs. Underpinning bibliometric approaches is a premise that published manuscripts are symbols of the knowledge produced through research. And according to Rivera-Huerta et al. (2011), researchers in the agriculture sector tend to produce scientific and technical outputs. Typical bibliometric analyses include publication counts, collaborative indices, citation analysis, and co-citation analysis. Citation analysis is a subset of bibliometrics that examines patterns in the citation of documents (Diodato 1994).

The use of bibliometrics in KT studies is not unusual. Hanney, Grant, Wooding & Buxton (2004), acknowledging that bibliometric analysis is sometimes incorporated into broader KT studies, adopted a bibliometric approach in an analysis of papers cited in

clinical guidelines. In addition, Sibbald, MacGregor, Surmacz & Wathen (2015) used a modified citation analysis approach to understand research impact and examined how and where a particular published paper was cited (Wathen et al., 2013). Likewise, Campbell et al. (2010) used a bibliometric approach to address some KT research questions that were difficult to answer objectively using alternative methods such as key informant interview. Furthermore, Estabrooks et al. (2008) applied bibliometric methods of first author co-citation analysis to map the historical development of knowledge utilization field between 1945 and 2004, and Read (2011) applied bibliometric techniques in investigating knowledge mobilization at the World Bank. Bibliometric analysis was used to trace citations in the World Bank's publications in order to map the spread of research through its online uptake by other organizations. Read (2011) found that three out of five World Bank publications had alternative versions posted on websites other than the World Bank's own site. Nevertheless, Woolfrey (2009) noted that usage of research results in government documents and national workshops does not necessarily translate into its direct input into policy changes, or the translation of these policies into government programmes; it implies a willingness on the part of government to utilize research data for decision-making.

2.7 Theoretical approach

As has been noted earlier, KT describes the sets of activities involved in advancing knowledge generated from research into effective changes in policy, practice and products (Barwick et al., 2005). KT process takes place within a complex system of interactions between researchers and knowledge users which may vary in intensity,

complexity, and level of engagement depending on the nature of the research, the findings, as well as the needs of the particular knowledge user (CIHR, 2008). Ward, House and Hamer (2009) conducted a thematic analysis of the knowledge transfer literature, identified 28 different models used to explain the knowledge transfer process, and found five common components of the knowledge transfer process: problem identification and communication; knowledge/research development and selection; analysis of context; knowledge transfer activities or interventions; and knowledge/research utilization. Ward et al. (2009) also identified three types of knowledge transfer processes: a linear process; a cyclical process; and a dynamic multidirectional process. The extant literature suggests that processes involved with KT are not unidirectional, but continuous, cyclical or iterative. KT is a complex and lengthy process (Majdzadeh, Sadighi, Nejat, Mahani, & Gholami, 2008) for which, so far, there is no satisfactory overarching theory. However, some theoretical frameworks have been applied in KT studies. These frameworks are the lenses through which KT has been conceptualized by researchers from various disciplines. The models explore the relationship between research, policy and practice. Examples of such models include: Knowledge to Action (KTA) model (Graham et al., 2006), Use of Research (UoR) model (Cooper & Levin, 2010), Tehran University of Medical Sciences (TUMS) model (Majdzadeh et al., 2008), Ottawa model of research use (Graham & Logan, 2004), and the Canadian Institutes of Health Research (CIHR)'s research cycle superimposed by 6 opportunities to facilitate KT (Sudsawad, 2007). Estabrooks, Thompson, Lovely and Hofmeyer (2006) suggested that theories applicable to studying KT are diffusion of innovation theory, research development dissemination utilization framework, how to

spread good ideas, Greenhalgh's Synthesis, Promoting Action on Research in Health services (PARiHS) model, just to mention but a few. Estabrooks et al. (2006) posited that theory is needed to develop testable and probably useful translation interventions. However, Brehaut and Eva (2012) advocated that rather than limiting choice of theories to the broader level of theories, researchers can leverage knowledge from theories that may not on their own provide a complete picture of KT, but that nonetheless describe components relevant to it. Appropriate KT theory is located in many disciplines (Estabrooks et al., 2006), and Ward et al. (2009) noted that the large number of models or frameworks for the process of transferring knowledge into action can cause confusion for researchers who are seeking to understand KT or to plan KT activities.

Although Estabrooks et al (2006) criticized that investigators often assume that terminology and concepts from other disciplines are transferable to their own, Kothari et al. (2011) argued that policy areas of health share features relevant to other social policy sectors outside of the health domain (a complex issue with multiple stakeholders, different funding mechanisms and incentives, cross-jurisdictional and cross-legislative considerations). Similarly, Jacobson et al (2003) remarked that although information about user groups in KT studies is context dependent, the value of such exploration does not lie in the specific user group information they may provide, but in what may be abstracted from them about the generic characteristics of user groups that are important to KT.

Some KT models make a distinction between knowledge producers and knowledge users, noting that the producers are involved in carrying out research, thereby producing research knowledge, while the users are practitioners, policy makers or

decision makers to whom research results may be relevant. Amara et al. (2004) identified three modes of research knowledge sharing: supply push, whereby research producers try to disseminate their work more effectively; demand pull, in which research users seek out relevant research; and interactive (integrated) approaches, where producers and users work together. The push and / or pull conceptualizations of KT are implicitly implied in some KT frameworks.

2.7.1 Science push, producer push or knowledge-driven model for KT

The science push model for KT emphasizes the flow of information from the producers of research knowledge to knowledge users, resulting in practice or policy decisions. In the producer push model, it is considered the responsibility of the researchers or knowledge producers to communicate research knowledge to potential users. The researchers contribute to the transfer of results into organizational and political arena by explicitly planning and implementing strategies to push knowledge towards audiences they identify as needing to know (Reardon, Lavis & Gibson, 2006).

2.7.2 Demand pull, user pull, or problem-solving model for KT

The pull view of KT conceptualizes research knowledge transfer whereby the users of research knowledge explicitly plan and implement strategies to pull knowledge from sources they identify as producing research useful to their own decision making (Reardon et al., 2006). This may also be a commissioning of information from researchers by policy-makers with the intent of addressing a well-defined policy problem. The pull model requires decision makers to locate, identify and incorporate research results and

scientific evidence into decision processes and policy making. Here, KT is the knowledge users' or decision makers' responsibility. Brouselle et al. (2009) noted that user pull was once the norm for KT.

2.7.3 Interactive or exchange model of knowledge translation

Reardon et al. (2006) premised that KT is facilitated when knowledge producers and knowledge users are known to one another and familiar with one another's needs, preferences, objectives and circumstances. Relationships are built and nurtured between those who produce and those who might use research knowledge to enable an exchange of information, ideas and experience. Interactive (or integrated) KT approaches engage potential knowledge users as parties in the research process (Bowen & Graham, 2013). Lavis et al. (2006) also discussed integrated KT models that foster linkages and exchange efforts between producers of research and users of research knowledge. Exchange may be achieved by engaging the knowledge users in shaping the research questions, interpreting study findings, crafting messages and disseminating research results. Lapaige (2010) noted that the interactive model of KT sustains partnerships between producers and consumers of knowledge, thereby producing findings which are more likely to be relevant to end users. Van de Ven and Johnson (2006), proponents of interactive KT, proposed engaged scholarship for addressing the KT problem, arguing that it enhances the relevance of research for practice and contributes significantly to advancing research knowledge in a given domain. The exchange approach also focuses on partnerships between researchers and research users collaborating for mutual benefit (Hamm, 2013). Kothari and Wathen (2013) suggested that integrated KT has the potential for research

that are more relevant to user context and findings that are more likely to address an identified knowledge-practice gap. Integral to the knowledge exchange model are researchers helping research users to build capacity to use research knowledge and users helping researchers' work to be more relevant (Reardon et al., 2006).

2.7.4 Theoretical frameworks

Some frameworks have recently been developed and used to understand knowledge translation, especially for the communication of health research knowledge. Frameworks for KT vary in their descriptions and emphasis. However, most authors agree that KT is a complex and lengthy process that requires innovative and dedicated action on the part of knowledgeable strategic planners and change agents (Oborn, Barrett & Racko, 2010). Kastner and Straus (2102) noted that although there are many theories for KT, most are not designed to cause change but rather describe change. Frameworks emphasize the need for KT practices to be feasible and adaptable to local circumstances, and to involve end users in the process. The Tehran University of Medical Sciences (TUMS) model (Majdzadeh et al., 2008) conceptualizes KT as the exchange efforts between decision makers and researchers repeatedly transferring questions and knowledge to each other within the context of an organization, while the Use of Research model (Cooper et al., 2009) describes knowledge use as the intersection of research with context and time. Knowledge translation in the Knowledge to Action (KTA) model, as put forward by Graham et al. (2006), is made up of a knowledge creation component and an action component. Each component contains several phases, with no definite boundaries between the two components and among their phases (Graham et al., 2006).

This study adopted Brehaut and Eva (2012)'s suggestion that researchers avoid adopting every construct from a particular theory in a one-size-fits-all manner, but tailor theory application efforts to the specifics of the situation by using an approach whereby individual constructs from a number of frameworks or models may be used to build a more appropriate theoretical framework that provides a better explanation. Hence, no particular KT framework was used it in entirety. Ideas from three KT frameworks were used in carrying out this study. The frameworks include the CIHR research cycle superimposed by 6 opportunities to facilitate KT (Sudsawad, 2007), Lavis' (2003) knowledge transfer framework, and Promoting Action on Research Implementation in Health Services (PARiHS) framework (Kitson, Harvey & McCormack, 1998).

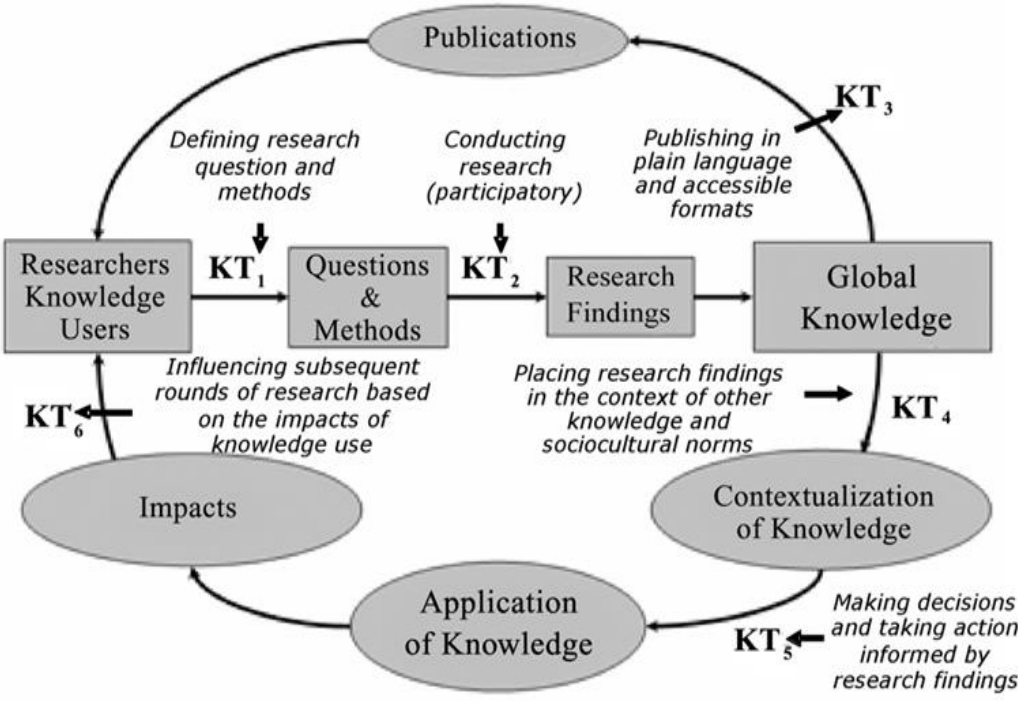


Figure 2.1: CIHR research cycle superimposed by 6 opportunities to facilitate KT (Sudsawad, 2007)

The CIHR's KT framework as shown in Figure 2.1, offers a global picture of the overall KT process as integrated within the research production cycle (Sudsawad, 2007). It

focuses on how KT is an integral part of the research cycle, such that within this cycle, CIHR identifies six (6) opportunities for knowledge exchange that go beyond the basic approach of publication after research. Those opportunities are:

- *KT1: Defining research questions and methodologies*
- *KT2: Conducting research (as in the case of participatory research)*
- *KT3: Publishing research findings in plain language and accessible formats*
- *KT4: Placing research findings in the context of other knowledge and sociocultural norms*
- *KT5: Making decisions and taking action informed by research findings*
- *KT6: Influencing subsequent rounds of research based on the impacts of knowledge use*

While the CIHR model notes opportunities for KT, it does not really expound on the KT process. However, *KT1* and *KT3* informed some questions that were asked in the data collection stage, and a hypothesis that was tested in the study. *KT1* identifies the process of defining research agendas as an opportunity for KT. Given that the agriculture research institutes are primarily funded by, and accountable to the FMARD, it was important to find out the effect of 'who determined what research studies are undertaken in the agriculture research institutes?' on the KT practices of the researchers. From the relationship of the agriculture research institutes with the FMARD in Nigeria, it is envisaged that researchers would more likely translate their research findings to the FMARD, if the research agenda was set by the FMARD in the first place. And this in turn may determine research utilization by policy actors in the ministry. Also, based on the recognition of publications as an opportunity for KT (*KT3*), this study adopted bibliometric techniques to measure agriculture researchers' KT efforts.

Lavis' framework is often cited in reference to KT strategies. Lavis, Roberston, Woodside, McLeod, and Abelson (2003) developed a framework for knowledge transfer that examined knowledge transfer processes outlined based on five questions designed to guide KT:

- *What should be transferred to decision makers (the message)?*
- *To whom should research knowledge be transferred (the target audience)?*
- *By whom should research knowledge be transferred (the messenger)?*
- *How should research knowledge be transferred (the KT process and support system)?*
- *With what effect should research knowledge be transferred (evaluation)?*

Many studies have adopted the Lavis (2003) framework (whole-scale, and in parts) in investigating the KT practices of researchers and research organizations (Couturier, Kimber, Jack, Niccols, Blyderveen and McVey, 2014; Moat, Lavis and Abelson, 2013; El-Jardali**,** Lavis**,** Ataya and Jamal, 2012; Opsahl, 2012; Cameron et al, 2010; Guindon et al, 2010; Lavis et al., 2010). Consequently, this study's survey, though with emphasis on agriculture research knowledge, is guided by the questions of the Lavis framework as they relate to the translation of agricultural research knowledge in Nigeria. It is noteworthy that the Ontario Ministry of Agriculture in Canada adopted these steps as proposed by the Lavis (2003) framework as its KT guidelines (template and checklist) for agriculture researchers in Ontario province.

Another framework that is used to describe KT is the Promoting Action on Research Implementation in Health Services (PARiHS) framework (Kitson et al., 1998). This was one of the first KT related frameworks developed in health research, and it has been applied in many research studies (Rycroft-Malone, 2004; Peter, Garrett & Dawn, 2005; Genius, 2007; Bansod, 2009; Gibb, 2013; Gozdzik, 2013; Powrie, Danly, Corbett,

Purath, & Dupler, 2014; Helfrich, Damschroder, Hagedorn, Daggett, Sahay, Ritchie, Damush, Guihan, Ullrich & Stetler, 2010). The PARIHS framework posits key interacting elements that influence the use of research knowledge in practice.

Figure 2.2: Promoting Action on Research Implementation in Health Services (PARIHS) framework (Kitson et al., 1998)

According to the PARiHS framework, the use of research knowledge in practice is a function of the interplay of three core elements: (1) the level and nature of the research evidence to be used; (2) the context or environment in which the research is to be placed; and (3) the method by which the research use is to be facilitated. PARiHS argues that three interacting bases positively influence KT: strong research evidence, supportive organizational context, and appropriate facilitation (Rycroft-Malone et al., 2002). The status of each of these elements can be assessed for having a weak or strong effect on KT. The PARiHS framework was deemed useful to inform this study, as it recognizes the influence of contextual factors on KT.

2.8 Chapter summary

This chapter presented a comprehensive review of the literature on: (1) the perspectives of knowledge translation; (2) the context for KT; (3) the theoretical frameworks for carrying out and / or studying KT; (4) knowledge brokering; (5) KT in developing countries; (6) KT with emphasis on agriculture; and (7) bibliometrics as a technique for measuring KT through publications. It was noted that the practice of KT includes the efforts put in by individuals or organizations in disseminating and using knowledge. KT can be done by individual researchers who seek out the target audiences for their research findings, plan, and then implement strategies to disseminate these findings to them. Members of an organization can also be responsible for transferring research findings within or outside their organization. KT can also be carried out with the intention of bringing about changes to policies. Although knowledge use is difficult to conceptualize and measure accurately, the use of knowledge can be measured along a continuum of three dimensions: instrumental use, conceptual use, and strategic use. In addition, popular theoretical frameworks that conceptualize the process of KT are the producer-push, user-pull, or interactive modes of KT; however, there is no single overarching theoretical framework for KT.

Chapter 3

3 Research methodology

This study examined the degree to which research scientists in the National Agriculture Research Institutes (NARIs) in Nigeria translate research knowledge, and the extent to which policy actors in the Federal Ministry of Agriculture and Rural Development (FMARD) use the research knowledge generated from the NARIs. Neither of these processes have previously been studied. This chapter begins with an explanation of the assumptions, followed by the research design. The next sections describe the study area, the study population, sampling techniques and data collection instruments that were used to carry out the research. Data analysis procedures are also discussed.

3.1 Assumptions

This study is built on the assumptions which emanate from the structure of the Nigerian FMARD and the research mandates of the NARIs. These assumptions are rooted in the apparent organization of the agriculture sector in Nigeria. The first assumption is that the researchers in the NARIs can and should be doing a better job at communicating their research findings to the FMARD. In 'Transforming Nigeria's Agriculture', a speech delivered by Dr. Akinwumi Adesina, the then Minister of Agriculture and Rural Development of Nigeria, at the inauguration of the Agriculture and Food Security Center of the Earth Institute of Columbia University, New York, USA, on September 10, 2013, the Minister talked a lot about the growth of the Nigerian agriculture sector but did not once mention the contribution of agriculture research in achieving this. The second assumption is that the directors (heads) of the technical departments in the FMARD

(referred to as policy actors), should be making use of the research findings from the NARIs given that the agriculture research in Nigeria are financed from government coffers. It is the investigator's position entering this study that agriculture research should be used to inform agriculture policies and other relevant decisions. The directors of the different departments in the ministry are responsible for formulating agriculture policies related to their various departments. This position is consistent with similar studies that surveyed policy makers made up of senior officials, directors, and heads of different department in the Ministry of Health in Algeria, Bahrain, Egypt, Iran, Jordan, Lebanon, Oman, Sudan, Syria, Tunisia and Yemen, concerning their use of research in policy making (El-Jardali et al., 2012; El-Jardali et al., 2014). Similarly, target participants in the study of health policy makers' capacity to access and utilize research in Nigeria, included the directors and the heads of departments in a state health ministry in Nigeria (Uneke et al., 2015a). In Nigeria, these individuals are described as the key actors in the health policy making process (Uneke et al., 2011). So, the question arises "what information goes into this process?" However, it becomes important to investigate the assumption that, if provided with relevant research knowledge, policy actors for agriculture in Nigeria will utilize research for policy formulation.

3.2 Research design

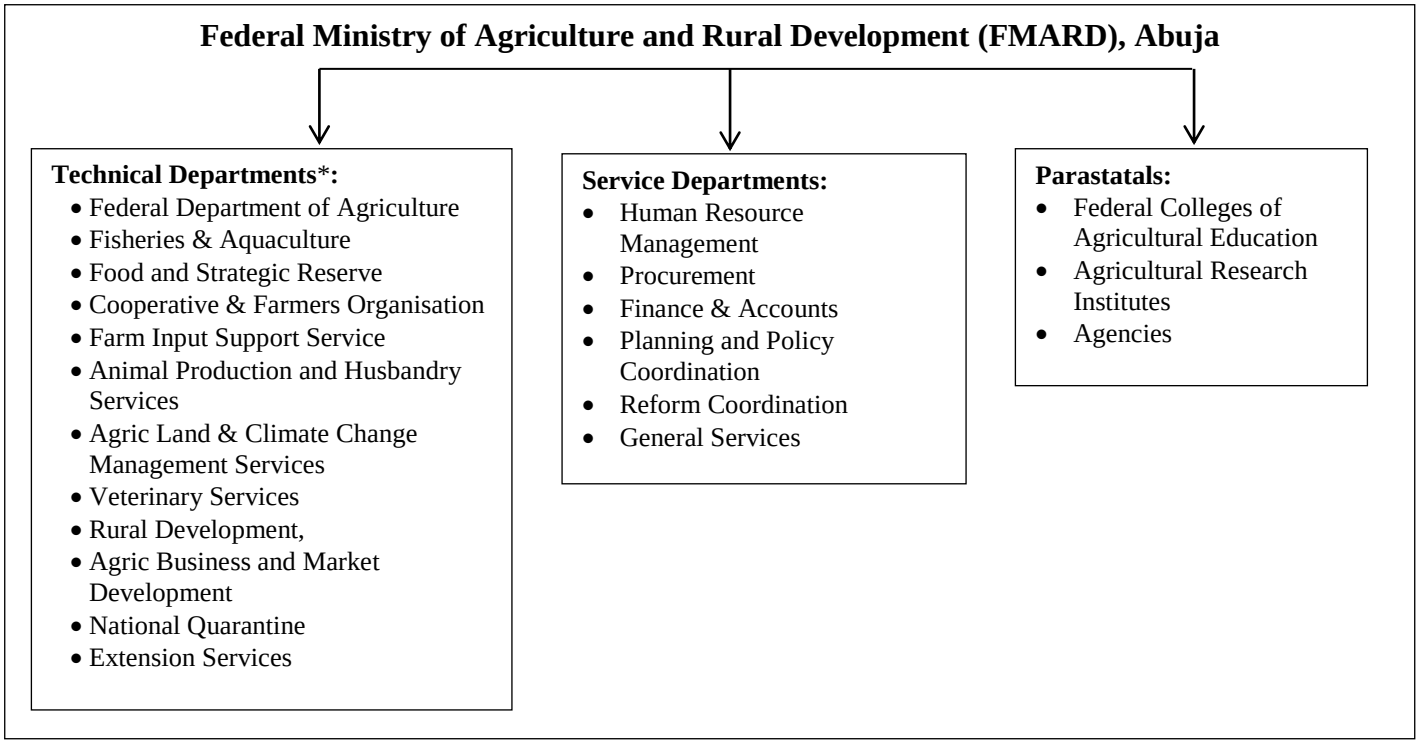
Methods used in carrying out KT studies are varied, and usually depend on the focus and purpose of the studies (Hanney et al., 2004). This study used the social survey research method, deeming it most fitting considering the research questions and study populations. It combined both quantitative and qualitative methods of data gathering, employing

questionnaires and interviews to collect data about the agriculture researchers' KT practices. The policy actors were interviewed to elicit information concerning their research knowledge use. In addition, bibliometric and content analysis methods were used to evaluate the transfer and utilization of research knowledge by the researchers and policy actors respectively.

3.3 Study area

Nigeria is a developing country and the most populated country in Africa. By land mass, it is reported to be the eleventh largest country in Africa, which is the world's second-largest continent. It lies on the west coast of Africa, occupying approximately 923,768 square kilometres of land bordering Niger, Chad, Cameroon, and Benin. It is made up of 36 states and a Federal Capital Territory (National Population Council [NPC], 2012). The states are further divided into local government areas and there are approximately 774 local government areas in the country. The country has a rich diversity of culture, with more than 250 ethnic groups, over 500 languages and dialects, and approximately 36 percent of the population live in urban areas (NPC, 2012). With a wide range of climate, vegetation zones and soil conditions, Nigeria prides itself of an ample array of agricultural production (United Nations Development Programme [UNDP], 2008) and close to 70 percent of the Nigerian rural population is involved in agricultural production (FMARD, 2011). In 2010, agriculture contributed about 40 percent to Nigeria's Gross Domestic Product (GDP) (FMARD, 2011). Nigeria has the largest and most elaborate National Agricultural Research System in sub-Saharan Africa, consisting of National Agricultural Research Institutes, Universities of Agriculture, Federal Colleges of Agriculture, Faculties of Agriculture, Faculties of Veterinary Medicine, and International

Agricultural Research Centers (Phillip, Ahmed, Abubakar & Chikwendu, 2009). Agriculture is a vital sector in the Nigerian economy, and the FMARD is the federal ministry in charge of regulating agricultural research, agriculture and natural resources, forestry and veterinary research throughout Nigeria. Established in 1966, the ministry has the responsibility of optimizing agriculture and integrating rural development for the transformation of Nigeria's economy in order to attain food security and position Nigeria as a net food exporter for socio-economic development (Federal Government of Nigeria [FGN], 2004). The FMARD is primarily funded by the Federal Government of Nigeria, and it currently superintends almost fifty parastatals operating as departments or agencies across the country. The organizational structure of the FMARD is divided into 2 major sections – the technical department and service departments (FMARD, 2012). Figure 3.1 depicts the composition of the FMARD, which used to be called the Federal Ministry of Agriculture and Water Resources (FMAWR) until April, 2010



*Technical departments on FMARD website as at July 13, 2015

Figure 3.1: Structure of the Federal Ministry of Agriculture and Rural Development in Nigeria

An attempt to sustain the value of agriculture in Nigeria led to the establishment of specialized institutions known as National Agriculture Research Institutes (NARIs), to carry out research in agriculture for socio-economic development of the country (FMARD, 2012). The FMARD supervises and provides funding for 15 NARIs, 16 federal colleges of agricultural education, and 13 agencies. The research institutes grew out of different circumstances at different times, with the objective of satisfying different needs for Nigeria's development. As an example, the National Root Crops Research and National Animal Production Research Institutes started as regional research stations aimed at effectively addressing the agricultural problems of different regions of Nigeria, while the National Institute for Horticultural Research was developed through the assistance of the United Nations Development Programme to combat poor nutrition and low standards of living (Ezeala & Yusuf, 2011). Other reasons for the establishment of agricultural research institutes include: to generate new agricultural technologies that are appropriate for the improvement of goods and services; to modernize indigenous technologies for improved production in agriculture; and to develop appropriate agricultural systems that will domesticate imported technologies to the Nigerian situation (FMARD, 2012).

3.4 Target population

The target populations for the study were all the researchers in the NARIs in Nigeria, and the directors/heads of the technical departments in the FMARD. The research institutes are located across different states in Nigeria. Figure 3.2 shows a map of Nigeria, while Table 3.1 displays the list of the agriculture research institutes, and their states of location

in Nigeria. A brief overview of the different NARIs under the purview of the FMARD is given in appendix D.

Figure 3.2: Map of Nigeria showing states, and situating it within Africa (NPC, 2009)

Table 3.1: National Agriculture Research Institutes in Nigeria (FMARD, 2015)

Names of Agriculture Research Institutes under the purview of the FMARD	**State of Location**
National Root Crops Research Institute (NRCRI), Umudike	Abia
National Horticultural Research Institute (NIHORT), Idi-Ishin	Oyo
Cocoa Research Institute (CRIN), Ibadan	Oyo
Nigerian Institute for Oil Palm Research (NIFOR), Benin	Edo
Rubber Research institute of Nigeria (RRIN), Iyanomo	Edo
Nigerian Institute for Oceanography and Marine Research, Victoria Island	Lagos
Lake Chad Research Institute (LCRI), Maiduguri	Borno
National Veterinary Research Institute (NVRI), Vom	Plateau

National Institute for Freshwater Fisheries Research (NIFFR), New Bussa	Niger
Nigerian Stored Products Research Institute (NSPRI), Ilorin	Kwara
National Cereals Research Institute (NCRI), Badeggi	Niger
Institute of Agricultural Research and Training (IAR&T), Ibadan	Oyo
National Animal Production Research Institute (NAPRI), Zaria	Kaduna
National Agricultural Extension Research and Liaison Services (NAERLS), Zaria	Kaduna
Institute for Agricultural Research (IAR), Zaria	Kaduna

3.5 Data Collection Instruments

3.5.1 Questionnaire

The survey instrument that was used to collect data from the researchers in the agriculture research institutes was built on a pre-existing and validated instrument. The questionnaire is a modified version of the ***McMaster University / World Health Organization Questionnaire on Knowledge Transfer and Exchange in the Health Sector*** (Cameron et al., 2010; Guindon et al., 2010; Lavis et al., 2010), with permission from G. Emmanuel Guindon. This study's survey instrument, which is also a modified version of the ***McMaster University Survey on Current Practices in Research Transfer*** (Lavis el., 2003), was developed and tested in a range of low-and middle-income countries. The original questionnaire focused on health researchers' engagement in a broad range of KT activities. The original questionnaire was translated into seven languages, and its reliability and validity were tested in China, Ghana, India, Iran, Kazakhstan, Laos, Mexico, Pakistan, Senegal and Tanzania. In addition to the Lavis (2003) survey, the instrument also drew on three other existing questionnaires: Landry et al. (2001); World Health Organization - Health Research Utilization Assessment Project: Questionnaire for Health Researchers (2003);

and World Health Organization - National Health Research Systems Analysis: Questionnaire to Individuals within the National Health Research System (2003). The instrument was found to have a very high internal consistency for sets of related terms, with Cronbach's alpha value ranging from 0.89 - 0.96. The authors reported that both face and content validities of the instrument were high, assessments of construct validity using criterion-related measures showed statistically significant associations for related measures, and assessments using convergent measures also showed significant associations (Cameron et al., 2010). The authors noted that "the questionnaire can be modified to focus on different high-priority topics simply by changing the description of the topic in the introduction to the questionnaire because all subsequent questions refer in generic terms to 'the health topic'" (Cameron et al., 2010, pg 4).

In order to make the instrument more appropriate for the present study, items were modified (with permission) where applicable by changing terms to reflect the objectives of the present study, and to answer the research questions about the KT practices of agriculture researchers in Nigeria (see Appendix A for this study's questionnaire). For example, the first item that was altered in the instrument was the reference to 'health research'; throughout the survey the term was changed to agriculture research. Secondly, knowledge transfer and exchange was also changed to 'knowledge translation'. References to patients were changed to policy actors, while references to international health organizations like WHO, were changed to reflect relevant international agriculture organizations such as International Fund for Agricultural Development (IFAD), Food and Agriculture Organization (FAO), and the Consultative Group for International Agricultural Research (CGIAR) consortium research centres. The

question that asked the researchers directly for their year of birth was changed to display a range of ages, because researchers in Nigeria would more readily answer a question concerning their age if they are asked to choose a range than them stating an actual figure.

The original developers of the questionnaire outlined it into three broad categories: "producer-push" efforts; efforts to facilitate "user pull"; and exchange efforts (Lavis et al., 2010). More specifically: the push efforts by research producers sought to identify what is transferred to potential knowledge users, with what investments, and with what passive and active strategies; facilitating user-pull efforts concerned what is implemented by researchers to enable potential knowledge users to access the knowledge as well as build their capacity; linkage and exchange efforts were about researchers' inclusion of potential knowledge users in the research and KT process (Cameron et al., 2010; Ellen et al., 2014). All questions in the survey were asked from the researchers' perspective concerning researchers' KT practices, and organized into conceptual domains. This structure was maintained in the present study for agriculture researchers.

Specifically, in the questionnaire for this study, the first section (questions 1 – 6) collected researchers' demographic data: sex; age; highest academic degree; position; and length of service in the institute. All but sex were collected as ordinal data. Subsequent sections elicited information about researchers' KT practices by asking them how often they communicated their research findings, either by themselves or in conjunction with their research institutes. The variables are all measured on a 5-point Likert scale ranging from 1 (never) to 5 (always). Question 7 asked how often researchers communicated their research findings to a group of potential users, question 8 asked them to state who the

main audience for their research findings are, and questions 9 – 11 and 14 – 16 asked the researchers about their KT activities. Question 12 asked the researchers to list up to five of their publications while question 13 asked them to list up to five presentations they had made at a conference. Questions 17 – 19 are related to the study's research question 2, while questions 22 – 26 concern barriers and facilitators of KT and are related to the study's research questions 3 and 4. Question 27 was an open ended question that asked the respondents about intermediaries for their KT activities. Similarly, question 28 was an optional open-ended inquiry to gather additional data concerning any other KT activities that the researchers performed for the policy actors in the FMARD that were not covered in the questionnaire.

Since the survey used an adapted version of a questionnaire related to KT of health research knowledge, the questionnaire was piloted in February, 2015 to ensure that the survey instrument was applicable in the context of KT of agriculture research knowledge in Nigeria. This was done also to see to it that the instrument was measuring constructs of interest and that question wordings were clear and unambiguous. Pilot testing was done by sending the questionnaire by email to seven researchers at the Faculty of Agriculture, University of Ibadan, Nigeria and at the Forestry Research Institute of Nigeria, Ibadan, Nigeria. Feedback was received from four people and the options for question 4 were adjusted to read: Research Officer II; Research Officer I; Senior Research Officer; Principal Research Officer; Chief Research Officer; Assistant Director; and Director.

3.5.2 Interview guide for researchers

The interview guide for the directors of the research institutes was carefully formulated by the investigator, and was guided by the reviewed literature and the research questions for the study. The thesis committee also looked through the guide thoroughly, made changes to it, and accepted the final version that was used (see Appendix B). Questions in the interview guide for the directors of the research institutes mirrored questions in the survey concerning researchers KT activities, but allowed for more in-depth probes.

3.5.3 Interview guide for policy actors

The interview schedule for the policy actors in the FMARD was created based on the research questions, and guided by the literature review. Questions were asked to help identify the importance of research knowledge to the policy actors. The interview explored the types of research that were most important, the features of specific studies that made them useful, aspects of the policy actors' job for which research was most relevant, and the ways of communicating the research to which the policy actors were most receptive, or found most useful. Some questions were adopted from the interview schedule for assessing research utilization in policy-making (Hanney et al., 2003), with permission from Steven Hanney and Miguel Gonzalez-Block, and the guide used in a qualitative study that investigated how Ugandan midwives' and managers' perceived relevance of the context sub-elements in the PARiHS framework, obtained with permission from Anna Bergström. Also, some questions were inspired by Estabrooks' (1999) factors that influence research utilization. The final interview guide was

thoroughly assessed by the thesis advisory committee. See Appendix B for the interview guide for the policy actors.

3.6 Questionnaire distribution, collection and analysis

In order to have an adequate representation of researchers from each of the NARIs, and to be able to test the study hypotheses, quota sampling technique was used where feasible, and convenience sampling otherwise. The investigator alone was involved in the field work, which started with the distribution of the questionnaires to the researchers at CRIN. Fifty percent of the researchers were sampled from each of the research institutes, with representatives from the different research programs (strata) within the NARIs. This was to check that researchers in different research programs in the institutes were adequately represented. The investigator went around the research divisions to distribute the questionnaires to the researchers available and willing to participate. However, the investigator was not able to personally administer questionnaires at NCRI and LCRI. A volunteer (agriculture researcher) helped administer the surveys at NCRI and LCRI. This was because majority of the researchers at NCRI were unavailable on the occasions the investigator visited. LCRI, in its own case, is located in Borno state, which at that time was unsafe to travel to due to the insurgent activity of Boko Haram.

Table 3.2: Data collection

Name of NARI	**Date of initial / first visit**	**Estimated / Total number of researchers reported**	**Number of questionnaires distributed**	**Number of questionnaires returned**	**Date returned / collected**
CRIN Ibadan, Oyo state	May 18, 2015	76[#]	40	33 (82.5%)**	July 1
IAR&T Ibadan, Oyo state	May 21, 2015	93[*]	50	43 (86.0%)	July 1
NIHORT Ibadan, Oyo state	May 25, 2015	105[#]	50	41 (82.0%)	July 2

NSPRI Ibadan, Oyo state	May 26, 2015	17*	15	14 (93.3%)	July 2
NSPRI Ilorin, Kwara state	May 28, 2015	58#	30	21 (70.0%)	July 3
NIFFR New Bussa, Niger state	June 2, 2015	78*	40	37 (92.5%)	August 10
NCRI Badeggi, Niger state	June 4, 2015	77*	30	18 (60.0%)	August 28
NIFOR Benin, Edo state	June 8, 2015	78*	40	35 (87.5%)	July 6
RRIN Benin, Edo state	June 10, 2015	65*	40	17 (42.5%)	July 6
NRCRI Umudike, Abia state	June 15, 2015	99*#	50	38 (76.0%)	July 13
IAR Zaria, Kaduna state	June 22	72*	35	28 (80.0%)	August 11
NAERLS Zaria, Kaduna state	June 23	63*	30	22 (73.3%)	August 11
NAPRI Shika, Kaduna state	June 25	47*	25	20 (80.0%)	August 11
NVRI Vom, Plateau state	June 30	149#	50	34 (68.0%)	August 18
NIOMR Lagos Island, Lagos state	July 8	190#	50	28 (56.0%)	August 14
NSPRI Yaba, Lagos state	July 9	15*	15	13 (86.7%)	August 14
LCRI Maiduguri, Borno state (mail)	August 7	26#	15	12 (80.0%)	August 24

– Source: International Food Policy Research Institute and Agricultural Research Council of Nigeria, 2014 (used this to estimate sample size when the NARI claimed to be less than the ARCN figure)

* – Source: Researcher(s) within the NARI

** – Return rate in parentheses

The different units surveyed in 13 of the research institutes are shown in Appendix E. At each of these institutes, the investigator was fortunate to have a volunteer (researcher) that took her round each unit to distribute the questionnaires. In some cases, when the investigator was informed about the number of units in the NARI, she divided the number of questionnaires she had for that NARI with the number of units, and gave out the same number of questionnaires to the first available researchers she met in each unit. In other instances, when she got to a department, and the investigator was told how many researchers were in that department, she administered the questionnaire to half that number on a first come first served basis. The units were named differently in the different research institutes as divisions, departments, programs or sections. At least one researcher was surveyed in the different units within each research institute listed in Appendix E.

In general, the sample size estimation was 50% for each NARI. At institutes with over 100 researchers, 50 questionnaires were distributed, while all the researchers were targeted in NARIs that had 15 research scientists or less. For the others (and majority), 50% of the researchers (approximated to the next multiple of 5) were surveyed. The least number of questionnaires distributed was 15, while the highest number of questionnaires distributed was 50. Out of about 600 questionnaires that were distributed, 454 questionnaires were returned, giving an overall response rate of 75.7%. Six questionnaires were not completed properly, and apart from some missing responses here and there, all other questionnaires provided complete data. The distribution of the number of usable questionnaires from the research institutes is shown in Table 3.3.

Table 3.3: Number of usable questionnaires analyzed from each of the research institutes

Acronym of National Agriculture Research Institute	Number	Percentage of total (%)
CRIN	33	7.4
IAR	25	5.6
IAR&T	43	9.6
LCRI	12	2.7
NAERLS	22	4.9
NAPRI	20	4.5
NCRI	18	4.0
NIFFR	37	8.3
NIFOR	35	7.8
NIHORT	41	9.2
NIOMR	24	5.4
NRCRI	38	8.5
NSPRI	49	10.9
NVRI	34	7.6
RRIN	17	3.8
Total	448	100.0

3.7 Quantitative data analysis

The questionnaires collected from the researchers were checked, coded and entered into SPSS worksheet and the software used to analyze the data. The initial level of analysis was a general data description for all questions measured on Likert scales and demographics, using descriptive statistics which included frequency counts. Proportions for the surveyed researchers' characteristics (demographics) were calculated, including frequency of engagement in KT activities. And in some cases, the data was re-coded (re-categorized) by combining the top two categories whenever an ordinal scale was used (e.g., frequently or always undertaking an activity, agreeing or strongly agreeing with a statement). Inferential statistical analysis was also carried out on the data to test the hypotheses. Table 3.4 shows the relationship between the research questions, and data analytical techniques, while Table 3.5 shows the relationship between the hypotheses, instruments and data analytical techniques.

Table 3.4: Relationship between research questions, instruments and analytical techniques

S/N	Research question	Instrument	questions / variables	Analytical technique
1	What efforts do researchers in the agriculture research institutes make in to translate their research findings to potential users, especially policy actors in the FMARD?	Questionnaire / Interview	Q9; Q10; Q11; Q14; Q15: Q16; Q17; Q18; Q19; Q20; IS(R) Q3, Q4,	Descriptive statistics: measures of central tendency; frequency tables and charts Qualitative analysis
2	What factors enable the translation of research knowledge by researchers in agricultural research institutes in Nigeria?	Questionnaire / Interview	Q22; Q23; Q22 – Q26; IS(R) Q5, Q8	Descriptive statistics: measures of central tendency; frequency tables and charts Qualitative analysis
3	What barriers inhibit the translation of research knowledge by researchers in agricultural research institutes in Nigeria?	Questionnaire / Interview	Q24; Q25; Q26; Q22 – Q26; IS(R) Q8	Descriptive statistics: measures of central tendency; frequency tables and charts Qualitative analysis
4	How do policy actors in the FMARD in	Interview	IS(P) Q3, Q6	Qualitative (thematic)

	Nigeria use research knowledge generated at the NARIs in their decision making process?			analysis
5	What factors enable the use of research knowledge by policy actors in the FMARD in Nigeria?	Interview	IS(P) Q3, Q5, Q6, Q7, Q8	Qualitative (thematic) analysis
6	What barriers inhibit the use of research knowledge by policy actors in the FMARD in Nigeria?	Interview	IS(P) Q3, Q4, Q7, Q8	Qualitative (thematic) analysis
7	Who are the intermediaries for the translation of research knowledge between the agriculture research institutes and the policy actors in the FMARD in Nigeria?	Questionnaire / Interview	Q27	Descriptive statistics: measures of central tendency
8	What is the influence/reach/spread of researchers' knowledge in the form of publications?	FMARD / NARIs websites Google Scholar		Bibliometric & web content analysis

Table 3.5: Study hypotheses and respective inferential statistical test

Hypotheses	**Instrument**	**Inferential statistical test**
There is no significant difference in the frequency of KT activities undertaken by the male and female researchers	Questionnaire	Mann–Whitney U test
There is no significant difference in the frequency of KT activities undertaken by the researchers in the different age groups	Questionnaire	Kruskal-Wallis test
There is no significant difference in the frequency of KT activities undertaken by the researchers with different highest academic degrees	Questionnaire	Kruskal-Wallis test
There is no significant difference in the frequency of KT activities undertaken by researchers in different positions in the research institutes	Questionnaire	Kruskal-Wallis test
There is no significant difference in the frequency of KT activities by researchers with different lengths of service	Questionnaire	Kruskal-Wallis test
There is no significant difference in the frequency of KT activities carried out by the researchers in the different agriculture research institutes	Questionnaire	Kruskal-Wallis test

3.8 Interview with the researchers

Based on the premise that interviews are useful in collecting data on issues that require the consideration of the individuals' own perception and subjective apprehensions (Berg, 2009), the directors of each research institute were purposively selected for an interview. The aim of the interview was to elicit from these significant players in the research institutes, the context surrounding the overall KT practices of the research institute to the FMARD. Individual interviews lasted between 20 minutes to 45 minutes. Each interview started with an explanation of the purpose of the study. Information letters were given to the interviewees, and their consents were obtained. Participants were assured that the data collected was for research purposes only. Focus group discussions were held in three of the research institutes where at least two researchers were available and were willing to be interviewed at the same time. In two cases, there were 2 people (NAERLS, and NFFRI) and in another case, there were 4 researchers (NRCRI) present at the FGD. There were no formal interviews at NIOMR, IAR&T and LCRI because no researcher volunteered or accepted to be interviewed. Table 3.6 shows the number of interviews held in each of the NARIs. In all, fourteen individual interviews and three focus group discussions were held with a total of 22 researchers from the NARIs. Five of the interviews were not audio recorded at the request of the interviewees, and twelve were recorded with the permission of the interviewees.

Table 3.6: Number of interviews held at the NARIs

NARI	Number	Interview or FGD	NARI	Number	Interview or FGD
NCRI	1	Interview	NAPRI	1	Interview
NIFFR	2	Interview (1); FGD (2 people)	IAR	1	Interview

RRIN	2	Interviews	NAERLS	1	FGD (2 people)
NSPRI	3	Interviews	NRCRI	1	FGD (4 people)
CRIN	2	Interviews	NIHORT	1	Interview
NVRI	1	Interview	NIFOR	1	Interview

3.9 Interviews with policy actors

Visits to the FMARD in Abuja, Nigeria, commenced on July 13, 2015 and interviews at the ministry lasted from July 15 to August 7, 2015. The directors (deputy directors or assistant directors) of the following technical departments in the FMARD were interviewed: Federal Department of Agriculture; Fisheries & Aquaculture; Food and Strategic Reserve; Cooperative & Farmers Organisation; Farm Input Support Service; Animal Production and Husbandry Services; Agric Land & Climate Change Management Services; Veterinary Services; Rural Development; Agric Business and Market Development; National Quarantine; Extension Services; Planning and Policy Coordination. The Permanent Secretary of the ministry was also interviewed. Several attempts to see the Director of Information for the bibliometric study proved unsuccessful.

A total of 14 individual interviews were conducted with the policy actors in the FMARD comprising of 13 males and one female. Interviews were held in the policy actors' offices in all cases. Each interviewee was given a written information letter about the study and each agreed to participate. Ten interviews were audio recorded, with the permission of the interviewees. The investigator took field notes for interviews that were not audio recorded.

3.10 Data analysis for interviews

3.10.1 Data analysis for interviews with researchers

All recorded interviews with the researchers were transcribed verbatim into text and the text was searched to identify themes conveying similar meanings. The interview transcripts were coded with QSR NVivo 10 software using a predefined code list based on the interview questions, using content and thematic analysis procedures. Coding for emergent themes was done by breaking responses into similar concepts and ideas, extracting meaning from transcribed data to locate patterns, similar ideas and concepts within the data, organizing into themes, and labeling them with identifiable names or phrases. Intra-coder reliability was carried out, whereby after initially coding the first three interviews with the agriculture researchers, the investigator then went back and re-coded the exact same interviews again. Although she came up with similar codes, she added two additional codes after this process. This not only speaks to the evolution of her coding technique, but meets the technical definition of reliability. During the actual data analysis, some of the codes were grouped together or split into sub-categories to better account for the findings (Berg, 2009).

3.10.2 Data analysis for interviews with policy actors

Audio-recorded interviews with the policy actors in the FMARD were transcribed verbatim into text, while field notes were typed up into a word processor and imported to QSR NVivo 10 software. The text was searched to identify recurrent themes conveying similar meanings, and coded using content and thematic analysis procedures. The process focused on each policy actor's description of if and how they used the research findings

generated from the agricultural research institutes. A priori codes were identified from the research questions being addressed as well as the questions in the interview schedule. Also, open codes were created from emerging themes after reading through interview transcripts (Berg, 2009). Intra-coder as well as inter coder reliability was carried out for the transcripts of the interviews with the policy actors. The investigator read through three interviews and coded them the first time. She coded the three interviews the second time but came up with similar codes. In addition, she sent the transcripts of the same three interviews with the policy actors to a colleague at the Faculty of Information and Media Studies (FIMS) at Western University. The aim of inter-coder reliability was to find out the second coder's ability to independently reproduce similar codes. Her colleague came up with similar codes and some additional codes, which were used for the data analysis. A list of the coding scheme is available in Appendix H.

3.11 Bibliometric study and web content analysis

Lee (2010) noted that publishing is a core activity of research focused institutions. So bibliometric techniques were used to evaluate the KT efforts of the agriculture researchers based on their publications. The bibliometric study was approached from two perspectives: (1) that looked at the characteristics and impact of documentary output from the research institutes – productivity and citation analyses; (2) that looked at the characteristics of the citers of the journal publications of researchers from the NARIs – citer analysis. A content analysis of documents from the Federal Ministry of Agriculture was also done to see how they have made reference to research findings from the research institutes.

Bibliometric evaluation is greatly affected by availability of data (Abramo & D'Angelo, 2011) and any bibliometric study can only be as good as the data source (Kaur et al., 2012). The initial plan for the bibliometric study was to use the data obtained from questions 12 and 13 in the questionnaire. These questions asked the researchers to write down a maximum of five of their most important research papers, and five conference papers they had authored. Although a total of 208 researchers answered this question, it was extremely difficult to read the hand writings of many respondents, leading to the decision to change the data source for the bibliometric study. The contents of the websites of each of the NARIs were perused thoroughly for any publications that could be used for the bibliometric study. Only the websites of NSPRI and CRIN contained comprehensive lists of publications of their researchers. Hence, only the publications of researchers from these two institutes were used for the bibliometric analysis. Journal articles authored by researchers in both NARIs, published between 2000 and 2015 were downloaded from their websites between April 2015 and August 2015. Other types of publications by the researchers which were available on the research institutes' websites but which were not used include book publications, abstracts, posters, technical reports, local conference proceedings, international conference proceedings, book of abstracts, annual reports and conference papers.

For the first approach of the bibliometric study, use of the publications was determined by the number of citations received by each as obtained from a citation database. The three citation databases considered for this purpose were Scopus, Web of Science, and Google Scholar. Scopus was considered because it is reportedly the largest abstract and citation database of peer-reviewed literature. Scopus delivers a very

comprehensive overview of the world's research output across all research fields - science, mathematics, engineering, technology, health and medicine, social sciences, and arts and humanities (https://www.elsevier.com/solutions/scopus). Web of Science (WoS), on the other hand, gives access to multiple databases that reference cross-disciplinary research, which allows for an in-depth exploration of specialized sub-fields within an academic or scientific discipline (Burnham, 2006). Web of Science has a very wide coverage of about 23,000 journals, 110,000 conference proceedings, 9,000 websites, and over 100 years of back files, over 87 million source items, 700 million citation references, and 256 scientific disciplines (Thompson Reuters, 2010). Abhaya et al. (2009) noted that an advantage of WoS over Scopus is the depth of coverage; WoS database goes back to 1945 and Scopus goes back to 1966. However, Scopus and WoS complement each other as neither resource is all inclusive. Google Scholar was checked to account for citations that could not be traced on Web of Science or Scopus.

The second aspect of the bibliometric study was the citer analysis. This section sought to identify the attributes of those citing the publications authored by the agriculture researchers in CRIN and NSPRI. The author's research impact analysis was conducted based on the number of individuals who have cited a given author. In this sense, it sought to identify impact using the number of citers, as opposed to the number of citations. According to Ajiferuke and Wolfram (2009), although citation represents an important acknowledgement, the question arises whether the reach of an author's research is more accurately determined by the number of citations received by an author, or the number of people who have cited and have been influenced by a given author's work, i.e., the number of citers (including self-cites). In performing the citer analysis, the

number of citers for each citing publication was tabulated using Excel, organized by name and affiliation of citing author.

From the perspective of the Federal Ministry of Agriculture and Rural Development, the bibliometric analysis sought to find evidence of the use of output from the research institutes in the FMARD's documents. Use of the researchers' works in the ministry was explored by looking into the ministry's documents in the hard copy or online full text version. The data sources from the ministry included: technical reports, policy briefs, published articles, speeches, administrative orders, executive regulations, reports and minutes of meetings. These documents were thoroughly read by the investigator with the aim of discovering any references to research findings from any of the NARIs. Reading/reviewing each document on the FMARD website followed a deductive thematic analysis approach to account for its development, purpose, and any specific mention of the NARIs, whether of a study conducted by a NARI researcher or a new approach that was based on NARI research (whether or not it directly cited that research). In addition, constructs related to the study's objectives such as, 'research', 'knowledge', 'researcher', 'research institute', were searched for within the texts of each document, as possible indicators, to investigate the use of research knowledge. The content analysis here is mainly frequency analysis and keyword finding.

3.12 Ethical considerations

To ensure that the study was carried out in an ethical manner, ethics approval was obtained from the University of Western Ontario's Non-Medical Research Ethics Board before embarking on data collection. In accordance with Article 2.4 of the Tri- Council

Policy Statement on Ethical Conduct for Research involving Humans, the investigator provided to the participants a letter of information which explained the objectives of the study, nature of research, form of participation requested, sponsors, conduct, and expected outcomes of the study. Each participant was also provided with a consent form because a questionnaire was administered or interview conducted. Also, in the analysis and presentation of data, information about participants remained confidential.

3.13 Chapter summary

This chapter presented the study methodology. Three methods were used for data collection: (1) questionnaires; (2) interviews; and (3) bibliometrics and web content analysis. The questionnaire used for this study was a modified version of a KT questionnaire that had been used in previous studies. The questionnaire collected data concerning the agriculture researchers' demographics, as well as the frequency with which they carried out a variety of KT activities to their target audiences. The interview guides were designed by the investigator guided by the study's research questions. Six hundred questionnaires were distributed to researchers in the fifteen NARIs, out of which 454 were collected and 448 analyzed. A total of 22 researchers were interviewed in the NARIs while 14 policy actors were interviewed from the FMARD. 264 journal articles from the websites of 2 of the NARIs were analyzed, as well as 50 documents from the FMARD. Data collected using the questionnaires were analyzed quantitatively using descriptive and inferential statistics, while the interview transcripts were analyzed qualitatively using thematic analysis. Also, data gathered for the bibliometrics aspect of the study were analyzed quantitatively while a summative approach was used for the web content analysis.

Chapter 4

4 Findings from the questionnaires

4.1 Introduction

Chapter III contained a description of the study methods including discussions about the survey instrument, interview guides, study population, data collection process and data analysis. This chapter presents the results of the statistical analysis on data collected from the questionnaire.

4.2 Demographic data

The data showed that out of 443 researchers that answered the question pertaining to their sex, 301 (67.2%) were male, and 142 (31.7%) were female (see Figure 4.1). In terms of age, forty-three researchers (9.7%) were less than or equal to thirty years old, 171 (38.2%) researchers were between thirty-one to forty years, 174 (38.8%) were between forty-one to fifty, while fifty-six (12.5%) researchers were more than 50 years old (see Figure 4.2). All researchers responded to the question about their highest academic qualifications with 253 (56.5%) of the researchers in the NARIs having a master's degree, 109 (24.3%) had a doctorate degree, while 78 (17.4%) had a bachelor's degree or the Higher National Diploma degree (see Figure 4.3). However, eight (1.8%) researchers had other types of degree qualifications, such as Doctor of Veterinary Medicine (DVM), especially from the Veterinary Research Institute. In terms of position, twenty-one respondents (4.7%) were assistant directors or directors while 164 (37.0%) were research officers. Almost half of the researchers (47.7%) were either senior, principal or chief research officers (see Figure 4.4). The areas of specialization of these researchers include

agricultural extension (noted by almost half of the researchers), animal science, fisheries, plant science, agronomy and post-harvest. Fourteen of these researchers (3.1%) had worked in the research institutes for less than one year, 284 (64.3%) had worked between one year to ten years in the research institutes, 111 researchers (24.7%) had worked between eleven to twenty-five years, whereas 33 researchers had worked more than twenty-five years in the NARIs (see Figure 4.5).

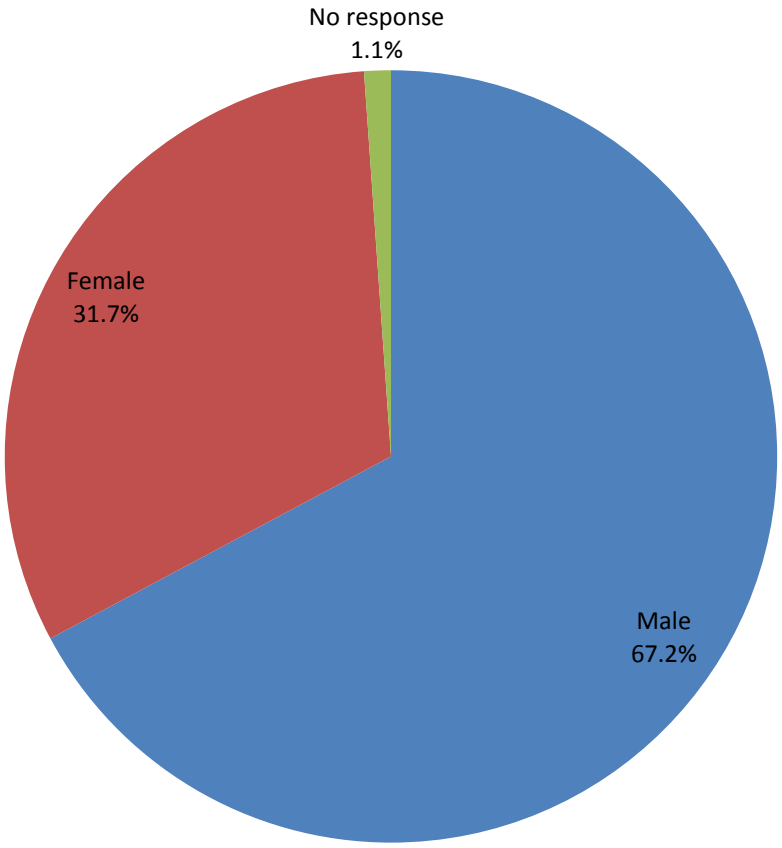


Figure 4.1: Distribution of researchers' sex

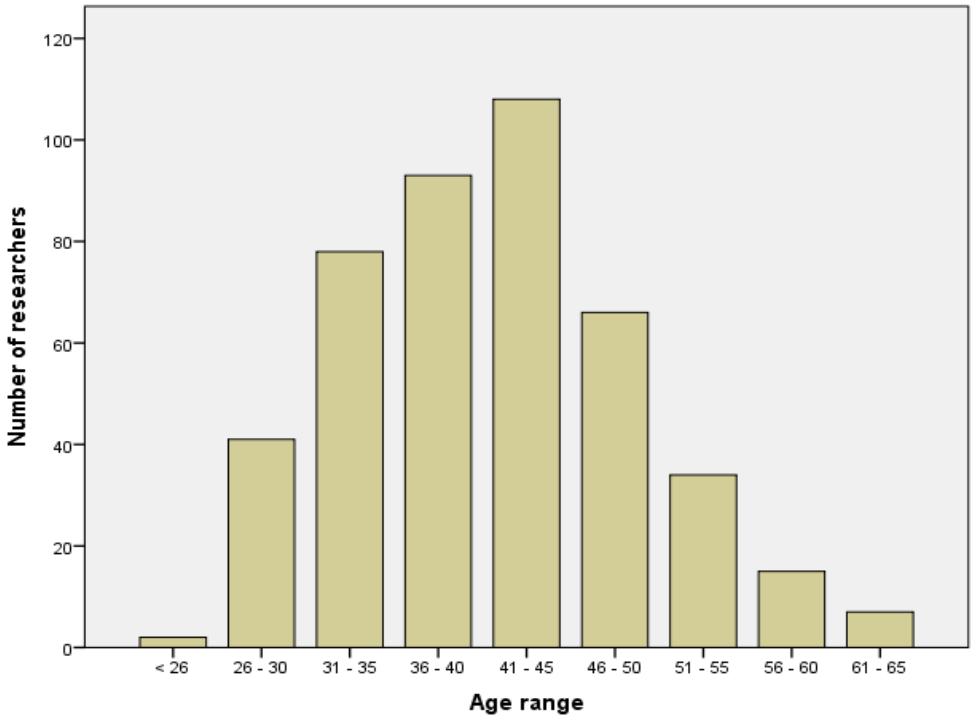


Figure 4.2: Distribution of agriculture researchers' age

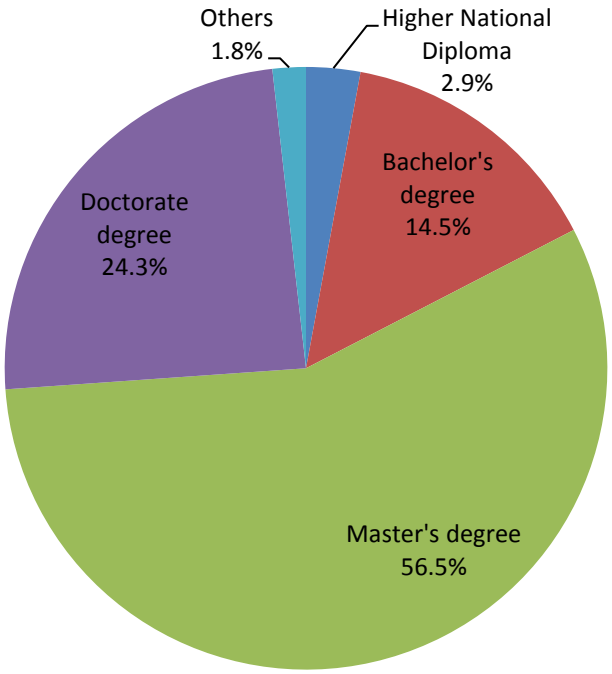


Figure 4.3: Highest academic qualification of the researchers

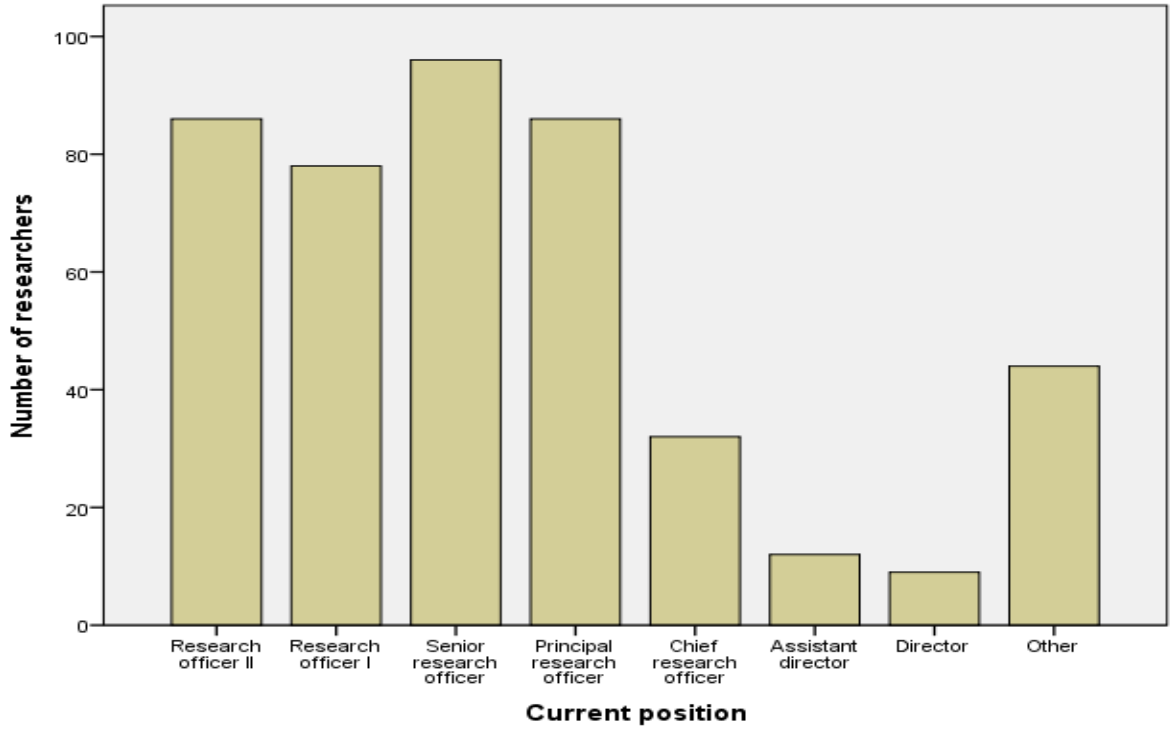


Figure 4.4 Current position of researchers

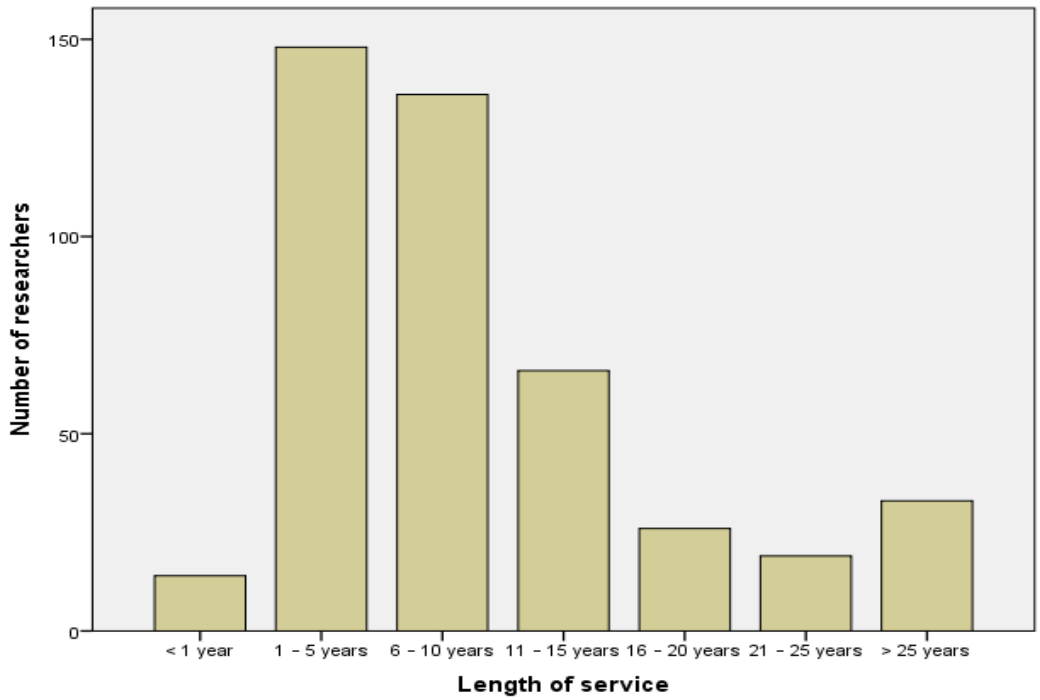


Figure 4.5: Length of service of researchers

4.3 Knowledge translation activities undertaken by agriculture researchers for categories of potential research users

The most often endorsed frequency of researchers' KT to FMARD was 'occasionally' as reported by 162 (36.2%) researchers but most researchers (62.3% combined) frequently or occasionally performed KT to the FMARD (see Table 4.1). The responses given by the researchers concerning their frequency of KT activities to other categories of potential target audiences listed in the questionnaire were similar. Although 'occasionally' was the most often reported frequency of researchers' KT activities to all target audiences, more than 60% of the researchers performed KT activities occasionally/frequently while the percentage of researchers that never or rarely performed KT activities was less than 20% for all categories of target audiences. In addition, eleven researchers wrote down specific other target audiences to whom they performed KT activities. These included – extension agencies, non-governmental organizations (NGOs), Farmer Development Union (FADU), students on industrial experience, subject matter specialists, universities, other tertiary institutions, West Africa Agricultural Productivity Programme (WAAPP), Agricultural Development Programmes (ADPs), women and youth associations, and the media.

Table 4.1: Frequency of researchers' KT activities for categories of potential research users

Target audience for KT	Never	Rarely	Occasionally	Frequently	Always	*No response*
Policy actors in the Federal Ministry of Agriculture and Rural Development (FMARD)	31 (6.9%)	50 (11.2%)	162 (36.2%)	117 (26.1%)	71 (15.8%)	17 (3.8%)
Agricultural goods / service providers (e.g. farmers, poultry owners, food stuff traders)	12 (2.7%)	45 (10%)	143 (31.9%)	141 (31.5%)	93 (20.8%)	14 (3.1%)
Managers in agricultural institutions, agro technology	20 (4.5%)	58 (12.9%)	205 (45.8%)	100 (22.3%)	44 (9.8%)	21 (4.7%)

companies, non-governmental organizations						
General public	18 (4.0%)	47 (10.5%)	167 (37.3%)	111 (24.8%)	79 (17.6%)	26 (5.8%)
Members of staff in other supervisory / affiliated / donor agencies (e.g., Agriculture Research Council of Nigeria, State Ministries of Agriculture, Local Governments) and International Organizations (FAO, IFAD, UNDP, World bank ADP, CGIAR Consortium, IITA, IFPRI)	12 (2.7%)	44 (9.8%)	161 (35.9%)	133 (29.7%)	86 (19.2%)	12 (2.7%)

4.4 Form of knowledge transferred by agriculture researchers

Providing full reports or brief summaries of research projects to target audiences, either in hard copy or electronically, seemed to be a common KT activity for the researchers, as more than 50% of the agriculture researchers indicated that they did this frequently or always (see Table 4.2). Similarly, 260 researchers (58%) occasionally or frequently developed messages for their target audience that specified possible action. However, while about 48.2% and 51.4% researchers occasionally or frequently mailed / emailed full reports and brief summaries respectively, large percentages (39.5% and 36.8% respectively) never or rarely performed these KT activities.

Table 4.2: Form of knowledge transferred by agriculture researchers (N = 448)

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Provided full reports on research projects to target audience, either in hard copy or electronically	33 (7.4%)	45 (10.0%)	126 (28.1%)	133 (29.7%)	95 (21.2%)	16 (3.6%)
Provided brief summaries of research reports to target audience, either in hard copy or electronically	24 (5.4%)	42 (9.4%)	133 (29.7%)	150 (33.5%)	76 (17.0%)	23 (5.1%)
Mailed or emailed full reports on research projects to target	75	102	150 (33.5%)	66 (14.7%)	34	21

audience	(16.7%)	(22.8%)			(7.6%)	(4.7%)
Mailed or emailed brief summaries of research reports to target audience	62 (13.8%)	103 (23.0%)	146 (32.6%)	84 (18.8%)	28 (6.3%)	25 (5.6%)
Developed messages for target audience that specified possible action (i.e., recommendations, take-home messages, actionable messages)	30 (6.7%)	67 (15.0%)	147 (32.8%)	113 (25.2)	63 (14.1%)	28 (6.3%)

4.5 Researchers' investments in fine-tuning KT approach to target audience

Many of the researchers (61.9%) either occasionally or frequently obtained or updated the contact information for their target audience (see Table 4.3). Similarly, 298 (66.5%) of the researchers occasionally/frequently obtained or reviewed information concerning the needs of their target audience. Also, more than 65% of the researchers occasionally/frequently tailored aspects of their KT approach to their target audience, spent time with the target audience discussing research reports or spent time discussing ideas based on the research findings. Likewise, 60.7% of the researchers either occasionally or frequently developed reports that were appealing to their target audience by using language appropriate to the target audience However, about 52.0% of the researchers frequently/always developed reports, summaries or messages that provided examples of how target audience could use the research, with another 31.5% of the researchers occasionally doing this.

Table 4.3: Researchers' investments in fine-tuning KT approach to target audience (N = 448)

KT activity	**Never**	**Rarely**	**Occasionally**	**Frequently**	**Always**	***No response***
Obtained or updated contact information for target audience	29 (6.5%)	71 (15.8%)	149 (33.3%)	128 (28.6%)	52 (11.6%)	19 (4.2%)
Obtained or reviewed	26	55	150 (33.5%)	148	51	18 (4.0%)

information about your target audience concerning their needs and goals	(5.8%)	(12.3%)		(33.0%)	(11.4%)	
Developed reports, summaries or messages that were appealing to target audience by using language appropriate to your target audience	19 (4.2%)	48 (10.7%)	137 (30.6%)	135 (30.1%)	78 (17.4%)	31 (6.9%)
Developed reports, summaries or messages that provided examples or demonstrations of how target audience could use the research	18 (4.0%)	34 (7.6%)	141 (31.5%)	163 (36.4%)	70 (15.6%)	22 (4.9%)
Tailored other aspects of KT approach to target audience	16 (3.6%)	65 (14.5%)	158 (35.3%)	149 (33.3%)	31 (6.9%)	29 (6.5%)
Spent time with target audience discussing research reports	28 (6.3%)	74 (16.5%)	169 (37.7%)	134 (29.9%)	30 (6.7)	13 (2.9%)
Spent time with target audience discussing ideas based on research findings for possible action	23 (5.1%)	66 (14.7%)	156 (34.8%)	144 (32.1%)	43 (9.6%)	16 (3.6%)

4.6 Researchers' investments in supporting their KT efforts

Answers by researchers showed that a majority either occasionally or frequently performed activities to support their KT efforts (see Table 4.4). Many of the researchers either occasionally or frequently reviewed the research literature about effective approaches to KT (56.0%), or reviewed information from websites about effective approaches to KT (56.0%), or participated in KT skill-building activities, such as conferences or courses about KT (56.3%), or shared experiences with people performing KT roles in other organizations (59.1%). Similarly, more than half of the researchers occasionally or frequently identified and worked with intermediaries for KT (58.5%), or identified and worked with the most credible messengers for their target audience (58.1%), or developed relationships with journalists (53.4%). However, only about 48.0% of the researchers occasionally or frequently worked with KT specialists in their research institutes.

Table 4.4: Researchers' investments in supporting their KT efforts (N = 448)

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Worked with knowledge translation specialists in research institute	52 (11.6%)	72 (16.1%)	105 (23.4%)	110 (24.6%)	87 (19.4%)	22 (4.9%)
Reviewed the research literature about effective approaches to knowledge translation	41 (9.2%)	80 (17.9%)	121 (27.0%)	130 (29.0%)	54 (12.1%)	22 (4.9%)
Reviewed information from websites about effective approaches to KT	46 (10.3%)	82 (18.3%)	117 (26.1%)	134 (29.9%)	45 (10.0%)	24 (5.4%)
Participated in KT skill-building activities, such as conferences or courses about KT	48 (10.7%)	66 (14.7%)	128 (28.6%)	124 (27.7%)	56 (12.5%)	26 (5.8%)
Shared experiences with people performing KT roles in other organizations	36 (8.0%)	89 (19.9%)	144 (32.1)	121 (27.0%)	35 (7.8%)	23 (5.1%)
Identified and worked with KT specialists outside research institute	61 (13.6%)	94 (21.0%)	121 (27.0%)	117 (26.1)	20 (4.5%)	35 (7.8%)
Identified and worked with people outside research institute who bring researchers and their target audiences together and build relationships among them that make knowledge translation more effective?	52 (11.6%)	90 (20.1)	142 (31.7%)	120 (26.8%)	24 (5.4%)	20 (4.5%)
Identified and worked with the most credible messengers for target audience (i.e., those who, regardless of their role, are seen as credible by members of target audience)	42 (9.4%)	92 (20.5%)	145 (32.4%)	115 (25.7%)	30 (6.7%)	24 (5.4%)
Developed relationships with print, radio and/or television journalists	50 (11.2%)	82 (18.3%)	149 (33.3%)	90 (20.1%)	52 (11.6%)	25 (5.6%)

4.7 Passive strategies used by researchers to transfer knowledge to target audiences

Based on the responses of the researchers, one could group the passive strategies they used to transfer knowledge to the target audiences into three categories. In the first category is the provision of free upon request articles and free upon request brief

summaries with a large percentage (61.6%) researchers occasionally or frequently employing either strategy (see Table 4.5). In the second category, there are more researchers who never or rarely employed the strategy than those who occasionally or frequently employed the strategy. In this category are mailing or emailing to target audience reports without an explicit request from some or all members of the target audience and mailing/emailing brief summaries to target audience without an explicit request from some or all members of the target audience. The remaining five passive strategies belong to the third category, in which at least 40.0% of the researchers never or rarely employed the strategy but with a higher percentage of researchers occasionally or frequently employing the strategy.

Table 4.5: Passive strategies used by researchers to transfer knowledge to target audiences

KT activity (N = 448)	**Never**	**Rarely**	**Occasionally**	**Frequently**	**Always**	***No response***
Provided *at a cost* and upon request articles, reports, syntheses or formal systematic reviews as a result of research for target audience	75 (16.7%)	113 (25.2%)	142 (31.7%)	78 (17.4%)	18 (4.0%)	22 (4.9%)
Provided *free* upon request articles, reports, syntheses or formal systematic reviews for target audience	41 (9.2%)	65 (14.5%)	151 (33.7%)	125 (27.9%)	44 (9.8%)	22 (4.9%)
Provided *free* upon request *brief summaries* of articles, reports, syntheses formal systematic reviews or *messages* that specified possible action for target audience	36 (8.0%)	71 (15.8%)	154 (34.4%)	122 (27.2%)	37 (8.3%)	28 (6.3%)
Mailed or e-mailed target audience *notices* that new material of potential interest to them as a result of research had been posted to a website	77 (17.2%)	120 (26.8%)	138 (30.8%)	66 (14.7%)	21 (4.7%)	26 (5.8%)
Mailed or e-mailed to target audience articles, reports, syntheses or formal systematic reviews *without an explicit request* from some or all members of target audience	90 (20.1%)	126 (28.1%)	141 (31.5%)	49 (10.9%)	11 (2.5%)	31 (6.9%)
Mailed or e-mailed to target audience *brief summaries* of articles, reports, syntheses or formal systematic	81 (18.1%)	138 (30.8%)	134 (29.9%)	52 (11.6%)	9 (2.0%)	34 (7.6%)

reviews and/or *messages* that specified possible action for target audience *without an explicit request* from some or all members of target audience						
Mailed or e-mailed to target audience a *newsletter* containing brief summaries or messages or dedicated sections for target audience	73 (16.3%)	114 (25.4%)	145 (32.4%)	50 (11.2%)	18 (4.0%)	48 (10.7%)
Submitted *media releases* from your research to print, radio or television journalists	82 (18.3%)	103 (23.0%)	148 (33.0%)	64 (14.3%)	25 (5.6%)	26 (5.8%)
Published research in non-scholarly publications read by target audience	73 (16.3%)	110 (24.6%)	147 (32.8%)	58 (12.9%)	31 (6.9%)	29 (6.5%)

4.8 Researchers' KT practices using interactions related to the research process

For all types of interactions but one, more than half of the surveyed agriculture researchers either occasionally or frequently interacted with their target audience during the research and KT process (see Table 4.6). For instance, during the time researchers developed research questions, objectives or hypotheses, 251 researchers (56.0%) occasionally or frequently interacted with the target audience. In addition, 267 of the researchers (59.6%) occasionally or frequently interacted with the target audience when undertaking KT activities for the target audience. However, 165 of the researchers (36.8%) rarely or never interacted with their target audience when analyzing or interpreting research findings, but this is in comparison to 49.1% of the researchers that occasionally or frequently interacted.

Table 4.6: Researchers' KT practices using interactions related to the research process

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Interacted when developing a specific research question, objectives or hypotheses	38 (8.5%)	84 (18.8%)	142 (31.7%)	109 (24.3%)	56 (12.5%)	19 (4.2%)
Interacted when establishing the preferred research design and	39 (8.7%)	101 (22.5%)	139 (31.0%)	107 (23.9%)	47 (10.5%)	15 (3.3%)

methods						
Interacted when executing the research	27 (6.0%)	80 (17.9%)	127 (28.3%)	125 (27.9%)	69 (15.4%)	20 (4.5%)
Interacted when analyzing / interpreting the research findings	56 (12.5%)	109 (24.3%)	134 (29.9%)	86 (19.2%)	41 (9.2%)	22 (4.9%)
Interacted when developing research products (e.g., research reports, brief summaries or messages)	58 (12.9%)	90 (20.1%)	134 (29.9%)	103 (23.0%)	45 (10.0%)	18 (4.0%)
Interacted when undertaking KT activities for your target audience	33 (7.4%)	68 (15.2%)	145 (32.4%)	122 (27.2%)	59 (13.2%)	21 (4.7%)
Interacted when responding to individual queries resulting from research products or knowledge translation efforts	45 (10.0%)	75 (16.7%)	143 (31.9%)	112 (25.0%)	55 (12.3%)	18 (4.0%)

4.9 Researchers' KT practices using interactions outside the research process

Apart from their extent of interaction with target audience within the research process, researchers were asked how often they interacted with their target audience outside the research process. The frequency of the researchers' interactions with the target audience outside of the research process was very similar to the frequency of the researchers' interactions with their target audience within the research process (see Table 4.7). A majority of the researchers occasionally or frequently interacted with their target audience outside the research process through: government sponsored meetings involving target audience (61.4%); committee or group involving the target audience (61.8%); conferences and workshops involving the target audience (65.6%); events organized by the NARIs (70.5%); events organized by the target audience (58.3%); formal private or public networks involving target audience (62.9%); informal conversations with the target audience (63.8%); and events organized by bilateral, regional or international organizations (60.5%). However, 185 researchers (41.3%) rarely or never interacted with

target audience through events organized by print, radio, or television journalists, in close comparison with 46.9% of the researchers that occasionally or frequently did.

Table 4.7: Researchers' KT practices using interactions outside the research process (N = 448)

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Interacted through government-sponsored meetings involving target audience	33 (7.4%)	76 (17.0%)	166 (37.1%)	109 (24.3%)	43 (9.6%)	21 (4.7%)
Interacted through committee or group involving target audience	35 (7.8%)	83 (18.5%)	186 (41.5%)	91 (20.3%)	29 (6.5%)	24 (5.4%)
Interacted through conferences and workshops involving target audience	24 (5.4%)	48 (10.7%)	150 (33.5%)	144 (32.1%)	64 (14.3%)	18 (4.0%)
Interacted through formal private or public networks involving target audience	40 (8.9%)	77 (17.2%)	177 (39.5%)	105 (23.4%)	31 (6.9%)	18 (4.0%)
Interacted through events organized by you or research institute	14 (3.1%)	37 (8.3%)	174 (38.8%)	142 (31.7%)	62 (13.8%)	19 (4.2%)
Interacted through events organized by target audience	42 (9.4%)	93 (20.8%)	164 (36.6%)	97 (21.7%)	28 (6.3%)	24 (5.4%)
Interacted through events organized by print, radio or television journalists	70 (15.6%)	115 (25.7%)	137 (30.6%)	73 (16.3%)	23 (5.1%)	30 (6.7%)
Interacted through informal conversations with target audience	16 (3.6%)	69 (15.4%)	164 (36.6%)	122 (27.2%)	41 (9.2%)	36 (8.0%)
Interacted through events organized by bilateral, regional or international organizations (e.g., IFAD, FAO, CGIAR research centres – IITA, IFPRI, CIAT, CIFOR, AfricaRice)	36 (8.0%)	61 (13.6%)	167 (37.3%)	104 (23.2%)	52 (11.6%)	28 (6.3%)

4.10 Passive strategies used by researchers to facilitate target audience obtaining research findings

The agriculture researchers were also questioned about the frequency with which they employed strategies that made it easier for the target audience to obtain research findings when needed. Researchers' responses showed that about half of the researchers occasionally or frequently did these (see Table 4.8). Passive strategies occasionally or

frequently undertaken by more than half of the researchers to facilitate the target audience to obtain research findings included: maintaining some reserve capacity to conduct short-term research projects in response to requests from the target audience (52.3%); identifying in websites/newsletters the specific individuals who could answer questions about research (51.4%); providing access to a searchable database of articles, reports, syntheses, and or reviews on relevant agriculture research (52.3%); and providing the target audience with access to a database of summaries of articles, reports, syntheses or formal systematic reviews or messages that specified possible action for target audience (54.9%). Although almost 50% of the researchers occasionally or frequently posted their research reports on their websites as well as identified in websites/newsletters the specific individuals involved in the development of a report, a considerable proportion of the researchers (About 39%) rarely or never did these.

Table 4.8: Passive strategies used by researchers to facilitate target audience obtaining research findings (N = 448)

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Posted on your website reports from your research studies	68 (15.2%)	106 (23.7%)	130 (29.0%)	84 (18.8%)	38 (8.5%)	22 (4.9%)
Provided access to a searchable database of articles, reports, syntheses, and or formal systematic reviews on relevant agriculture research	44 (9.8%)	98 (21.9%)	132 (29.5%)	102 (22.8%)	38 (8.5%)	34 (7.6%)
Provided access to a searchable database of summaries of articles, reports, syntheses or formal systematic reviews or messages that specified possible action for your target audience	48 (10.7%)	97 (21.7%)	161 (35.9%)	85 (19.0%)	30 (6.7%)	27 (6.0%)
Clearly identified in websites, newsletters the specific individual(s) who was involved in the development of a report, summary or message	60 (13.4%)	114 (25.4%)	131 (29.2%)	92 (20.5%)	24 (5.4%)	27 (6.0%)
Clearly identified in websites, newsletters the specific	54 (12.1%)	111 (24.8%)	137 (30.6%)	93 (20.8%)	30 (6.7%)	23 (5.1%)

individual(s) who could answer questions about research						
Maintained some reserve capacity (i.e., financial or human resources that can be redirected when required) to conduct short-term research projects in response to requests from your target audience	64 (14.3%)	103 (23.0%)	154 (34.4%)	80 (17.9%)	21 (4.7%)	26 (5.8%)

4.11 Active strategies employed by researchers to increase the capacity of target audience to use research knowledge

Results from the data analysis showed that 272 (60.7%) researchers occasionally or frequently developed the capacity of their target audience to assess the quality and applicability of research (see Table 4.9). Similarly, 279 (62.3%) of the researchers occasionally or frequently developed the capacity of their target audience to adapt research to increase its perceived relevance. Also, 282 (62.9%) of the surveyed researchers in the national agriculture research institutes in Nigeria occasionally or frequently carried out activities to develop the capacity of their target audience to assess the quality and applicability of research. However, in comparison to 54.1% of the researchers that occasionally or frequently developed capacity of the target audience to acquire research through searchable databases, 33.5% of the researchers rarely or never developed capacity of their target audience to acquire research through searchable databases.

Table 4.9: Active strategies used by researchers to increase the capacity of target audience to use research knowledge (N = 448)

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Developed capacity of target audience to *acquire* research through searchable databases	46 (10.3%)	104 (23.2%)	145 (32.4%)	97 (21.7%)	37 (8.3%)	19 (4.2%)
Developed capacity of target	34	84	161 (35.9%)	111 (24.8%)	42	16

audience to *assess* the quality and applicability of research	(7.6%)	(18.8%)			(9.4%)	(3.6%)
Developed capacity of target audience to *adapt* research to increase its perceived relevance	25 (5.6%)	74 (16.5%)	153 (34.2%)	126 (28.1%)	52 (11.6)	18 (4.0%)
Developed capacity of target audience to *apply* research knowledge (e.g., by combining research with other types of information relevant to the decisions they face)	26 (5.8%)	68 (15.2%)	151 (33.7%)	131 (29.2%)	51 (11.4%)	21 (4.7%)

4.12 Knowledge exchange efforts initiated by researchers

Like with the other KT practices listed in the questionnaire, the researchers gave similar responses to the frequency with which they carried out activities that indicated integrated knowledge translation. The most common frequency for each of the knowledge exchange efforts listed in Table 4.10 was occasionally but while at least 50.0% of the researchers occasionally or frequently initiated each knowledge exchange effort, a considerable percentage (ranging from 25.4% to 35.9%) never or rarely initiated it.

Table 4.10: Knowledge exchange efforts initiated by researchers (N = 448)

KT activity	Never	Rarely	Occasionally	Frequently	Always	*No response*
Established or maintained long term *partnerships* with representatives or members of target audience (e.g., through an advisory board)	36 (8.0%)	78 (17.4%)	139 (31.0%)	112 (25.0%)	59 (13.2%)	24 (5.4%)
Involved members of target audience in conducting a *needs assessment* for your target audience	38 (8.5%)	80 (17.9%)	135 (30.1%)	111 (24.8%)	49 (10.9%)	34 (7.6%)
Involved members of target audience in establishing the *overall direction of research* conducted by research institute	39 (8.7%)	120 (26.8%)	133 (29.7%)	107 (23.9%)	22 (4.9%)	27 (6.0%)
Involved members of target audience in establishing the *overall direction of KT activities* undertaken by research institute	48 (10.7%)	105 (23.4%)	141 (31.5%)	105 (23.5%)	23 (5.1%)	26 (5.8%)

Involved members of target audience in *assessing the progress of research* conducted by research institute	43 (9.6%)	102 (22.8%)	136 (30.4%)	108 (24.1%)	33 (7.4%)	26 (5.8%)
Involved members of target audience in *assessing the progress of KT activities* undertaken by research institute	53 (11.8%)	108 (24.1%)	122 (27.2%)	102 (22.8%)	32 (7.1%)	31 (6.9%)

4.13 Percentage of researchers' total work time spent on KT activities

Three hundred and four researchers estimated the percentage of their own total work time during a typical 12 months period in which they spent performing KT activities. As shown in Figure 4.6, the range of time researchers spent doing KT is wide. A few of the researchers indicated that they spent as low as 0% of their time doing KT, while a few researchers spent 90% of their time carrying out KT. Researchers' responses revealed that on the average, researchers devoted about 46.71% of their time doing KT in a typical year.

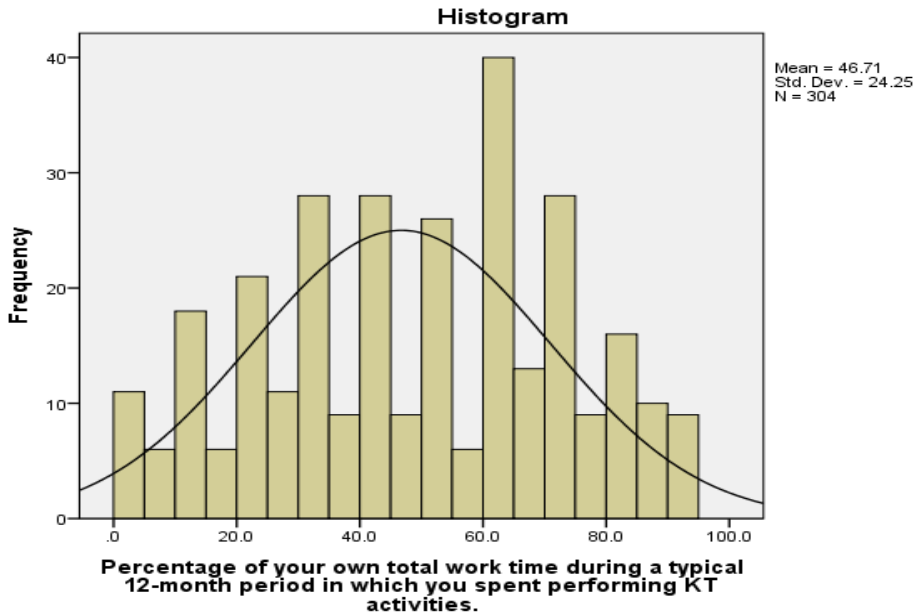


Figure 4.6: Percentage of researchers' work time devoted to KT activities in a year

4.14 Barriers and facilitators of researchers' KT activities

Concerning facilitators for KT, 342 researchers (76.4%) disagreed/strongly disagreed that their research institute was not seen as a credible source of agriculture research knowledge (see Table 4.11). In addition, 290 (64.7%) of the researchers agreed/strongly agreed that the translation of research was aided by requirements within their institute to publish findings. More than half (55.6%) of the surveyed researchers agreed/strongly agreed that structures and processes existed to link researchers to target audience. Similarly, almost half (49.6%) of the researchers agreed/strongly agreed that KT was helped by the mix of researchers and target audience with their research institute. Two hundred and twenty (49.1%) of the researchers also agreed/strongly agreed that KT activities could be paid for through research grants which researchers were eligible to apply, 203 (45.3%) of the researchers agreed/strongly agreed that personal and organizational contact with their target audience was stable over time, and 202 (45.1%) of the researchers expressed that their research institute made available financial and human resources to assist with KT activities. However there were some factors concerning the target audience that had almost equal percentage of researchers that agreed/strongly agreed to them and those that disagreed/strongly disagreed to them. Some of these factors include that: the target audience had access to technical support for translating research knowledge into action; the target audience made decisions about agriculture issues on the basis of research; and the target audience did not lack the expertise for translating research knowledge into action. These factors were agreed/strongly agreed to by 163 (36.4%), 134 (29.9%), and 133 (29.6%) of the

researchers respectively, and equally disagreed/strongly disagreed to by 140 (31.3%), 151 (33.7%), and 179 (39.9%) of the researchers, respectively.

Table 4.11: Facilitators for KT (N = 448)

Factors affecting KT	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	*No response*
My research institute was not seen as a credible source of agriculture research knowledge	219 (48.9%)	123 (27.5%)	48 (10.7%)	20 (4.5%)	10 (2.2%)	28 (6.3%)
The translation of research was helped by requirements within my institute to publish findings	14 (3.1%)	34 (7.6%)	81 (18.1%)	230 (51.3%)	60 (13.4%)	29 (6.5%)
Structures and processes existed to link researchers and your target audience	9 (2.0%)	56 (12.5%)	102 (22.8%)	196 (43.8%)	53 (11.8%)	32 (7.1%)
The translation of research was helped by the mix of researchers and target audience within my research institute	21 (4.7%)	63 (14.1%)	94 (21.0%)	202 (45.1%)	20 (4.5%)	48 (10.7%)
KT activities could be paid for through research grants for which I was eligible to apply	24 (5.4%)	63 (14.1%)	110 (24.6%)	163 (36.4%)	57 (12.7%)	31 (6.9%)
Personal and organizational contacts among your target audience were quite stable over time	18 (4.0%)	81 (18.1%)	116 (25.9%)	171 (38.2%)	32 (7.1%)	30 (6.7%)
My research institute made available financial and human resources to assist me with KT activities	35 (7.8%)	80 (17.9%)	98 (21.9%)	178 (39.7%)	24 (5.4%)	33 (7.4%)
Target audience had access to technical support for translating research knowledge into action	33 (7.4%)	107 (23.9%)	113 (25.2%)	146 (32.6%)	17 (3.8%)	32 (7.1%)
Target audience did not make decisions about the agriculture issue on the basis of research	31 (6.9%)	120 (26.8%)	135 (30.1%)	118 (26.3%)	16 (3.6%)	28 (6.3%)
Target audience lacked the expertise for translating research knowledge into action	45 (10.0%)	134 (29.9%)	101 (22.5%)	118 (26.3%)	15 (3.3%)	35 (7.8%)

The most prominent barrier, noted by 248 researchers (55.3%), was the high cost for translating research knowledge (see Table 4.12). Two hundred and seven (46.3%) of the researchers also disagreed/strongly disagreed that the target audience invested

financial or human resources in joint research initiatives while 196 (43.7%) of the researchers disagreed/strongly disagreed that the target audience invested financial or human resources in KT activities. However, a good proportion (41.7%) of the researchers did not perceive any crisis in the agriculture system that drew attention away from agriculture research.

Table 4.12: Barriers for KT (N = 448)

Barriers against KT	**Strongly Disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**	***No response***
The cost for translating research knowledge from my agriculture research into action was very low	91 (20.3%)	157 (35.0%)	78 (17.4%)	76 (17.0%)	21 (4.7%)	25 (5.6%)
Target audience invested financial and/or human resources in joint research initiatives	67 (15.0%)	140 (31.3%)	107 (23.9%)	91 (20.3%)	14 (3.1%)	29 (6.5%)
Target audience invested financial and/or human resources in knowledge translation activities (e.g., hired staff to identify and make available relevant research)	62 (13.8%)	134 (29.9%)	111 (24.8%)	102 (22.8%)	10 (2.2%)	29 (6.5%)
Perceived crises in the agriculture system drew attention away from agriculture research	65 (14.5%)	122 (27.2%)	107 (23.9%)	107 (23.9%)	19 (4.2%)	27 (6.0%)

4.15 Researchers' access to information sources for research and KT activities

Most of the agriculture researchers reported having access to information sources for research and KT activities (see Table 4.13). Three hundred and eighty-two researchers (85.3%) indicated that they had access to the internet at least once a month to conduct searches and download the results while 372 researchers (83.0%) had access to at least five scientific journals published locally, nationally or regionally. In addition, 324

(72.3%) of the researchers had access to at least five scientific journals indexed in international reference databases. However, even though 322 (71.9%) of the researchers responded to having access to a personal computer with a functional internet connection at all times to conduct and download searches, almost 22.0% of the researchers did not have access to a personal computer with a functional internet connection at all times to conduct and download searches.

Table 4.13: Researchers' access to information sources during research and KT activities

Access to information sources (N = 448)	**Yes**	**No**	**Don't Know**	***No response***
Had access to at least five scientific journals indexed in international reference databases	324 (72.3%)	81 (18.1%)	18 (4.0%)	25 (5.6%)
Had access to at least five scientific journals published locally, nationally or regionally	372 (83.0%)	45 (10.0%)	10 (2.2%)	21 (4.7%)
Had access to the internet at least once a month to conduct and download searches	382 (85.3%)	40 (8.9%)	3 (0.7%)	23 (5.1%)
Had access to a personal computer with a functional internet connection at all times to conduct and download searches	322 (71.9%)	98 (21.9%)	6 (1.3%)	22 (4.9%)

4.16 Support received by researchers for research and KT activities

Although 91 (20.3%) of the researchers indicated that at the time they began conducting their agriculture research, the agriculture research environment in Nigeria was unsupportive/very unsupportive of individuals who conducted their type of research, 241 (53.8%) of the researchers responded that the agriculture research environment in Nigeria was supportive/very supportive of individuals who conducted their type of research when they began conducting their agriculture research (see Table 4.14). Likewise, 215 (48.0%) of the researchers noted that over the time they conducted their research, the agriculture research environment in Nigeria became supportive/very supportive of individuals who

conducted their type of research. Similarly, more than 50% of the researchers indicated that their research institute was supportive/very supportive of individuals who conducted their type of research when they began conducting their research, and over the time the researchers conducted their research, the research institute became supportive/very supportive of individuals who conducted their type of research, and over the time the researchers undertook KT activities, the research institute became supportive/very supportive of individuals who undertook KT activities in their research area. In addition, approximately 50% of the researchers indicated that when they began to undertake their KT activities and over the time they undertook KT activities, their research institute was and has become supportive/very supportive of individuals who undertook KT activities in their research area. However, while 41.1% of the researchers noted that the agriculture research environment in Nigeria was supportive/very supportive of them when they began their type of research, 35.5% noted that the agriculture research environment in Nigeria was neither supportive nor unsupportive. Similarly, while 40.2% of the researchers noted that the agriculture research environment in Nigeria was supportive/ very supportive of individuals who conducted their type of research over time, 36.2% noted that the agriculture research environment in Nigeria was neither supportive nor unsupportive.

Table 4.14: Support received by researchers for research and KT activities (N = 448)

Type of support	**Very unsupportive**	**Unsupportive**	**Neither supportive nor unsupportive**	**Supportive**	**Very supportive**	***No response***
How supportive was the agriculture research environment in Nigeria when you began conducting your agriculture research of individuals who conducted your type of research?	13 (2.9%)	78 (17.4%)	89 (19.9%)	217 (48.4%)	24 (5.4%)	27 (6.0%)

Over the time you conducted your research, how supportive has the agriculture research environment in Nigeria become of individuals who conducted your type of research?	11 (2.5%)	77 (17.2%)	113 (25.2%)	197 (44.0%)	18 (4.0%)	32 (7.1%)
How supportive was the agriculture research environment in Nigeria when you began conducting your research of individuals who undertook KT activities related to your research?	14 (3.1%)	56 (12.5%)	159 (35.5%)	172 (38.4%)	12 (2.7%)	35 (7.8%)
Over the time that you undertook your KT activities, how supportive has the agriculture research environment in Nigeria become of individuals who undertook KT activities related to your research area?	9 (2.0%)	59 (13.2%)	162 (36.2%)	175 (39.1%)	5 (1.1%)	38 (8.5%)
How supportive was your research institute when you began conducting your research of individuals who conducted your type of research?	4 (0.9%)	44 (9.8%)	106 (23.7%)	227 (50.7%)	30 (6.7%)	37 (8.3%)
Over the time that you conducted your research, how supportive has your research institute become of individuals who conducted your type of research?	9 (2.0%)	40 (8.9%)	128 (28.6%)	217 (48.4%)	21 (4.7%)	33 (7.4%)
When you began conducting your research, how supportive was your research institute of individuals who undertook KT activities related to your research area?	8 (1.8%)	39 (8.7%)	136 (30.4%)	205 (45.8%)	17 (3.8%)	43 (9.6%)
Over the time that you undertook KT activities, how supportive has your research institute become of individuals who undertook KT activities in your research area	7 (1.6%)	35 (7.8%)	133 (29.7%)	215 (48.0%)	21 (4.7%)	37 (8.3%)

4.17 Researchers' views concerning KT

More than three-quarters of the researchers (81.0%) held the view that their research had credibility among their target audience (see Table 4.15). In the same vein, 342 (76.3%) of the researchers believed their research was considered relevant by the target audience and 301 (67.2%) of the researchers disagreed/strongly disagreed that their research was not yet ready for use. Furthermore, 336 (75.0%) of the researchers agreed/strongly agreed

that their research coincided with the needs and expectations of the target audience while 322 (71.9%) of the researchers agreed/strongly agreed that their research coincided with Nigeria's priorities. While a small percentage (38.6%) of the researchers agreed/ strongly agreed that researchers who conduct agriculture research are primarily responsible for KT activities related to their agriculture research (i.e. push model) and a smaller percentage (18.5%) agreed/strongly agreed that the target audience for agriculture research are primarily responsible for KT activities related to the agriculture research (i.e. pull model), it was interesting to note that a large percentage (59.8%) of the researchers agreed/ strongly agreed that both researchers and target audience are jointly responsible for KT activities related to the agriculture research (i.e. push and pull model).

Table 4.15: Researchers' views concerning KT

Views concerning KT	**Strongly Disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**	***No response***
My research was not considered relevant by target audience	168 (37.5%)	174 (38.8%)	42 (9.4%)	25 (5.6%)	10 (2.2%)	29 (6.5%)
My research coincided with Nigeria's priorities (e.g., with a National Research Agenda)	14 (3.1%)	28 (6.3%)	49 (10.9%)	193 (43.1%)	129 (28.8%)	35 (7.8%)
My research coincided with the needs and expectations of target audience	9 (2.0%)	24 (5.4%)	45 (10.0%)	229 (51.1%)	107 (23.9%)	34 (7.6%)
My research lacked credibility among target audience	212 (47.3%)	151 (33.7%)	38 (8.5%)	9 (2.0%)	9 (2.0%)	29 (6.5%)
My research was not yet ready for use	135 (30.1%)	166 (37.1%)	76 (17.0%)	34 (7.6%)	4 (0.9%)	33 (7.4%)
Researchers who conduct agriculture research are primarily responsible for KT activities related to their agriculture research	31 (6.9%)	85 (19.0%)	125 (27.9%)	146 (32.6%)	27 (6.0%)	34 (7.6%)
Target audience for agriculture research are primarily responsible for KT activities related to the agriculture research	68 (15.2%)	141 (31.5%)	124 (27.7%)	75 (16.7%)	8 (1.8%)	32 (7.1%)
Both researchers and target audience are jointly responsible for KT activities related to the agriculture research	17 (3.8%)	46 (10.3%)	89 (19.9%)	213 (47.5%)	55 (12.3%)	28 (6.3%)

4.18 Hypotheses testing

Tests were run on the data to determine if there were any differences in the frequency of the researchers' KT activities to the FMARD among researchers' demographic groups. All hypotheses were tested using Statistical Package for the Social Sciences (SPSS) software version 20. In addition to the variable that measured the frequency of the agriculture researchers' KT activities to the policy actors in the FMARD, a new variable was created that measured the frequency of the researchers' overall KT by computing the median of the frequencies of the researchers' KT activities across audience types.

The following sets of hypotheses were tested concerning the frequency of the agriculture researchers' KT activities to the FMARD and the researchers' demographics:

1. H_{01A} – there is no significant difference in the frequency of KT activities undertaken by the male and female researchers to the FMARD.

Table 4.16: Descriptive statistics of frequency of KT to FMARD by researchers' sex

Ranks					
	Sex	N	Mean Rank	Sum of Ranks	Median
Frequency of KT to FMARD	Male	292	223.05	65131.50	3.00
	Female	135	194.42	26246.50	3.00
	Total	427			

Table 4.17: Mann-Whitney test results

Test Statistics[a]	
	Frequency of KT to FMARD
Mann-Whitney U	17066.500
Asymp. Sig. (2-tailed)	.020
a. Grouping Variable: Sex	

From the test results displayed in Table 4.17, there is a significant difference in the frequency of KT activities carried out to the FMARD between male and female agriculture researchers. Table 4.16 shows that the mean rank of male researchers is

higher than that of female researchers implying that male researchers do KT more frequently to the FMARD than female researchers.

2. H_{01B} – there is no significant difference in the frequency of KT activities undertaken by the researchers in the different age groups to the FMARD.

Table 4.18: Descriptive statistics of the frequency of KT to FMARD carried out by researchers in the different age groups

Ranks				
	Age group	N	Mean Rank	Median
Frequency of KT to FMARD	≤ 30 years old	41	170.24	3.00
	31 – 35 years old	78	192.18	3.00
	36 – 40 years old	86	210.06	3.00
	41 – 45 years old	105	226.49	3.00
	46 – 50 years old	64	216.52	3.00
	51 – 55 years old	33	240.14	4.00
	> 55 years old	20	289.00	4.00
	Total	427		

Table 4.19: Kruskal-Wallis test results for the researchers' age group

Test Statistics[a,b]	
	Frequency of KT to FMARD
Chi-Square	19.198
df	6
Asymp. Sig.	.004
a. Kruskal Wallis Test	
b. Grouping Variable: Recoded age	

Results in Table 4.19 show that there is a significant difference in the frequency of the agriculture researchers' KT activities targeted at the FMARD between at least two age groups. A pairwise comparison test showed that the significant differences in the frequency of the researchers' KT activities to the FMARD were between researchers that were less than or equal to thirty years old and those greater than fifty years old (≤30 and >50), and between researchers between 31 – 35 years of age and those greater than fifty years (31–35 and >50). Researchers who were above 50 years carried out KT more frequently to the FMARD than those less or equal to 35 years old.

3. H_{01C} – there is no significant difference in the frequency of KT activities undertaken by the researchers with different highest academic degrees to the FMARD.

From the results displayed in Table 4.21, there is no significant difference in the frequency of KT activities undertaken by researchers to the FMARD based on the researchers' academic degrees.

Table 4.20: Descriptive statistics of the frequency of KT carried out to the FMARD by the researchers with different highest academic degrees

Ranks				
	Highest academic degree	N	Mean Rank	Median
Frequency of KT to FMARD	Higher National Diploma	11	207.36	3.00
	Bachelor's degree	62	189.52	3.00
	Master's degree	244	210.97	3.00
	Doctorate degree	107	242.21	4.00
	Others	7	238.79	4.00
	Total	431		

Table 4.21: Kruskal-Wallis test results for the researchers' highest academic qualification

Test Statistics[a,b]	
	Frequency of KT to FMARD
Chi-Square	8.936
df	4
Asymp. Sig.	.063
a. Kruskal Wallis Test	
b. Grouping Variable: Highest academic degree	

4. H_{01D} – there is no significant difference in the frequency of KT activities undertaken by the researchers in different positions in the research institutes to the FMARD.

Table 4.22 displays the descriptive statistics of the frequency of KT activities carried out by the researchers in different positions to the FMARD and Table 4.23 shows the Kruskal-Wallis test results for the researchers' position.

Table 4.22: Descriptive statistics of the frequency of KT carried out to the FMARD by researchers in different positions in the research institutes

Ranks				
	Current position	N	Mean Rank	Median
Frequency of KT to FMARD	Research officer II	82	203.49	3.00
	Research officer I	75	190.03	3.00
	Senior research officer	95	192.12	3.00
	Principal research officer	84	227.77	3.50
	Chief research officer	32	235.72	4.00
	Assistant director	12	309.79	5.00
	Director	8	339.69	5.00
	Other	39	232.77	3.00
	Total	427		

Table 4.23: Kruskal-Wallis test results for the researchers' position

Test Statistics[a,b]	
	Frequency of KT to FMARD
Chi-Square	27.018
df	7
Asymp. Sig.	.000
a. Kruskal Wallis Test	
b. Grouping Variable: Current position	

There is a significant difference in the frequency of KT activities carried out by researchers in different positions in the research institutes to FMARD. A pairwise comparison test revealed significant differences in the frequency of KT activities carried out by researcher officer 1 and assistant director, between research officer 1 and director, between senior research officer and assistant director, and between senior research officer and director. The researchers in higher positions in the NARIs (assistant directors and directors) appeared to carry out KT more frequently to the FMARD.

5. H_{01E} – there is no significant difference in the frequency of KT activities to the FMARD by researchers with different lengths of service.

Table 4.24 displays the descriptive statistics of the frequency of KT activities carried out by researchers to the FMARD, based on their length of service in the NARIs and Table 4.25 shows the Kruskal-Wallis test results for researchers' length of service.

Table 4.24: Descriptive statistics of the frequency of KT carried out by researchers to the FMARD by length of service in the research institutes

Ranks				
	Length of service	N	Mean Rank	Median
Frequency of KT to FMARD	< 10 years	285	201.92	3.00
	10 - 20 years	90	220.03	3.00
	> 20 years	50	263.50	4.00
	Total	425		

Table 4.25 Kruskal-Wallis test results for researchers' length of service

Test Statistics[a,b]	
	Frequency of KT to FMARD
Chi-Square	12.022
df	2
Asymp. Sig.	.002
a. Kruskal Wallis Test	
b. Grouping Variable: Length of service	

There is a significant difference in the frequency KT activities carried out to FMARD by researchers with different lengths of service. This is shown in Table 4.25. A pairwise comparison test showed that there is a significant difference in the frequency of KT activities between the researchers' who have worked in the NARIs for less than ten years (<10years) with those who have worked for more than twenty years (>20years) in the research institutes. The researchers who have worked in the NARI longer appeared to carry out KT activities more frequently to the FMARD.

6. H_{01F} – there is no significant difference in the frequency of KT activities to the FMARD undertaken by researchers in the different research institutes.

Table 4.26 displays the descriptive statistics of the frequency of KT activities carried out by the researchers in the different research institutes to the FMARD and Table 4.27 shows the Kruskal-Wallis test results for researchers in the different research institutes.

Table 4.26: Descriptive statistics of the frequency of KT activities carried out to FMARD by researchers in the different research institutes

Ranks				
	National Agriculture Research Institutes	N	Mean Rank	Median
Frequency of KT to FMARD	NIHORT	39	211.85	3.00
	NIFOR	34	197.93	3.00
	RRIN	17	229.18	3.00
	NIFFR	37	227.15	3.00
	NIOMR	22	225.73	3.00
	NAPRI	18	144.58	3.00
	NAERLS	19	218.97	3.00
	IAR	23	211.39	3.00
	CRIN	32	221.44	3.00
	NSPRI	47	241.91	3.00
	NVRI	34	212.12	3.00
	NRCRI	38	147.33	3.00
	IAR&T	41	249.87	4.00
	LCRI	12	277.00	4.00
	NCRI	18	243.22	4.00
	Total	431		

Table 4.27: Kruskal-Wallis Test Results for researchers in the different research institutes

Test Statistics[a,b]	
	Frequency of KT to FMARD
Chi-Square	30.185
df	14
Asymp. Sig.	.007
a. Kruskal Wallis Test	
b. Grouping Variable: National Agriculture Research Institutes	

Table 4.27 shows that there is a significant difference in the frequency of KT activities undertaken by the researchers in the different research institutes to the FMARD. A pairwise comparison of the frequency of KT activities carried out by researchers in the

different NARIs to the FMARD disclosed that the significant differences were between NRCRI and NSPRI, and between NRCRI and IAR&T.

In addition to the tests run to find out if there were differences in the frequency of the agriculture researchers' KT practices to the FMARD based on the researchers' demographics, statistical tests were run to test for the differences in the agriculture researchers' overall KT activities among demographic groups. The following sets of hypotheses were tested concerning the frequency of the agriculture researchers' overall KT activities to all potential target audience groups:

7. H_{02A} – there is no significant difference in the frequency of overall KT activities undertaken by the male and female researchers.

Table 4.28: Descriptive statistics of frequency of overall KT by researchers' sex

Ranks				
	Sex	N	Mean Rank	Median
Researchers' overall KT	Male	298	226.14	3.00
	Female	140	205.36	3.00
	Total	438		

Table 4.29: Mann-Whitney test results

Test Statistics[a]	
	Researchers' overall KT
Mann-Whitney U	18881.000
Wilcoxon W	28751.000
Z	-1.705
Asymp. Sig. (2-tailed)	.088
a. Grouping Variable: Sex	

From the test results in Table 4.29, there is no significant difference in the frequency of overall KT activities between male and female agriculture researchers.

8. H_{02B} – there is no significant difference in the frequency of overall KT activities undertaken by the researchers in the different age groups.

Table 4.30: Descriptive statistics of the frequency of overall KT carried out by researchers in the different age groups

Ranks				
	Age group	N	Mean Rank	Median
Researchers' overall KT	≤ 30	42	185.49	3.00
	31 - 35	78	213.86	3.00
	36 - 40	90	213.42	3.00
	41 - 45	107	226.36	3.00
	46 - 50	66	220.24	3.00
	51 - 55	34	248.57	4.00
	> 55	21	250.21	4.00
	Total	438		

Table 4.31: Kruskal-Wallis test results for researchers' age group

Test Statistics[a,b]	
	Researchers' overall KT
Chi-Square	7.644
df	6
Asymp. Sig.	.265
a. Kruskal Wallis Test	
b. Grouping Variable: Recoded age <30 - >50	

Results in Table 4.31 show that there is no significant difference in the frequency of the agriculture researchers' overall KT activities in the different age groups.

9. H_{02C} – there is no significant difference in the frequency of overall KT activities undertaken by the researchers with different highest academic degrees.

From the results displayed in Table 4.33, there is no significant difference in the frequency of KT activities undertaken by the researchers with different academic degrees.

Table 4.32: Descriptive statistics of the frequency of overall KT carried out by the researchers with different highest academic degrees

Ranks				
	Highest academic degree	N	Mean Rank	Median
Researchers' overall KT	Higher National Diploma	12	269.00	3.75
	Bachelor's degree	65	205.12	3.00
	Master's degree	250	213.11	3.00
	Doctorate degree	108	245.69	4.00
	Others	7	218.43	4.00

	Total	442		

Table 4.33: Kruskal-Wallis test results for the researchers' highest academic qualification

Test Statistics[a,b]	
	Researchers' overall KT
Chi-Square	8.696
df	4
Asymp. Sig.	.069
a. Kruskal Wallis Test	
b. Grouping Variable: Highest academic degree	

10. H_{02D} – there is no significant difference in the frequency of overall KT activities undertaken by researchers in different positions in the research institutes.

Table 4.34 displays the descriptive statistics of the frequency of overall KT activities carried out by the researchers in different positions in the NARIs while Table 4.35 shows the Kruskal-Wallis test results for the researchers' position.

Table 4.34: Descriptive statistics of the frequency of overall KT carried out by the researchers in different positions in the research institutes

Ranks				
	Current position	N	Mean Rank	Median
Researchers' overall KT	Research officer II	86	226.02	3.00
	Research officer I	77	195.30	3.00
	Senior research officer	95	203.13	3.00
	Principal research officer	85	223.36	3.00
	Chief research officer	32	207.06	3.00
	Assistant director	12	270.67	4.00
	Director	9	284.39	4.00
	Other	42	260.68	4.00
	Total	438		

Table 4.35: Kruskal-Wallis test results for researchers' position

Test Statistics[a,b]	
	Researchers' overall KT
Chi-Square	15.615
df	7
Asymp. Sig.	.029
a. Kruskal Wallis Test	
b. Grouping Variable: Current position	

There is a significant difference in the frequency of overall KT undertaken by researchers in the different positions in the research institutes. However, the pairwise comparison test did not reveal where the significant difference was, though the medians and mean ranks for senior ranking researchers (assistant director and director) are greater than those for junior researchers.

11. H_{02E} – there is no significant difference in the frequency of overall KT activities undertaken by the researchers with different lengths of service in the NARIs.

Table 4.36 displays the descriptive statistics of the frequency of overall KT activities carried out by researchers based on their length of service in the NARIs and Table 4.37 shows the Kruskal-Wallis test results for the researchers' length of service.

Table 4.36: Descriptive statistics of the frequency of overall KT by length of service in the research institutes

Ranks				
	Length of service	N	Mean Rank	Median
Researchers' overall KT	< 10 years	293	210.74	3.00
	10 - 20 years	92	219.60	3.00
	> 20 years	51	261.09	4.00
	Total	436		

Table 4.37: Kruskal-Wallis test results for the researchers' length of service

Test Statistics[a,b]	
	Researchers' overall KT
Chi-Square	7.865
df	2
Asymp. Sig.	.020
a. Kruskal Wallis Test	
b. Grouping Variable: Length of service	

As shown in Table 4.37, there is a significant difference in the frequency of overall KT activities by researchers with different lengths of service in the NARIs. A pairwise comparison test revealed that the frequency of KT activities undertaken by the

researchers who have worked in the NARIs for less than ten years (<10years) is significantly less than the frequency of KT activities done by the researchers who have worked in the NARIs for more than twenty years (>20years).

12. H_{02F} – there is no significant difference in the frequency of overall KT activities undertaken by the researchers in the different research institutes.

Table 4.38 displays the descriptive statistics of the frequency of overall KT activities carried out by the researchers in the different research institutes and Table 4.39 shows the Kruskal-Wallis test results for the researchers in the different research institutes.

Table 4.38: Descriptive statistics of the frequency of the overall KT activities carried out by the researchers in the different research institutes

Ranks				
	National Agriculture Research Institutes	N	Mean Rank	Median
Researchers' overall KT	NIHORT	40	214.93	3.00
	NIFOR	35	201.11	3.00
	RRIN	17	203.00	3.00
	NIFFR	37	195.19	3.00
	NIOMR	22	207.59	3.00
	NAPRI	19	160.00	3.00
	NAERLS	21	219.43	3.00
	IAR	24	215.63	3.00
	CRIN	33	224.30	3.00
	NSPRI	49	236.43	3.00
	NVRI	34	193.65	3.00
	NRCRI	38	187.74	3.00
	IAR&T	43	307.47	4.00
	LCRI	12	296.08	4.00
	NCRI	18	262.50	4.00
	Total	442		

Table 4.39: Kruskal-Wallis test results for the researchers in the different research institutes

Test Statistics[a,b]	
	Researchers' overall KT
Chi-Square	43.028
df	14
Asymp. Sig.	.000
a. Kruskal Wallis Test	
b. Grouping Variable: National Agriculture Research Institutes	

Table 4.39 shows that there is a significant difference in the frequency of KT activities undertaken by the researchers in the different research institutes. A pairwise comparison test showed that the frequency of overall KT activities carried out by the researchers in IAR&T is significantly greater than the frequency for researchers in NAPRI, NVRI, NFFRI, NRCRI, NIHORT or NIFOR.

4.19 Chapter summary

This chapter presented the results of the descriptive and inferential statistical analyses carried out on the data collected using the questionnaires concerning the agriculture researchers' demographics and KT activities. It showed that there were twice as many male researchers as there were female agriculture researchers. Many of the researchers were between 31 to 50 years of age, and more than half of the researchers had worked in the NARIs between 1 to 10 years, and about a tenth of the researchers were directors. Majority of the researchers indicated that they carried out KT targeted at the policy actors in the FMARD "occasionally", while more than 50 percent of the researchers had carried out KT targeted at farmers frequently or always. The most popular KT activity was providing reports, and funding was the top ranked barrier noted by more than 50% of the agriculture researchers.

Chapter 5

5 Findings from the interviews with researchers

5.1 Introduction

This chapter presents the findings from the interviews with the researchers in the agriculture research institutes concerning their KT activities, especially to the policy actors in the FMARD. Fourteen individual interviews and three focus group interviews were held with a total of 22 researchers from the NARIs. Recurrent themes are illustrated with some quotes from the original text for emphasis.

5.2 Type of research carried out at the NARIs

All the interviewed researchers talked about the type of research studies that are carried out at their research institutes. It is noteworthy that all the researchers mentioned that they carried out research studies in line with the research institutes' mandates. The following quotes are examples of what the researchers said about this:

> *"...part of our mandate is to survey the inland water bodies across the federation. We restrict ourselves to our mandate*."
>
> "*…as the name suggests that we carry out research on storage; that means how one can extend the shelf life of agricultural products, all forms of agricultural product. So, that's what we do. That's preventing it from destruction, from damage by pests and diseases or any agent of spoilage. We basically do research on post-harvest of agricultural produce. We research into house hold facilities for preservation or in extending the shelf life of such*"
>
> "*...we will not deviate from our underlined mandate…*"

However, some of the researchers articulated more about the type of their research than what is specified in their respective mandates. These included research studies into

specific sponsored or customized projects for the unique benefit of individuals or farmers. Two of such responses are illustrated below:

> "*…there are some other proprietary projects that we undertake here, like somebody wanting to bring in a product through his company, he will give it to us, we will do research, we will look at it, then we can recommend it if those products are good for them to be used.*"
>
> "*…because farmers are at the background of our minds, any research we are turning out is how to develop technologies which will be applicable to farmers, and not just basic research as is being done in universities. I am talking about extendable research, the research that can get back to the farmers or the young entrepreneurs. Those are the types of research that we undertake here.*

A few researchers also noted that the researchers in their institute carried out basic agricultural research, also called pure research or fundamental research studies, for better understanding of some aspects of agriculture and to increase the scientific knowledge base on their agricultural topics. An example of a researcher's comment on this is given below:

> "*We have the core research…we have also the basic science research, like the microbiologists, the entomologists, the biochemists, and when these people develop a procedure or a protocol on how to preserve food, we suggest this to economic evaluation.*"

5.3 Relationship between NARIs and FMARD

The interviewed researchers attested to different types of relationships between their research institutes and the FMARD. The most common relationship indicated by sixteen researchers was that the research institutes were parastatals under the FMARD. At some point during the interviews, it became apparent what researchers meant by them being 'under' the FMARD. It meant that the FMARD had supervisory capacity over the

NARIs. 'Under' also meant that the FMARD coordinated (some of the activities of) the NARIs. The following quotes are some of the ways the researchers described their relationship with the FMARD:

> "*We are one of the parastatals under the FMARD*"
>
> "*The FMARD as a ministry is only a coordinating body*"
>
> "*…the ministry is our parent body*"
>
> "*…we are under the FMARD. But we are a department under them… definitely we are under the ministry, so they are our umbrella body*"
>
> "*It's a direct link, we are under them, they promote us, everything; recruit staffs, they manage us, so we are answerable to them. You know, they are like our boss… yes they are our boss.*"

'Being under the ministry' also meant that the FMARD controlled the NARIs' funds. This was noted directly or indirectly by some of the interviewees from the NARIs, and this is vividly illustrated in the quotes below:

> "*…without them, we cannot have any fund from the Federal Government. So we report to them, they get funds from the Federal Government for us. That's how it works.*"
>
> "*…they manage our budget, we propose our annual budget to them on what we want to do and so they in turn send it to the Federal Government. So, all agric research institutes present their budgets to the ministry, then the ministry will now present it to the budget office*"
>
> "*…usually what we do is that when we prepare our budget, the ministry would go and defend the budget, what would be given to the ministry. And then usually… because the ministry would have been told, this is what we are giving to you as a ministry including your own parastatals. We are giving it X amount. So the ministry would now decide that for each of the research institute, this is the envelope we are giving you. They call it envelope, so we are giving you… let's say a hundred million, for example. So you go and make your budget based on a hundred million. So the government gives ministry limit of how much they can spend in a year, the ministry now say "ok, you take this, you take this, go and make your budget based on this amount.*"."

A few of the researchers mentioned alternative sources of funding for their research and KT activities. The two quotes below illustrate other types of funding available to researchers in the research institutes:

> "*…in some cases, we make proposals, in line with foreign donors. If there is a grant, we compete for grants. We also have some funding from other agencies like CORAF. I think you have heard of CORAF? WECARD is the English version, West and Central African Council for Agricultural Research and Development in Senegal; but the CORAF is the French acronym name for that. What they do is to see how they can develop commodities to enhance its market value; they also help us most especially at the post-harvest level*."

> "*Dr. XX here is in charge of our West African Agricultural Productivity Programme WAAPP, it is a World Bank funded project*"

5.4 Initiator of research agenda for the NARIs

Given the general acknowledgement that the NARIs function 'under' the FMARD and are funded by the FMARD, it became important to find out who then determined the research agenda for researchers in the NARIs. Reports from the interviews (and focus group discussions) found that although most researchers admitted that the FMARD provided all their funding, only a couple of interviewees stated categorically that the FMARD determined what research studies were conducted at their institutes. The research agendas of the various institutes were to a greater extent set internally by the researchers in the institutes in accordance with mandates given to them by the Federal Ministry of Agriculture. However, as noted in the following quotes, once in a while, the FMARD approaches researchers in the institutes with special research requests.

> "*The federal ministry, sometime ago… they want us to research on crops like palm oil, rubber, cotton, rice and tomatoes, they discovered that most of them waste a lot, like rice, they do not import more of it from abroad. So, to help*

> *producers on what can be done to improve the shelf life of the crops, or to have the crops in abundance and increase the production; so we were told that anything we want to do must be in this line*."

> "*…there was one time there were some cocoa beans that were being mouldy, and the minister heard about it. The minister sent down a mail to us for us to work on it.*"

Other than the infrequent research requests sent by the FMARD, the prominent determinants of the research agendas of the NARIs were the administrators / management of the NARIs and the researchers themselves. The following quotes illustrate that the research agendas of the NARIs were set internally by the researchers in the NARIs:

> "*…we have what we call the Research and Technical committee within the research institute, it is their responsibility to sit down and look at the mandate of the institute; if we want to do any research work, we have to center it on the mandate, for example, what are the problems on ground*?"

> "*How we define it is through our in-house meetings. And interestingly, the ministry is supposed to be in attendance during the in-house meetings. But the major stakeholders, the major participants, those who will actually be talking will be the members of this system here*."

> "*Individuals are expected to research. For individual researchers, they are asking us to specify our areas of specialization; they expect us to work, even if nothing is coming from up; they expect me to do research and produce paper that may impact our community. Like me, they expect me to do research in fruits and vegetables because that is my specialty*."

> "*…we generate our own research ideas from what we call annual research review meetings in the research institute*".

The interviews with the researchers also revealed that some other factors decisively influenced the research agendas of the NARIs. These ranged from the researchers' observed needs, needs of the Nigerian farmers, farmers groups' requests, or previous research findings as illustrated in the following quotes:

> "*…our research studies here are demand driven. Like farmers that have problems with their crops. They come here; we have a crop production unit. They go there,*

do survey, take sample, come and analyse the problem at the department, brainstorm and come out with a rigid, lasting solution for the problem"

"*…we have our researches in twofold, we have individual research, which more often than not are demand driven. Even… you are going out… you saw a need and then you now make some interviews because there is something we call participatory rural appraisal, which means that you want the people to... the end-users… the supposed end-users to tell you what their challenges are. So from there a research could be initiated.*

"*…we invite our farmers groups, rice or other crop marketers, we invite even policy makers, and we invite so many interest groups along the value chain of crop specifics to the institute. We present to them our research findings for the year, and they ask questions and they also give us input on their observations and their challenges on the field and we build it into our research agenda. That is our way, the way we get those research ideas. And that will not stop us from doing our basic researches, but we always take this as priority researches*"

5.5 Transfer of research findings to the policy actors in the FMARD

All the researchers interviewed indicated that the findings from the agriculture research carried out at their NARIs were transferred to the FMARD. The most popular mode of transfer mentioned by many of the researchers was the NARIs' annual reports. The following quote succinctly makes the point:

"*…well every year, we are expected to submit our annual report to the ministry, but sometimes, they ask for specific information, maybe within the year or after some few years and that we will have to collate and give to them. The annual one is like a mandatory summary of what has been done this year*"

In addition to the annual reports, the research institutes often submit other written reports to the FMARD as indicated below:

"*There are other reports within the year that we are supposed to submit to the ministry, and that we do regularly, by so doing they are updated to know what we are doing here; what are the prospects; that is beyond what we have done, what are the challenges; why we didn't achieve as much as we desired. So, there are regular reports in writing which we submit to the parent ministry*"

Nearly all the interviewed researchers noted that it was the responsibility of the executive director to transfer the research findings generated from the NARIs to the FMARD. Nevertheless, three interviewees (including a director of research) noted that it was the director of research's responsibility to relate the NARI's research results to the FMARD. Interviewees also indicated that the research findings from the NARIs were normally sent to the office of the minister for agriculture in the FMARD. A few of the interviewees noted that the reports sent to the FMARD usually included all the NARIs activities (both research and otherwise) of the previous year.

Researchers also implied that the reports sent to the FMARD were somewhat mandated or expected, and were simply an 'FYI' for the policy makers in the FMARD, as illustrated in the quotations below:

> "*…in the annual report, we indicate all research works, we give a resume, a kind of summary of what has been carried out, and the results. We also have progress report so that they know what is going on*"
>
> "*…there are other reports within the year that we are supposed to submit to the ministry, and that we do regularly, by so doing they are updated to know what we are doing here*"

However, it appears that in some cases, researchers considered sending the report to be KT, since to them this practice was carried out with the expectation that their research findings will be useful for decision making by the policy actors in the FMARD. This is illustrated in the quotation below:

> "*…it is supposed to inform them (the FMARD)… because they review the agricultural policies from time to time. So it is this type of information that they are supposed to use. For them to say ok, these are the results, these are the problems, how do we move forward. That is the ideal thing*"

Also, a researcher noted that the reports to the FMARD included implications for policy from the research studies. According to this researcher:

> "*…our annual report includes implications for policy because we need to include that one to tell them that maybe some limitations you are facing… it should be there. If there are some other things that you still want to get done, it will be included there also so that they (the FMARD) are aware of what you are facing*"

A few of the researchers mentioned that they had received requests from the FMARD for their research findings. According to one of them:

> "*…they (the FMARD) send requests, sometimes quarterly too or twice in a year. I am not sure now how regular it is. But it is usually sent to the planning department. It is sent to the institute, the director now sends it to the planning people to collate everything and send out.*"

The reports sent to the FMARD by the researchers in the NARIs were not without some outcome. As noted by these interviewees in the quotations below:

> "*…for example when the avian influenza problem came up, we did the diagnosis and sent the report to the ministry. They then set up a committee on how to control the disease. So the policy the government now made was on advice from our research institute, to now say look we want to vaccinate or we don't want to vaccinate, or we want to do test and slaughter.*"
>
> "*...and then when we develop vaccines, we say these vaccines are available for vaccination. The government now say ok look, we are going to draw up a policy that there has to be annual vaccination campaign for this disease, this disease, this disease. And sometimes they buy the vaccinations and give to the farmers to use in vaccinating against those diseases*"
>
> "*…all the policies under fisheries are informed by the activities carried out with fisheries research. For instance, the regulations on fishing, encouragement to go on culture fisheries, and the aqua culture practises now that are emerging all over the country are as a result of the researches conducted here*."

5.6 Events that bring researchers in NARIs in contact with policy actors from FMARD

Apart from the annual reports which researchers at the NARIs send to the FMARD, some interviewees also talked about other events that brought researchers in contact with the policy actors at the FMARD. These events were considered to be a chance for knowledge sharing between researchers and policy actors. Conferences, seminars, and (committee) meetings were mentioned by a few researchers as opportunities through which their research findings were transferred to the policy actors in the FMARD. Other events were agricultural trade fairs and World Food Day while workshops were mentioned by a couple of interviewees. Below are a few quotes addressing this issue:

> "*The ministry used to organize what they call value chain meetings every year, and those value chain meeting… we are the key participants… like if their interest is rice, they bring researchers, extension agent, every interest group, in the rice value chain to discuss challenges and to seek proper solutions and possibly where can government come in… and that sharpens the direction of the policies*"
>
> "*We do through Agricultural Trade Fairs, World Food Day, seminars and workshops*."
>
> "*We have the Fora, called annual cropping skill*."
>
> "*…there are meetings we attend; policy meetings where we make our input*"

While some researchers noted that some of the meetings where they had the opportunity to interact with the policy actors were organized by the FMARD, some others noted that the research institutes also organized meetings that brought them in contact with the policy actors for knowledge translation. An example of such allusion is described in the quotation below:

> "*…in the course of our own implementation here, it becomes necessary to hold workshops for these things. Where farmers or end-users, it is not only farmers, we talk of those in the producing industry, they are also there; where end-users, with*

> *the institute, and the parent ministry are brought together; because mostly when the ministry organises a meeting, they will not call the end-users, because it not their business. But when we call a meeting the end-users would be there, the policy makers, that is, the parent ministry will be represented and then we have a tripartite interaction. By so doing again they know what we are doing, they know the challenges even presented by the end-users which can reflect on the next policy document. So, these are the areas of interaction that enables the parent ministry to know what we are doing, the prospects and challenges."*

Some researchers also implied that their interactions with policy actors from the FMARD at meetings were quite productive in suggesting policy directions as stated by the interviewee below:

> "*…when they meet in Abuja and we are invited on policy issues we are there to make our input. And that has been very helpful in letting them know these are perhaps new areas of interests in the industry, these are challenging areas that need to be addressed*."

It is also noteworthy that although some researchers indicated that they thought their research output could be used to inform agriculture policy making in Nigeria, some other researchers seemed not to be concerned about the policy relevance of their research; it appeared that the policy implications of their research findings were not something these researchers had given a lot of consideration to. Below is a quotation from one researcher that implied this:

> "*…we can make input to policy and eh...we can make a draft and initiate. But the policy formulation comes from the ministry. They can involve us to make our own input. Because if there's anything on postharvest, what is expected is that we should be involved, we should be consulted. At least they will say this is an expert in this area. And the expert in that area should be able to… advise on that area.*"

5.7 Other non-FMARD target audiences for NARIs' research output

Considering that the NARIs are agricultural research institutes set up for the agricultural development of Nigeria, researchers talked a lot about other target audiences as potential users of their research. Farmers were the most commonly noted target audience for the research studies carried out at the NARIs. The quotes below demonstrate the pre-eminence of farmers as the primary target of the NARI's research output:

> "…*our number one focus is farmer*."
>
> "*We carry out our research studies for onward transfer to the farmers*."
>
> "…*the research results are disseminated to the farmers to improve their lots*."
>
> "*I think major target of our research is the resource poor farmers*"

The state Agriculture Development Programmes (ADPs) were also noted as a target audience for the NARI's research output as illustrated in the quote below:

> "*...then, when we publish, it is distributed to the ADPs, it is distributed to the state ministries of agriculture, it is distributed to the ministry itself*."

The ADP is an approach to rural development in Nigeria with an objective to boost agricultural production as well as contribute to rural livelihood and food security (Ugwu, 2007). The production and manufacturing industries, as well as the general populace were also mentioned by some researchers as prospective target audience for their research output. A few quotes alluding to these are as follows:

> "*General public, including market people, farmers; there are also individuals that go into field mill and store produce according to seasons, like poultry people, they store produce during seasons… when it is off season the price spike. Even housewives too, because they store produce, though not like field farmers*"
>
> "*End-users are any stakeholder in agric, even the marketers, food marketers, food consumers, so... general public, even people that transport food*."

> "…*so the actual end-users are those in the industry, and in the industry we talk of upstream and downstream sector. The upstream sector is what we call the agric or the agro based sector of rubber industry. The downstream sector is the industrial sector of the rubber industry*"

5.8 Other KT activities done by researchers

Respondents mentioned a few KT-related activities that they carried out to disseminate their research findings to their potential target audiences. In all but one of the cases, the recipients were the farmers. One of these activities is the Research Extension Farmer Input Linkage System (REFILS), a knowledge transfer activity organized by the NARIs. REFILS was established to ensure effective agricultural research, extension and input delivery services for farmers to increase and sustain agricultural production in various states in Nigeria (Ironkwe, 2010). The general focus of the REFILS programme is sustainable farming system research and extension for effective adaptation and dissemination of improved technologies for enhanced livelihood along the agricultural commodity value chain in various states in Nigeria. Some researchers also mentioned that they transferred their research findings to farmers through organized vocational trainings and workshops. These are exemplified in the quotes below:

> "…*we provide vocational workshops that are organised for training workshops, organised for the end-users of any area of research that you have discovered, even including the old ones too, that are from some survey done, we normally discover that even the ones we have on shelf have not gone to some places. So if those ones are yet to get to a place, we will move it to a place through a workshop. If there are new ones too, we will organise a workshop for stakeholders*"

> "…*through our workshops, through our in house trainings, people come here for trainings. We train farmers, through that they get to know what we are doing. But some farmers, we go out to train them. Some of them are being trained in their own localities, and they are being trained even in their own dialect*"

Demonstration plots were also used as KT means to reach farmers by the researchers in the NARIs as noted in the quotes below:

> "*…and a lot of demonstration plots, some of them will organize demonstration plots for them and our applied research, we show them how to get it done by them seeing it. We call it farmers' participatory approach. Let them know how to get it done. It is a like a do-it -yourself approach, that is learning by doing. That is what they mean by participatory. They learn by doing it themselves.*"
>
> "*…sometimes, we have the demonstration plots among them, in the farmers' fields and they do it themselves. Like this our hybrid now, they plant it themselves, we show them that this is how to get it done, and they do it themselves and monitor themselves. So that they can compare: what have they been doing with what have we brought to them?*"
>
> "*We have some other dissemination pathways like the demonstration plots over there where our visitors can come and visit.*"
>
> "*Then the next one is cost effective fish processing gains, and the general translation of all those things is the establishment of adopted villages and these adopted villages all these technologies are show case there for process and result demonstration which we have in some villages already.*"

Researchers in the NARIs equally mentioned that they organized exhibitions and agriculture shows as a means of extending their research findings to farmers. This is typified in the quotes below:

> "*…then some of the things we do are extended to the public or farmers during exhibitions, agric shows. Then once in a while we also have open days where we display the things that we do, pictures, summaries of research findings in form of posters.*"
>
> "*…when we go for outreach we do exhibitions too, like farmers field day, we do train farmers, when you interact with them they love it, we showcase the technology relevant to them, the way and manner it works.*"
>
> "*…an exhibition room, we are trying to put on as one of our dissemination pathways.*" "*…and most of the time we are doing exhibition, we normally go with those birds.*"

Researchers noted that they also used manuals to transmit their research findings to farmers as depicted in the quotes below:

> "*…another thing though, we even have some illustrative manuals for them because we know that some of them cannot even read, but when you make everything pictorial, they can understand what you are saying just by looking at the pictures.*
>
> "*And I told you that we go there with our manuals and this time around, also with illustrative manuals. Illustrative manuals that are full of photographs or what have you that farmers can learn on their own.*"
>
> "*…we have banners to show our products, and we have CDs which we produced into videos for farmers to buy as a training manual for each of these sessions*"

The broadcast media was not left out as a medium for KT for agriculture research knowledge in Nigeria. Few researchers talked about disseminating their research results via broadcast media as illustrated in the quotes below:

> "*Once in a while we go on radio, once in 6 months we go on radio but it is too small*."
>
> "*…we have radio programmes. We have radio programmes in Hausa; one programme is being broadcast through the FRCN in Kaduna, and then another one in Yoruba through the FRCN in Ibadan. And then we have one in Igbo and Pidgin English which is in FRCN Enugu. They are not very regular because of funding problems."*

Publications were also acknowledged as a medium through which researchers in NARIs translated their research findings to potential target audiences as shown in the quotes below:

> "*That is why some people, after their findings they try to publish so that it will move faster*."
>
> "*…from publishing them in journals and the rest and they make it very mandatory for us as researchers to publish or perish… so if you don't publish, you remain where you are"*

5.9 Responsibility of knowledge translation in the NARIs

The interviews revealed that 'who' was responsible for KT in the research institute depended on who the target audience was. Some of the researchers explicitly implied that it was the duty of the researchers in the research extension department to transfer research findings from the NARIs to the potential target audiences, who were farmers in most cases. But in the case of policy actors at FMARD, researchers generally expressed that it was the responsibility of the executive directors of the NARIs to transfer the reports of research findings from the NARIs to the FMARD. A few quotes exemplifying these are as follows:

> "*…it's such a way we have a department that is responsible for dissemination that is the socio economics and extension division, it is their main or major responsibility to disseminate all the information. It is the socio economics and extension division work to disseminate, to see whether this information or findings is being implemented by policy makers*"
>
> "*…individuals don't disseminate information directly to the fishermen, they have to route it through the socio economics department*"
>
> "*So it's the extension outfit. But don't forget that under the extension we still have what they call SMS, that's subject matter specialist. The researchers that are specialized in there will go along to go and train the farmers. So who go along, they train them, practicalize it… how it can be done to them. They will see it themselves and adopt it themselves. And apart from that the other way we always do is that we have a place here where we can train farmers*."

5.10 Motivation to carry out KT activities

Some of the respondents talked about their motivation to do research and undertake KT activities. For the majority, it was because the NARIs are funded to carry out research; they carried out research and KT to be accountable for time and money. Recognition was

also mentioned by one researcher as an inducement to carry out research and KT. This researcher stated that:

> "*…whether you like it or not, many of these farmers are with cooperatives, all these have a feedback (a way) of getting to the ministry again that ooh CRIN is working. It's not just based on our attestation at the ministry, other agencies relate with them, cocoa association of Nigeria relate with the ministry, they are a private establishment but they still relate to the ministry and say ooh look CRIN is working, CRIN is working. And by that they are passing feedback about us*."

5.11 Funding problem as a major barrier for research and KT activities

Funding was reported by some of the researchers as a major issue that inhibited their research and KT activities. This is illustrated in the following quotes:

> "*…at times we are given money to do the work but when it comes to advocating, going around places they will tell you they do not have*."
>
> "*The radio programmes are not broadcasted very regular because of funding problems. Sometimes if we don't pay, of course they will stop until we are ready to pay. You know being a government establishment with all the problems of funding now*."
>
> "*…we still have that problem in Africa of how to disseminate some of our breakthrough, because they are very costly to disseminate*."

5.12 NARIs' support for KT activities

The two quotes below are examples of what researchers noted concerning the types of support their NARIs provided for knowledge translation activities:

> "*The research institute has five technical department, one of the department is the extension arm, which is scheduled with the transferring all the knowledge, technologies and everything to the end users*."
>
> "*…we have our extension arm, it is regularly funded, and hmm… we partake in monthly technology review meetings, hmm… then we attend conferences and show case what we are doing. The research institute funds these. We also attend exhibitions and the rest*"

5.13 Chapter summary

This chapter presented the findings from the interviews with the agriculture researchers. The interviews were carried out in order to supplement the data collected using the questionnaires. A total of 22 agriculture researchers were interviewed from the 15 NARIs. And consistent with the findings from the questionnaire, researchers revealed that the most popular method of KT to the policy actors was through the NARIs' annual reports, which were typically sent by the directors of the NARIs. The researchers also identified funding as a major barrier to their KT activities to policy actors and other target audiences.

Chapter 6

6 Findings from the interviews with the policy actors

6.1 Introduction

Agriculture research findings can enhance agriculture policymaking, but to date no research exists on the use of research knowledge for agricultural policymaking process in Nigeria. This chapter of the study explored the views and practices of the policy actors in the FMARD, regarding their use of research knowledge generated from the NARIs for policymaking. A total of 14 individual interviews were conducted with the policy actors in the FMARD. Findings are presented in sections, and recurrent themes are illustrated with some quotations from the original text to complement the meaning.

6.2 Relationship between the FMARD and the NARIs

While speaking about the NARIs, some of the policy actors alluded to the types of relationships they (and their departments) had (or expected) from the researchers in the NARIs. The policy actors implied that the NARIs were established to meet the research needs of the FMARD and that the FMARD has a supervisory role to the NARIs as shown by the quotes below:

> "…*we control them, they are under us. We do not decide their research agendas, but we approve some of the things they do in terms of budget. When they do their budgets, they bring in their budget proposals here, and we look through it before we forward to the federal government. So in essence, we know what they want to do, where they are looking at in terms of research areas, and we also give them directions*."

> *"…those research institutes they were established to meet the immediate needs of the ministry through research, their research findings."*
>
> *"…the research institutes are under the ministry, the ministry supervises their work. Although not directly, but through the Nigerian Agriculture Research council which coordinates the affairs of the research institutes, and the ARCN is supervised by the ministry. The ministry also provides funding to the institutes. The institutes prepare their budget for the year, incorporating the different projects that they want to embark upon. This budget is then defended before the ministry. The ministry will then accept or reject some projects depending on the resources available because, because the ministry cannot use all the resources they have to fund only research projects in the research institutes. The projects that are approved are then included in the ministry's budget and sent to the minister of project, and this budget will also be defended. Then, in terms of policy, the ministry formulates policy guidelines, and these guidelines that will direct what the research institutes do. All we do is that this ministry supervises the research institutes.*"

However, a few of the policy actors did emphasize that they and the researchers at the NARIs were partners in satisfying the needs of the farmers as well as promoting the development of Nigeria. This emphasis is illustrated in the quotes below:

> "*…the main aim of the institutes is to carry out research and evaluation, and produce results that will help the local farmers growing such crops in the area in terms of new innovations, new techniques, improved varieties all aimed at improving their produce output and outcome."*
>
> "*…and the whole idea is to put some of these research findings into proper use; so that they don't just end up as research findings but they must be implemented for the betterment of the Nigerian farmer*."

6.3 Policy making role and sources of input into policy making

Interviews with the directors, deputy directors and assistant directors in the FMARD confirmed the assumption that these persons were in positions to formulate agriculture

policies as all the interviewees confirmed that their roles in the ministry included policy formulation. Examples of the policy actors' comments concerning their policy formulation role are as follows:

> "… *This is the brain child of policy formation*. "
>
> "… *formulating policies is the core thing that we do*."
>
> "…*I support the various policy development in the Federal Ministry of Agriculture and Rural Development*."
>
> "…*Policies are formulated here in animal production and husbandry services, and it has to key into the agric policies of the ministry*."

Concerning the types of inputs that inform agriculture policies, some policy actors acknowledged that research knowledge was considered in agriculture policy formulation process. Some of the policy actors mentioned making research requests to researchers in the NARIs. Examples of the types of requests are:

> "…*another typical one is for them to improve that of wheat. Because when we started producing wheat before, we did not have the comparative advantage. But we asked the Lake Chad Research Institutes to do it and they came out with a very good variety that is producing more. Then also we also discovered that there is a lot of poverty and malnutrition in the North Eastern part of the country and the north western part of the country. We also requested them to do research for us since the cheapest food people eat there is maize. So we requested them to do a research that will produce high lazin maize. Lazin is a proteinous substance; we want our maize to be fortified with lazin. So that by the time an average child in the North East or North West is eating a high lazin, he is actually eating a balanced diet and we would have avoided malnutrition. They have also done for us bi-fortification on Irish potatoes…"*
>
> "…*initially our mandate crops were just maize sorghum and rice. So when we wanted to go into things like rice and cowpea, we discussed with them (NSPRI) to see if we can, because cowpea - beans is difficult to store because of the pest. So we now give them an idea, if they can give us small small technology that the farmers can actually adapt and actually they have been doing very well in terms of those things*."

In addition to the direct research request, some of the policy actors noted that they received research findings directly from the researchers in the NARIs. However, one policy actor noted the research results were sent indirectly through another agency, ARCN as indicated in the quote below:

> "*…not us. I think most of their research outputs are sent directly to the ARCN. I cannot say for certain how often, because most of their results are sent first to the ARCN. The results are usually not sent directly to the ministry; however, if there is anything that has to do with a particular department, it could be sent directly."*

The policy actors noted that the research results from the NARIs usually came in form of written reports. A sample of such statements is given below:

> *"…it is a report, a report of the outcome of the research; hard copy reports, no electronics; we are yet to go on electronics."*

As per frequency of the reports, they did not get to the policy actors on regular basis as noted in the comments below by a few of the policy actors:

> *"…it is periodic. Research is not something that you do every year and get results. So they can get a new thing out after three years, they will tell you just a little thing, do it this way do it that way, stop using this agro chemical, use that one we have discovered... you know output of research trickles in."*

> *"…well it's not regular reports particularly when it is attached to a request that we can discuss with the management, and they would pass it through the department and the management will administer the call for the director or who so ever and they can handle it or they may use that and meet with the perm sec and the director and the minister and then the research institutes executive directors."*

In addition, a couple of policy actors mentioned consulting research output from non-agriculture based research institutes in Nigeria, e.g., Nigeria Institution of Social and Economic Research (NISER) and the International Institute of Tropical Agriculture

(IITA), Ibadan, Nigeria. Other sources of input into agricultural policies in Nigeria, as noted by the policy actors and indicated in the quotes below, include experts, stakeholders and the government.

> "*…and what we did was that we brought in professors from different universities that have to do with agriculture and economics. Call them professors or experts, because some were not professors, but they were doctors. Some were from within Nigeria, while some were from outside Nigeria, but they are Nigerians. So they came together to review the agricultural policy…*"

Another source noted by the policy actors is stakeholders. This is illustrated in the quote below:

> "*…because of the Nigerian situation, we get the information either from people who are actually on the field, because we don't have data, there is paucity of data in the country. So, either from the farmers, or from stakeholders, people in the business*"

And a third source for agriculture policy making is government, as shown in the quote below:

> *"…basically our policies are to drive government agenda, whatever government wants to do. Then all we need to do is sit down and see what are the kinds of policies that would make us to be able to achieve that agenda or that objective of whatever government decides."*

6.4 Policy actors' use of research findings from the NARIs

Concerning whether policy actors have referred to the research output from the NARIs in the context in which they worked, some interviewees hinted that they had at least once used some research findings from the NARIs in the past three years for diverse reasons. However, only a few cited specific instances of use of research result from the NARIs

and just two of them indicated that they had read research reports from the NARIs. The following quotes illustrate their use of research from the NARIs:

> *"…based on their (NVRI) own analysis, and patho-genetic analysis of this avian influenza episode, they (NVRI) now realised it was a different stream from what happened in 2006. We used that information and now it has also set the tune for us to be able to plan appropriately on how to tackle the present problem we are in now."*

> *"I talk to IAR the most because IAR carries out the analysis on fertilizer samples and also field trials for the different grades of fertilizers. We work with them on a continuous basis. So when I want to know which one is most suitable to which part of the country, I use the results of fertilizer trials from IAR."*

> *"…all the production practices that we recommend in this department (FDA) are from the findings from the research institutes… for example using Cassava, research findings from National Root Crop Research Institute Umudike have produced a lot of varieties of cassava, but the most recent varieties of cassava that we grow: TMS3027, TMS 30572, TME419 are the latest varieties of cassava that are being put up for the cassava HQCF because of their growth characteristics. This is the type of variety that we recommend to the farmers, and we will want them produce for future farming*."

> "*…I will say we rely on results from the institutes. All aspects of REFILS – Research Extension Farmer Input Linkage System has to do the research findings from the different institutes. Whether is on cotton, oil palm, rice, cowpea, or tomatoes. They are all what they (the researchers in the research institutes) have told us to do. Like all the practices for instance are recommendations from the findings from the research institutes. We don't have any technologies we drive on our own; they are all from the research institutes. There is nothing that we are doing that is not recommended from the research institutes*."

6.4.1 Research studies from the NARIs meeting the priorities of the FMARD

Some of the policy actors mentioned how much the studies of the researchers in the NARIs meet the priorities of the FMARD, which are the needs of the Nigerian farmers. For instance, some noted:

> *"…in recent years, they are very much in line with the ministry's priorities. Like at Umudike, we are looking at having bio-fortified crops, not genetically modified crops."*

> *"…well you see, the research institutes going by their name 'research' develop studies based on what they feel are the needs following an initial needs-assessment. It is from the results of these needs assessment that the institutes tailor their research focus."*

However, some policy actors noted that they did not use the findings from the NARIs because the research studies carried out in the NARIs did not address the agricultural priorities set by the FMARD or the Nigerian farmers' needs. Some policy actors implied that some researchers in the NARIs carried out research studies to meet researchers' own personal needs and for publications to get promoted. These policy actors speculated that because the research institutes are considered as academic institutes in Nigeria and a researcher's promotion is dependent on the individual's number of publications, some researchers carried out studies for publications only. The quotes below buttress some of these points made by the policy actors:

> *"…most of the research we get from the institute is not tailored to what we can use in our value chain."*

> "…*most of the research outcome are been carried out to get promotion, because before you can be promoted as a lecturer or researcher, you must do research*."
>
> "…*let me tell you this, before 2011, when the new minister assumed office, the research studies at the agricultural research institutes were supply driven – for promotion and other benefits- rather than demand driven*."
>
> "…*well, initially I must confess it does not seem to address our priority because that is the naked truth, because the research is not been carried out with our needs. If they had come to us, this is our problem. And that is major problem we have in Nigeria, people research on whatever they like. Like Nigerian Cereals Research Institute Badeggi, the Root Crops Research Institute Umudike, they are just on their own."*
>
> "…*although the research is supposed to be demand driven, according to the needs of the farmers. Though at times it doesn't occur in our research institutes like that, because you discover that some of the research institutes like the way you are doing now, they will go and research in favor of their personal findings*."

Another policy actor, who reported not using research output from the NARIs, noted that their work involved complex sets of activities which research knowledge generated from only one research institute could not satisfy. More specifically, he stated that:

> "…*we are talking about water, agriculture, agronomy, power supply, the processing aspect of the farm produce; so no one research institute can do all those things*."
>
> "…*you know sometimes before we get information on their research results, it doesn't tally with our budget process*."

Another reason given was that the research institutes might not be adequately aware of FMARD departments' mandates enough to carry out policy relevant research studies that might meet policy actors' needs. Some other policy actors noted that the standard of research output from the NARIs was also a barrier to using the research. The policy actors attributed inadequate funding for agriculture research for this, as noted by a couple of them:

> "…*but I will tell you the shortcomings in research institute are not the problem of the research institutes themselves, it is funding. Research requires a lot of funds, if you don't fund them, will they be using their personal resources to subsidise government activities? It is not sustainable. They need funding.*"
>
> "…*like any other organization in this country; they (the NARIs) are also bedeviled by so many problems, like the issue of funding. That is what we always hear. And I am sure you will agree with me that research is a very expensive business and maintaining research institute is also not child's play so they've also had their challenges in the recent past and it is been hampering a lot of their research activities as a matter of fact.*"
>
> "…*because sincerely speaking they are underfunded. You should know that agriculture generally is underfunded in this country."*
>
> "…*most of the research institutes are poorly funded*."

Another reason noted for the non-use of research output from the NARIs was lack of awareness by the policy actors due to non-dissemination by the researchers. This is depicted in the quote below:

> "…*let me be specific for instance, there is a tree they call Neem (Dongoyaro). The seed, if they dry it, the dried seeds, and the dried powder can actually go a long way to kill insects and pests. It is very cheap and they are all over. They (researchers at NSPRI) now did a product "Bioneemside", that is the name, it's a biological something. The Neem tree, the seed they just dry it and you know it is very cheap. So they did it, it was with them, it was not known to us until one, certain someone, one ibo man came and said he wanted to actually practicalize it and see whether it is useful. They have so much information, but it's in their shelve*s."

6.5 Events that connect policy actors with researchers in the NARIs

Different ways were given by the policy actors by which they interacted with researchers in the NARIs. One common way was at some stakeholder meeting that involved policy actors and researchers as members. This is aptly illustrated by the following quotes:

"…*we always have stakeholders meeting. We also have fishery development committee meeting, which researchers in the two research institutes are members of"*

"…*specifically we have an institute, National Stored Product Research Institute based in Ilorin, whose execute Director actually chairs a committee called it post-harvest value chain, and I am the desk officer for that, and secretary for that committee*."

"…*like I mentioned, bio safety is a committee; it is a management authority that looks after GMO introduction and bio technology. We work with the research institutes in that bio safety committee, all the regulatory bodies work in that committee so that exchange of information is shared on any product coming in as a bio technology product.*"

"…*for instance in disease investigations and disease surveillance, we have the Veterinary Institute in Vom, we jointly go out to do field activities, get the samples, when there are samples to be analysed we send it to the laboratory, they do the analysis, give us feedback and we now take decisive actions*."

"…we sat down and some researchers from the research institutes and universities to now bring all these national policies. So the policy is now in place, the National Food Safety Policy. And the policy is being run by a committee, they call that committee the National Food Safety Landing Committee, and I am representing this ministry in that committee."

In some cases, it was the researchers in the NARIs that organized events that brought researchers in contact with policy actors in the FMARD, as noted in the quotes below:

"…*the research institutes usually have meetings - fortnightly (FNTs) - what they do in those meetings is to bring all the relevant stakeholders. If they feel that the ministry or a particular department needs to have a representative in those meetings, in order to make their contributions or comments, once they know that that department is relevant to the core subject area of discussion, and then they bring us in.*"

"…*the research institutes have programmes and in the beginning of each year, you know when they are discussing their programmes, they invite the ministry's staffs and our representatives go there. They dialogue, brainstorm on the different programmes. For instance in NIFOR, as a board member, I chair the technical*

> *subcommittee and that is the arm that is responsible for research. So I know whatever they are doing and sometimes I tell them this research is not relevant to want we need immediately*."

Other times it was the ministry forming special committees and involving researchers from the NARIs as members. One policy actor specifically stated:

> *"…one that is burning right now is the constitution of four committees by the permanent secretary. One of the committees is on cotton, to revamp cotton and to see that Nigeria's cotton becomes internationally acceptable and competitive. There were saddled with the responsibility of revamping the Nigerian cotton industry, to make it meet international standards, and become competitive too. In this committee, I can assure you that IAR will be represented by at least a member; NAERLS might also have to send a representative. There is a committee on extension, and another one on live stock, cattle and animal husbandry. And these committees will have members from the relevant agriculture research institutes. In these examples, it is we now (the Federal Ministry of Agriculture) that is calling them. The ministry is calling on members of the research institutes to be a part of these committees, and brainstorm to see how to solve issues that are creating challenge and contribute knowledge from their research findings.*"

6.6 Chapter summary

This chapter presented the findings from the interviews with the policy actors regarding their use of research knowledge generated at the NARIs. A total of fourteen policy actors were interviewed. Majority of the interviewed policy actors noted that their roles in the FMARD included policy formulation. They also claimed to be aware of the research studies that were carried out at some of the NARIs, and noted that they interacted with the agriculture researchers at committee meetings. Regarding the use of the research findings generated from the NARIs in the context of their policy-making role, policy actors did not note any significant use of the research findings. Lack of relevancy of some of the research findings to policy making and the complexity of the policy making process were cited by the policy actors as the main constraints to their uptake of the research findings.

Chapter 7

7 Bibliometric and web content analyses

7.1 Introduction

The objective of this analysis was to conduct a bibliometric evaluation of the agriculture researchers' dissemination of their research output in form of journal publications. This chapter also presents findings from an analysis of documents from the FMARD's website. The data obtained from the two NARIs' websites were copied onto a Microsoft Excel sheet, and the following information were extracted: author(s)' names; title of article; name of journal; year of publication; and volume and issue number of article. First of all, an attempt was made to find these articles in Google Scholar, Scopus and then Web of Science. Out of the 264 articles for CRIN and NSPRI, 192 (CRIN = 164 & NSPRI = 28) were found with a title search on Google Scholar, while 72 (28%) were not recognized or could not be found in Google Scholar. In addition, when searched using titles, abstracts and keywords on the Scopus database, only 23 of the articles from CRIN were found. Similarly, 12 artcles were found in Web of Science, when searched using article titles. As shown in Figures 7.1 – 7.3, not many of the researchers' articles could be traced in Scopus and Web of Science, as compared to those indexed in Google Scholar. And so, the bibliometric analysis of researchers' publications will be based on Google Scholar.

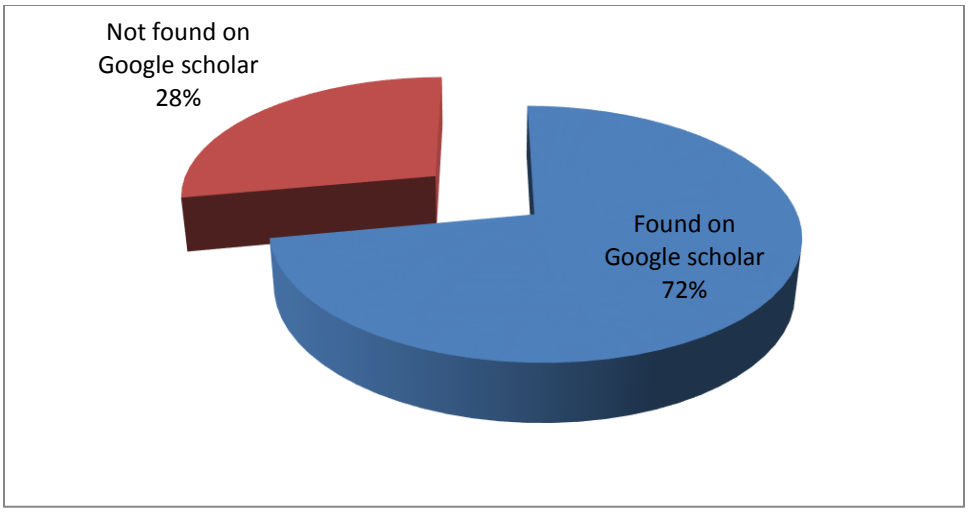


Figure 7.1: Proportion of researchers' articles found on Google scholar

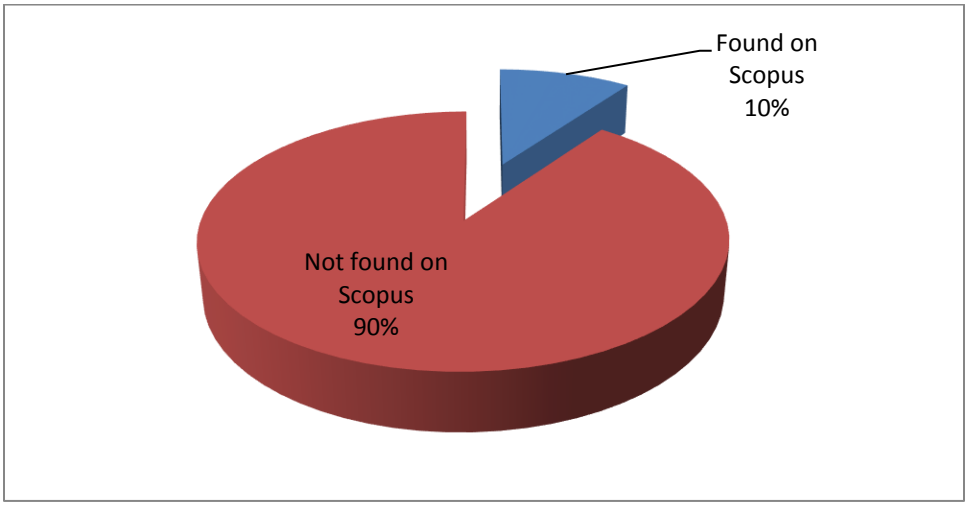


Figure 7.2: Percentage of NARI researchers' articles found on Scopus

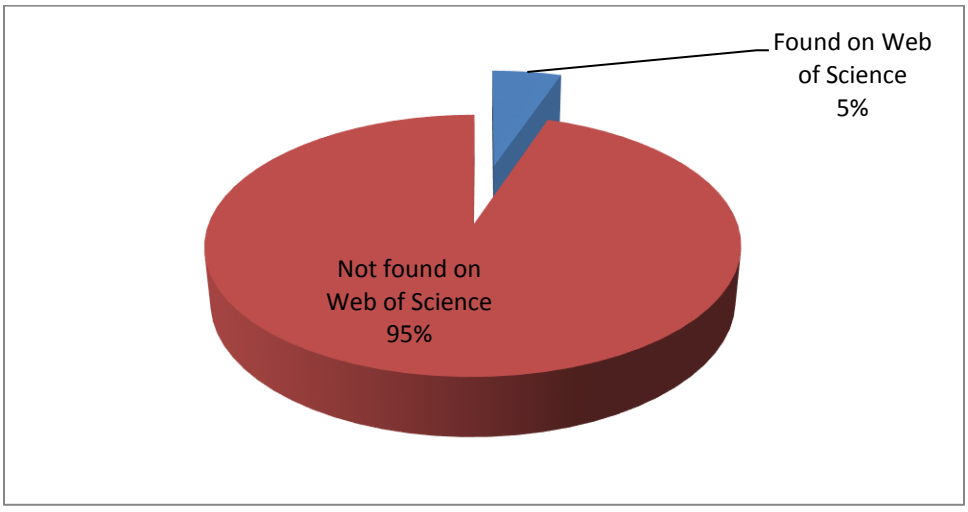


Figure 7.3: Proportion of NARI researchers' articles found on Web of Science

7.2 Characteristics of publications

The analysis showed that between the years 2000 and 2015, the average number of journal articles published by the researchers in both NARIs was approximately 16 articles per year. The highest numbers of journal articles published were recorded in 2011 and 2013 with 43 and 42 journal articles respectively (see Figure 7.4).

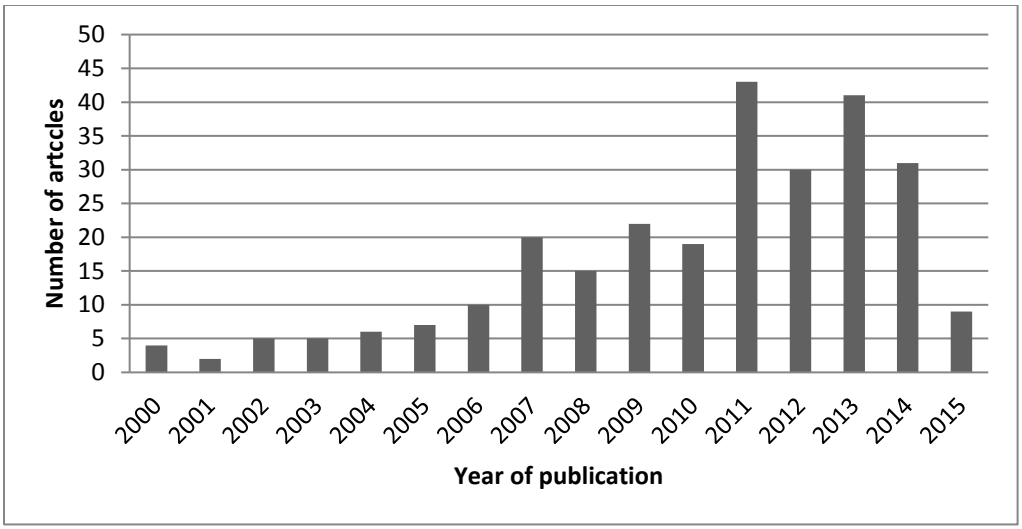


Figure 7.4: Number of CRIN and NSPRI researchers' articles published; 2000 - 2015

The articles were published in 135 different journals with an average of 2 articles per journal. The top three journals in which the researchers published their research outputs were the Nigerian Journal of Soil Science, Journal of Applied Biosciences and Journal of Agricultural Science (see Table 7.1). On the other hand, there were a total of 86 journals that published only one article each from researchers in both NARIs.

Table 7.1: Top journal destinations for CRIN and NSPRI researcher output

Name of Journal	Frequency	Place of Publication
Nigerian Journal of Soil Science	21	Nigeria
Journal of Applied Biosciences	11	International
Journal of Agricultural Science	8	International

Moor Journal of Agricultural Research	7	Nigeria
Obeche Journal	7	Nigeria
African Journal of Biotechnology	6	Africa
ARPN Journal of Agricultural and Biological Sciences	6	International
World Journal of Agricultural Sciences	6	International
African Scientist	5	Africa
Applied Tropical Agriculture	5	Nigeria
International Journal of Applied Research and Technology	5	International
Journal of Soil and Nature	5	International
African Journal of Agricultural Research	4	Africa
African Journal of General Agriculture	4	Africa
American- Eurasian Journal of Agricultural and Environmental Sciences	4	International
Asian Journal of Agricultural Sciences	4	International
Bioscience Research Communications	4	International
Research Journal of Agricultural and Environmental Management	4	Nigeria

A further analysis showed that for the researchers from CRIN, more than 50% of the articles were published in journals outside of Africa, 23.7% were published in Nigerian journals, and 15.6% published in other African journals (see Figure 7.5). However, it was not clear for 16 articles (7.1%), the places of publication of the journals in which they were published. For NSPRI, 35 articles were published in international journals, while five and one were in Nigerian and other African journals respectively (see Figure 7.6).

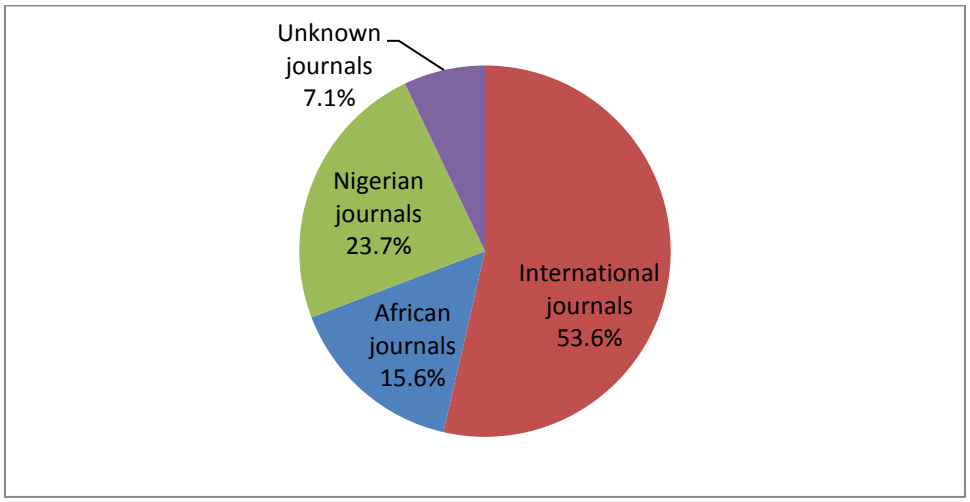


Figure 7.5: Place of Journal Publication for CRIN researchers' articles

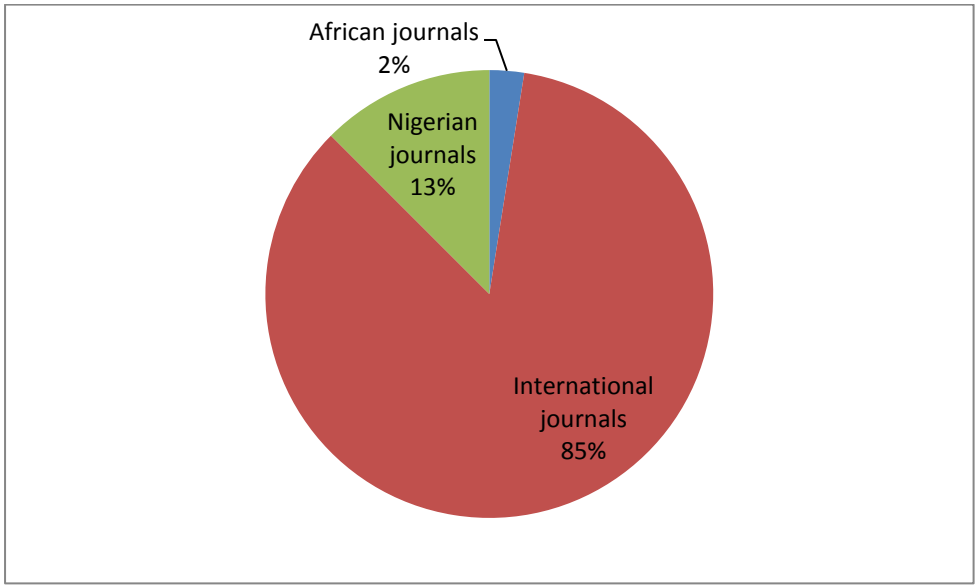


Figure 7.6: Place of journal article publication by researchers in NSPRI

The average number of authors for articles by researchers at CRIN was approximately 4 with almost 80% of the articles having 2 – 5 authors (see Figure 7.7). The average number of authors for articles authored by NSPRI researchers was also 4 but with approximately 68% of the papers written by two to five authors (see Figure 7.8).

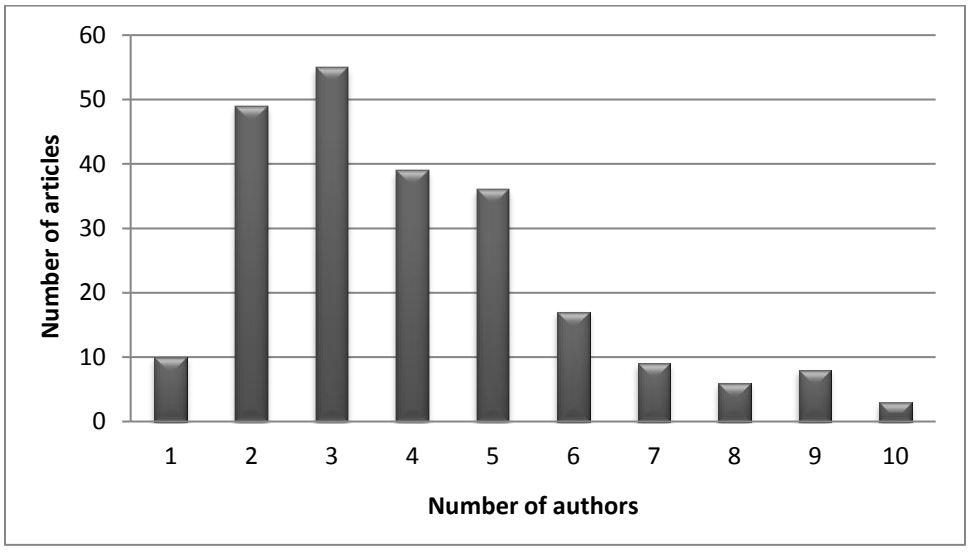


Figure 7.7: Number of authors per article for CRIN researchers

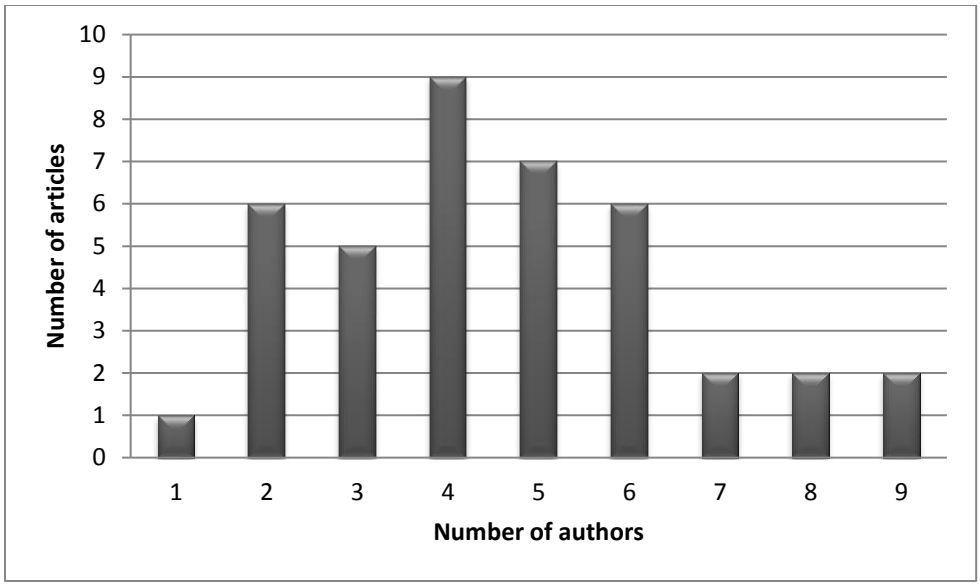


Figure 7.8: Number of authors per article for NSPRI researchers

7.3 Citation analysis

Citation analysis of CRIN articles found in Google Scholar revealed that 49 articles had yet to be cited, the highest number of citations was 48, and the average number of citations per article was 5.23 (see Table 7.2). In the case of NSPRI, 13 articles had yet to be cited, the highest number of citations was 14, and the average number of citations per article was 2.04 (see Table 7.3).

Table 7.2: Number of citations received in Google Scholar by CRIN researchers' articles

CRIN	
Number of citations	**Number of documents**
0	49
1	26
2	31
3	8
4	9
5	5
6	6
7	6
8	4

9	3
10	2
11	2
12	2
13	1
14	2
15	1
16	2
17	2
22	1
34	1
48	1

Table 7.3: Number of citations received in Google Scholar by NSPRI researchers' articles

NSPRI	
Number of citations	**Number of documents**
0	13
1	3
2	2
3	6
4	1
5	1
9	1
14	1

7.4 Citer analysis

Citer analysis is an important part of measuring spread, reach and impact of documentary output of researchers. Citer analysis provides qualitative measures of researchers' impact by providing information about the citations of their work, including who is citing the research, where the citers are, what institution the citers are from, in which publications the citers have published, or in which disciplines the citers have published.

Results from the citer analysis showed that a total of 15 publications authored (or co-authored) by 65 researchers at NSPRI had received a total of 57 citations (including self-citations) in Google Scholar. These 57 citing publications were authored by a total of 178 citers. Almost 25% of these citers were affiliated to Nigerian institutions and with almost another 25% affiliated with institutions in India, Kenya or Romania (see Table 7.4).

Table 7.4: NSPRI citers' countries of affiliation

Country	Number of citers
Nigeria	44
India	28
Kenya	14
Romania	11
Belgium	8
Iran	8
USA	8
Brazil	7
China	7
Bangladesh	5
Benin	5
Sénégal	5
Oman	4
Armenia	3
Germany	3
Mauritius	3
Saudi Arabia	3
Cuba	2
Indonesia	2
Spain	2
Botswana	1
Canada	1
Ecuador	1
Ireland	1
Sri Lanka	1
U.K	1

Upon closer scrutiny of the affiliations of NSPRI citers from Nigerian institutions, it is noteworthy that while the majority were from academic departments in universities, five citers were affiliated with a sister NARI - National Horticultural Research Institute (see Table 7.5). However, three citers were affiliated with NSPRI, out of which 2 individuals were self-citing.

Table 7.5: Affiliations of NSPRI citers from Nigerian institutions

Department of Biological Sciences, Usmanu Danfodiyo University Sokoto, Nigeria
Department of Agricultural Economics and Extension, Kogi State University, Anyigba, Nigeria.
Department of Agricultural Economics, University of Agriculture, Makurdi, Nigeria
Department of Agricultural Extension and Rural Development, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria.
Department of Biochemistry, Federal University of Technology, Akure, Nigeria
Department of Biological Sciences, Covenant University, Ota, Nigeria
Department of Biological Sciences, Jigawa State University, Kafin-Hausa, Nigeria
Department of Biology, Katsina State University, Katsina State, Nigeria
Department of Chemistry and Industrial Chemistry, Bowen University, Iwo, Osun State, Nigeria
Department of Computer Science, University of Ibadan, Ibadan, Oyo State, Nigeria
Department of Crop Protection, University of Maiduguri, Maiduguri, Borno State, Nigeria
Department of Food Science and Technology, Federal University of Agriculture, Abeokuta, Nigeria
Department of Hospitality and Tourism, Federal University of Agriculture, Abeokuta, Nigeria
Department of Nutrition and Dietetics, Federal University of Agriculture, Abeokuta, Nigeria
Department of Microbiology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria.
National Horticultural Research Institute, Idi-Ishin, Ibadan, Nigeria
Nigerian Stored Products Research Institute Headquarters, Ilorin, Kwara State, Nigeria

In the case of CRIN, the 115 journal articles indexed in Google Scholar had received a total of 602 citations, which were authored by a total of 1786 citers. Citers of the journal articles authored by CRIN researchers were affiliated with institutions from 62 different countries of the World (see Table 7.6 for top citing countries). Out of 1786 citers, 725 (about 35%) were from Nigeria, of which 278 were self-citers from CRIN. Interestingly, just as in the case of NSPRI, India came second with about 106 citers but in

contrast with NSPRI which had only one other African country (apart from Nigeria) in the top 10, there were 3 African countries in the top ten.

Table 7.6: CRIN citers' countries of affiliation (countries having at least 5 citers)

Country	Number of citers
Nigeria	725
India	106
Brazil	70
Pakistan	69
Benin	67
Iran	63
China	55
Indonesia	50
South Africa	46
Ghana	42
Cameroon	39
Italy	33
Malaysia	33
Côte d'Ivoire	27
Portugal	26
Germany	23
Kenya	23
Egypt	22
France	22
Finland	20
USA	19
Saudi Arabia	18
Romania	16
UK	16
Canada	11
Colombia	11
Morocco	10
Netherlands	8
Ethiopia	7
Serbia	7
Uganda	7
Togo	6
Vietnam	6
Luxembourg	5
Mexico	5

Poland	5
Zimbabwe	5

Most of the affiliations of CRIN citers from Nigerian institutions were faculties of agriculture in Nigerian post-secondary education institutions. However, there were citers affiliated with four of the other NARIs – NIHORT, NIFOR, NSPRI and IAR&T (see Appendix G).

7.5 How are policy actors using agriculture researchers' outputs? A look at the documents

A content analysis was also carried out to find out if and how policy actors referenced the research output from the NARIs in the FMARD's documents. For this study, all documents on the ministry's website as at July 13, 2015, including press releases, media releases, publications, news, policies and speeches were downloaded and perused. The structured review of the documents from the FMARD was guided by the summative content analysis techniques (Hsieh, 2005). A total of 50 documents were downloaded, saved and read. It was posited that these documents would contain mentions of the NARI's research studies, research output or researchers. It was also assumed that the analysis of the documents from the FMARD will explain the FMARD's use of research output from the NARIs, or collaborations between the policy actors in the FMARD and the researchers in the FAMRD. In each downloaded document, evidence of any references made to any of the NARIs' was sought. Words derived from the interest of the study pertaining to KT were identified, such as the 'names of the NARIs', 'research', 'researcher', 'research knowledge'. A total of 9 documents (18%) obtained from the FMARD website had references to the NARIs, but the references were not made to their

research findings. Six of the documents referenced the NARIs in respect to collaboration roles / activities with them. Some examples are given below:

> "*...collaborating with all relevant National Agricultural Research Institutes (NARIs) on available improved animal production, value addition, marketing, and feed technologies"*;
>
> "*...carry out field trials on pilot basis in collaboration with research institutes on new fertilizer technologies to determine adoption or otherwise*";
>
> "*…the development and modernisation of the means of production, processing, storage, and marketing of fish and shell fish monitoring, control and surveillance of Nigeria's marine and freshwater fisheries resources for the achievement of resource conservation in partnership with relevant research institutes*…"

One document was the compendium of special committees, their memberships and terms of reference. It was about the constitution of committees, in which researchers from the research institutes were listed as members. Three of four committees had researchers from the NARIs listed as members. However, two documents (4%) made direct reference to actual analysis and findings obtained from one of the research institutes. In both instances, references were made to the results of suspected Avian Influenza (AI) samples analyzed by researchers at NVRI.

7.6 Chapter summary

This chapter presented the results of the bibliometric analysis of the publications obtained from two of the NARIs as well as content analysis of documents obtained from the FMARD website. Out of the 264 journal articles published by researchers from the two NARIs, 192 were traced on Google Scholar and had received over 659 citations from other scholars located in 67 different countries of the World. However, documents obtained from the FMARD website did not reveal many references to the research findings from the NARIs.

Chapter 8

8 Discussion

8.1 Introduction

This chapter presents the discussion of findings obtained from both the qualitative and quantitative methods of data collection employed, as well as from the bibliometric and web content analyses. The results are discussed in congruence with the main research questions and the objectives of the study, to address the research questions and to meet objectives of the study in view of the empirical work conducted. Findings from this study are quite similar and relate closely to the reviewed literature.

8.2 Agriculture researchers' efforts to translate their research knowledge

8.2.1 Agriculture researchers' KT efforts to policy actors in the Federal Ministry of Agriculture and Rural Development

Agriculture researchers in Nigerian research institutes attested that knowledge generated from their research was regularly transferred to the policy actors at FMARD. Although most of the researchers who completed the questionnaires indicated that they occasionally or frequently carried out KT activities targeted at policy actors in the FMARD, the in-depth interviews revealed that the primary effort that was made to do this was by sending an annual report to the policy actors. The report typically included all the research institutes' activities for the previous year, and was not limited to research output. Moreover, the study revealed that the annual report was sent to the FMARD by senior members in the NARIs, and not necessarily by individual researchers. It can be argued

that because it is a requirement for the NARIs to provide reports of their research activities to the FMARD, this may not be considered as KT. Nevertheless, this is considered to be KT because some of the researchers noted that the reports were provided to enlighten the policy actors' decision making process with the research findings. In addition, providing reports as a KT effort is consistent with findings from other studies. For example, although on an individual level, health researchers in selected Eastern Mediterranean countries disseminated research reports to senior officials from the Ministries of Health in their respective countries (El-Jardali et al, 2012; El-Jardali et al., 2014) in an effort to communicate their research findings to the policy makers as well as to bridge the gap between research and policy. Likewise, health researchers developed research reports in transferring their knowledge to policy makers in Israel (Ellen et al., 2014). However, considering that the annual reports did not contain only research findings, an enhancement to the preparation and packaging of the reports may also make it more likely for policy actors to better understand and utilize relevant research findings therein for decision making. Related studies have demonstrated that there is a need to improve the ways in which researchers present and disseminate research to policy makers (El-Jardali et al., 2012). El-Jardali et al. (2014) noted that the production of policy briefs was a new approach to packaging research evidence to inform deliberations among policy makers on high priority policy issues in Eastern Mediterranean countries.

It is recognized that KT efforts, strategies and activities vary according to the type of research to be translated and the intended user audience (CIHR, 2004). Notwithstanding, apart from the reports, the agriculture researchers in Nigeria rarely used other strategies as an attempt to transfer their knowledge to the policy actors in the

FMARD. The findings from this research indicate that many of the researchers only occasionally performed majority of the KT activities listed in the questionnaire, like obtaining and reviewing information about the policy actors concerning their needs and goals, and then developing reports that were appealing to the policy actors by using appropriate language. The survey of the agriculture researchers also showed that very few researchers frequently interacted with the policy actors during the research process, implying that the agriculture researchers in Nigeria rarely had opportunities for integrated knowledge translation with the policy actors in the FMARD. This is similar to findings from related studies; a study conducted in Israel found that less than a third of the health researchers frequently engaged in KT activities targeted at health policy makers in Israel (Ellen et al., 2014) while another study found that only a few KT activities were undertaken by more than half of the researchers surveyed in ten low- and middle-income countries (Lavis el al., 2010). As regards the medium of communication between agriculture researchers and policy actors, email was not a popular medium of communication between the agriculture researchers and policy actors in Nigeria, as very few of the researchers noted frequently sending emails containing reports, articles, summaries, reviews or synthesis of their research findings to the policy actors in FMARD. This is consistent with similar studies (Lavis et al., 2010; El-Jardali et al., 2012; Ellen et al., 2014) and can be viewed as a reflection of the low availability, access to and adoption of internet and communication technologies (ICTs) by agricultural researchers in Africa (Mugwisi, Mostert & Ocholla, 2015; Ponelis & Holmner, 2015).

Furthermore, very few of the agriculture researchers carried out activities aimed at supporting their KT efforts. For example, few participated in KT skill building activities

or worked with KT specialist or knowledge brokers within or outside their research institutes. Likewise, less than a quarter of the agriculture researchers were involved in active strategies to increase the capacity of the policy actors to use research knowledge, corroborating again findings concerning health researchers' KT activities in Israel (Ellen et al., 2014). Some of the reasons given for the limited efforts in carrying out KT activities that are targeted to policy actors in the FMARD include: (1) the belief by some researchers that they did not need to or have to carry out KT activities that are targeted to the FMARD since it was the responsibility of the more senior researchers; (2) the assumption by some researchers that the annual report sent to the FMARD was sufficient; and (3) the perception that it was solely the duty of the director of research or the executive director in the NARI to communicate research findings to the policy actors in the FMARD. The first and third reasons tie in with the bureaucratic culture in the Nigerian public service as observed by Ekeke (2011), who noted that the bureaucratic culture in the Nigeria public service has affected knowledge transfer by creating an empire around the head who must be consulted before knowledge is transferred in the Nigerian public service (Ekeke, 2011). Nevertheless, interviews with the agriculture researchers revealed that, similar to the health researchers in Israel (Ellen et al., 2014) and in ten low-and middle-income countries (Lavis et al., 2010), some agriculture researchers in Nigeria frequently interacted with policy actors outside the research process either through meetings, conferences, or workshops. Also, the agriculture researchers often had annual research review meetings in the NARIs with representatives from the FMARD in attendance. Interactions between the actors involved in KT have been noted to be an avenue for KT (Campbell, 2010; Driedger et al., 2010; Langlois et

al., 2016; LaRocca et al., 2012) and in the case of the agriculture researchers and policy actors in Nigeria, the meetings they had together were considered to be opportunities for KT.

Attempts were made to see whether there were differences in the researchers' KT efforts due to their demographics. The study showed that there was a significant difference in the frequency of KT practices between male and female agriculture researchers to the FMARD, whereby the male researchers carried out KT more frequently to the policy actors in the FMARD. Also, researchers who are above 50 years of age, researchers who are higher up the ranks in the NARIs, and those who have worked in the research institutes for more than 20 years, carried out KT more frequently to the FMARD. It is not surprising that the more senior researchers in the NARIs do more KT to the FMARD for some reasons. Firstly and intuitively, it can be expected that the number of years of experience and seniority of researchers may have increased researchers' opportunities for carrying out KT. This reason is also supported by Landry et al. (2006) who showed that researchers' years of experience in research increased their likelihood of transferring knowledge. Secondly, as has been noted earlier, KT targeted at the FMARD was typically carried out by the directors in the NARIs. Clearly, these directors are high up in the hierarchies of the institutes and must have had considerable number of years of experience.

8.2.2 Agriculture researchers' efforts to translate their research findings to other potential users

Although this study was mainly carried out to assess the KT practices of agriculture researchers to policy actors in Nigeria, other important target audiences for agriculture knowledge noted in the study include farmers, young entrepreneurs, production and manufacturing industries, food marketers, teachers of agricultural science, fisher folk (fish farmers), rubber farmers, students, and every stakeholder in the agriculture sector. True to the origin of the activity and study of KT and consistent with reports of studies on agriculture knowledge dissemination (Rogers, 2003; Blake & Ottoson, 2009), the KT efforts from the agriculture researchers were revealed to be mostly targeted to farmers, as almost all the interviewees indicated that researchers carried out KT strategies that aligned with the need to get evidence to farmers.

Some of the efforts that the agriculture researchers made to transfer their research findings to the famers include the establishment of adopted villages and adopted schools, and the organization of workshops targeted at farmers and farmer groups. With these KT strategies, the agriculture researchers had much direct interactions with farmers to show them how to use research findings generated at the NARIs. These KT mechanisms are also consistent with related studies, where face-to-face seminars and workshops were used to transfer research findings to farmers (Butler et al. 2006; Gaitan-Jurado et al. 2013; Hocevar & Istenic 2014; Ibrahim et al. 2014; Koka 2013; Reichardt et al. 2009). Some researchers at the NARIs also organized Research Extension Farmer-Input Linkage System (REFILS), which is an organization of extension researchers to improve productivity of farmers in Nigeria. The concept of REFILS is that extension workers pass

information to farmers on farm inputs and market situations (Nnadozie et al., 2015). KT was also done with individual farmers through field days at the village square, residence of opinion leader, and at organized workshops for farmers.

Additionally, researchers at the NARIs also produced communiqués targeted at the general public. Some researchers in some NARIs had an in-house magazine, others had phone-in radio programmes broadcasted through the Federal Radio Corporation of Nigeria (FRCN), or aired TV programmes. Furthermore regular meetings and conferences of professional agriculture based societies, groups and associations also served as avenues for the agriculture researchers' KT activities to other potential audiences and stakeholders. Such meetings included the annual meeting of the Agriculture Extension Society of Nigeria, the Agriculture Society of Nigeria, Soil Society of Nigeria, and Farm Management Association, all of which had members from researchers in the NARIs. At these gatherings, researchers were able to share their research findings to inform and empower users. In addition, students came to the NARIs on excursions, on guided tours, for industrial training, or as interns, which served as opportunities for researchers to transfer knowledge to students.

The researchers' mention of a variety of target audience for their research knowledge validates the fact that agriculture research knowledge has the potential to be beneficial to a lot of target audiences and stakeholders (Elueze, 2016). Nevertheless, unlike reports in the literature that showed that the use of ICTs was prominent among the KT support system for agriculture research (Feng et al., 2007; 2009; 2010; Gaitan-Jurado et al., 2013; Isoe & Nakatani, 2011; Lin & Heffernan, 2010; Malhan & Rao, 2007; Nielsen et al., 2009), this was not the case for the agriculture researchers in Nigeria. As

was noted in the earlier subsection, this may be explained by the low adoption of ICTs among agriculture researchers in Nigeria (Oyewole, SaheedIge & Oyetunde, 2013).

8.3 Barriers that inhibit the translation of research knowledge by researchers in the agricultural research institutes in Nigeria

A number of barriers were highlighted by the agriculture researchers but the top two barriers were: (1) funding and (2) logistics for KT. Funding was a major problem for the KT activities of agriculture researchers in Nigeria. The issue of funding as a barrier for KT has also been noted in other studies; Lavis et al. (2010) observed that the cost of KT is high, and Huzair (2013) noted that poor funding affects the overall KT process. In addition, comments about the poor funding made by the agriculture researchers in Nigeria as a barrier for effective KT are not farfetched. This is because in Nigeria, research takes place within an environment of social, political, and economic constraints, orchestrated by many years of colonial rule, in addition to homegrown problems of economic mismanagement and official corruption (Nwagwu, 2006). Another barrier mentioned by the researchers was that of time and training for KT activities; this was a theme that some researchers seemed to be passionate about. They emphasized that time, budget, and training were major inhibitors to their KT practices. This mirrors the views of some health researchers who indicated that not having an explicit budget for KT was a barrier for them (El-Jardali et al., 2014). Again, similar to a factor noted by health researchers in low- and middle-income countries (Lavis et al., 2010), some researchers in Nigeria felt that their research translation effort was hampered by a lack of academic rewards for KT activities. This might explain why most of the researchers prioritized

publishing research findings in academic journals as they get rewarded in form of promotion for such publications. In addition, it appears that the notion of KT for policy decisions or the use of research for agriculture policy (evidence informed agriculture policy) is not a concept that was popular among some researchers. Some of the agriculture researchers might not have given a lot of consideration to the idea that their research findings could influence agriculture policy directions in Nigeria.

8.4 Policy actors' use of agriculture research knowledge generated at the NARIs for policy decision making

Snell (1983) proposed three models of research utilization - instrumental, conceptual, and symbolic - as a useful starting point for thinking about the process of research utilization by policy makers. Snell (1983) noted that research may be used in a variety of ways in decision making, and suggested that both researchers and policy makers appreciate that research can serve a variety of purposes. Despite the fact that all the policy actors interviewed in this study indicated that their roles at the Federal Ministry involved agriculture policy formulation, they implied that they did not often refer to the research output from the NARIs to formulate policies. However, a few of the policy actors indicated that they had initiated research at the NARIs in the past, consistent with findings by El-Jardali et al. (2012) in their study of health policy makers in Eastern Mediterranean countries. The policy actors in the FMARD also reported occasional interactions between them and the researchers in the NARIs. However, in the course of the interviews, policy actors could only cite few instances in which they had utilized research knowledge for decision making. One example was when a policy actor in the FMARD used a report of the patho-genetic analysis carried out by researchers in National

Veterinary Research Institute to plan appropriately on how to tackle an episode of avian influenza. Another example was when one respondent used the results of fertilizer trials from Institute of Agriculture Research to recommend the best fertilizers to be used by farmers in various locations in Nigeria. Nevertheless, the paucity of policy actors' use of research knowledge generated by the researchers at the NARIs is not dissimilar to findings from related studies. For instance, policy makers in Eastern Mediterranean countries did not frequently utilize research knowledge (El-Jardali et al., 2012).

Given that the policy actors seemed to be aware of the mandates of some of the relevant NARIs and about some of the research findings that have come out of these research institutes but did not use the research directly, one could infer that their use of research knowledge might be more conceptual than direct or symbolic. This would be consistent with the findings of Amara et al. (2004) and Cherney and McGee (2011). Conceptual use of research is described in the literature as when research findings change the understanding of a situation, provide new ways of thinking, or offer insights into the strengths and weaknesses of particular courses of action (Estabrooks, 1999). On the other hand, symbolic use is whereby research became an instrument of persuasion, or when research was used as a political tool and to legitimize particular courses of action or inaction, used to validate or defend a position already taken for other reasons (Estabrooks, 1999). According to Weiss (1980), direct use of research is rare and when observed, it tends to be more frequent in private than in public organizations. Furthermore, the findings from this study showed that the fact that the FMARD was a supervisory body over the NARIs and funded the research activities of the researchers did not seem to prompt the policy actors to use the research findings generated at the research

institutes. This is somewhat consistent with the findings from a study conducted in 2004 in Cameroon that revealed that Cameroonian policy-makers did not make substantial use of research even when the research was commissioned by them (Wolley, 2009).

8.5 Barriers that inhibit the use of research knowledge by policy actors in the Federal Ministry of Agriculture and Rural Development in Nigeria

Policy actors in the FMARD recognized the importance of using research, but findings from the study showed limited use of NARI's research knowledge by the policy actors. Consistent with previous studies (Cherney et al., 2012), the complexity of the policy actors' work came up as one of the reasons why they did not often refer to research from researchers at the NARIs. Another notable barrier mentioned by the policy actors in the FMARD was the lack of relevance of some of the research studies being carried out at the research institutes for policy making. This is similar to the observation in a report from a workshop hosted by the International Food Policy Research Institute (IFPRI) in Nigeria concerning sustainable solutions for ending hunger and poverty, where it was noted that the lack of policy-relevant research was one of the issues that hindered the agricultural policy support facility in Nigeria (Fan, 2008). The policy actors inferred that some of the research studies conducted at the different NARIs were not in line with the agricultural priorities of the FMARD, and this contributed to their seldom-use of research output from the NARIs. Lack of policy relevant research studies is not an uncommon barrier for research use, as previous studies have reported that policy makers complained about researchers not aligning their research studies with high priority policy issues. For example, health policy makers in Eastern Mediterranean countries cited the lack of

research targeting policy as a barrier that constrained their use of research findings for decision making, and emphasized the need for researchers to better align their research studies with high priority policy issues (El-Jardali et al., 2014). Although the Nigerian agriculture researchers insisted that the Nigerian farmers' needs were a priority to them and for their research studies, the policy actors in the FMARD suggested that some researchers in the NARIs were more focused on carrying out studies for publications and promotions.

The slow process of knowledge production (WHO 2006) was also reported in this study, whereby the issue of 'inconclusive' nature of research studies was portrayed to be a barrier to policy actors' use of research findings from the NARIs for policy decision making. This is somewhat similar to the views of health policy makers in some Eastern Mediterranean countries who complained that research findings were not delivered at the right time (El-Jardali et al., 2012). The policy actors in the FMARD complained that research often results trickled in, implying that the timeliness of research findings was a prerequisite for agriculture policy actors' use of research knowledge from the NARIs. This is a similar situation concerning the use of research evidence in policymaking in the health sector in Nigeria, where it was found that evidence was used more when it was perceived to be timely (Onwujekwe et al., 2015).

8.6 Intermediaries for the translation of agriculture research knowledge in Nigeria

The KT literature indicates that having researchers working with and through credible knowledge mediators may constitute a way around the time constraints faced by

individual researchers to translate knowledge (Lavis et al., 2003). In the case of the agriculture researchers in Nigeria, while one interviewee mentioned that they did not have any intermediaries in transferring their research findings to their target audiences, some seemed to consider the researchers in the extension departments to be their intermediaries with the farmers, and a few mentioned the ARCN as the mediator between the researchers in the NARIs and the policy actors in the FMARD. However, it is important to note that KT for agriculture research knowledge in Nigeria appeared to be done at an organizational level, rather than at an individual researcher level. There was a 'group ideology / team mentality' observed from the researchers in some research institutes in Nigeria, which might be explained by the fact that the Nigerian public service administrative culture places more emphasis on the team rather than the person (Ekeke, 2011). This ideology was exhibited by a few researchers who believed that as long as their research knowledge gets translated, it does not matter much who translates it, so long as both the researcher in question and the 'translator' belonged to the same NARI. In addition, some of the interviewed researchers answered the questions with a high emphasis on the collective word 'we' rather than 'I', implying that all researchers in the NARI worked collaboratively as a team. In this sense, although KT activities targeted at farmers and farmer groups were the responsibility of agriculture extension researchers, the extension researchers were not quite considered to be intermediaries. Instead, it was considered ideal to allow researchers to carry out research, while researchers in the extension divisions do KT targeted at farmers. Although the researchers also mentioned that specialized researchers (called subject matter specialists) were often invited to give demonstrations along with the extension people during KT activities to farmers, there

was no indication from any of the interviewed researchers as to whether this was problematic. It however appeared that this structure was actually quite effective and a good use of the scientists' time, because having individual scientists doing KT to farmers may not be a good use of their time, which can be better spent doing more research (Lavis et al., 2003).

The literature suggests that the messengers / agents / intermediaries for the transfer of agriculture research knowledge are called extensionists (Alcon et al. 2014; Feng et al. 2009; Feike et al. 2010; Floriancyzk et al. 2012; Hocevar & Istenic 2014; Klerkx et al., 2012; Okocha 1995). While the findings from this study somewhat corroborates this with regards to the agriculture researchers' KT targeted at farmers, it does not reveal any specific role for an intermediary for KT directed at the policy actors. Also, researchers mentioning ARCN did not specify what exactly the ARCN does as an intermediary to support KT of agriculture research knowledge for policy making in Nigeria, to aid the transfer of knowledge (Meyer, 2010) or to encourage the connections that ease knowledge transfer (CHSRF, 2003) between researchers in the NARIs and policy makers in the FMARD. They only noted that they also sent a copy of their annual reports to the ARCN.

8.7 Influence / reach / spread of researchers' knowledge in form of publications

The citation and citer analyses of the agriculture researchers' output in form of journal article publications revealed that the agriculture researchers in the NARIs are actively publishing their research output in form of journal articles. This is not surprising, given

that the results of scientific research are mainly disseminated through publications of peer reviewed papers in scholarly journals (Moed, 2005; 2009). Findings from the bibliometric analysis showed that the works of researchers from two of the NARIs were published in more than 100 journals issued in different countries of the world. However, many of the researchers published their works in Nigerian academic journals, especially the Nigerian Journal of Soil Science, corroborating the findings by Utrobičić, Chaudhry, Ghaffar and Marušić (2012), that local and regional scientific journals are important factors in bridging gaps in KT in low-and middle-income countries. In addition, several of the works authored by the agriculture researchers had been taken up and cited by other scholars. Scholars who cited the works of the Nigerian agriculture researchers were affiliated with a variety of institutions in over 67 different countries. This is an integral finding that shows that Nigerian research is being considered in other countries. However, scholars in Nigeria who cited the work of the agriculture researchers were mainly affiliated with universities. Apparently, the policy actors in the FMARD did not seem to be using these publications as none of the citers was affiliated to the FMARD. Nevertheless, scholarly publications are knowledge dissemination channels and Serenko et al. (2012) advocated that researchers should not change their research publication behavior but, instead, infrastructure should be developed to facilitate the translation of knowledge so that it reaches users in the most efficient way.

The websites of some of the NARIs also contained information about the researchers, their research studies, and research output. The use of NARIs' websites to disseminate research is considered as an opportunity for KT, which can be strengthened. Tetroe et al. (2010), supplementing interviews with information from websites, noted that

a health research agency supported and promoted KT by providing a form of research synthesis that was developed and posted on its website. Websites were also used as one of the dissemination strategies in the Evidence-Based Health Promotion Resources (EBHPRs) to assist and encourage practitioners to use and evaluate evidence-based interventions in public health topics in Victoria, Australia (Armstrong et al., 2007). Likewise, Lamari and Ziam (2014) suggested that KT has been greatly enhanced through the use of web platforms, such as websites.

8.8 Chapter summary

This chapter discussed the findings from the study and was arranged according to the research questions. In the discussions, efforts were made to corroborate the findings with results from similar studies, and wherever there was a divergence, attempts were made to adduce reasons for it. Also, the implications of the research findings for the agriculture researchers and policy actors in Nigeria were noted.

Chapter 9

9 Summary, conclusions and recommendations

9.1 Summary and conclusions

This study investigated knowledge translation of agriculture research knowledge in Nigeria from the perspectives of the agriculture researchers and policy actors. It elucidated the KT practices of the researchers in the agriculture research institutes in Nigeria and explicated the policy actors' use of research knowledge for decision making. Data for the study were collected using questionnaires and interviews. Six hundred questionnaires were administered to the researchers in 15 agriculture research institutes, out of which 448 usable questionnaires were analyzed for the study. In addition, interviews were held with 22 researchers from the different NARIs about their KT practices to target audiences for agriculture research knowledge. Fourteen policy actors in the FMARD were also interviewed concerning their use of research knowledge generated at the NARIs. Data for the bibliometric study were obtained from the websites of two agriculture research institutes that contained a comprehensive list of researchers' publications, as well as from the website of the FMARD. Quantitative analyses were carried out on data collected using the questionnaires and the data collected from the NARIs websites for the bibliometric study, while the interviews were analyzed qualitatively.

Findings concerning the KT practices of agriculture research scientists in Nigeria showed that the researchers made efforts to transfer their research findings to potential target audiences, especially to the Nigerian farmers, through a variety of practices. Activities used to transfer knowledge to farmers and farmer groups include organized

vocational trainings, workshops and demonstrations. However, these activities were done occasionally and used the existing structure of extensionists. The main avenue researchers used to communicate their research findings to policy actors was by sending an annual report to the Federal Ministry of Agriculture. This strategy appears to be basic and inexpensive, and can be argued not to be KT considering that sending reports is a requirement. However, it is a way of getting the research out. The general expectation of the researchers was that the reports would be used appropriately within the Ministry of Agriculture. Similarly, although policy actors acknowledged that the annual reports from the NARIs were sent to the FMARD, the policy actors gave no indication as to what became of the reports or who exactly acted on the content of the NARI's annual reports. Policy actors suggested that the reports were received at the office of the Minister of Agriculture and forwarded to the appropriate officers, possibly for shelving. In addition to transferring their research knowledge to farmers as well as sending annual reports to the FMARD, many of the agriculture researchers from two of the institutes were actively publishing their research output as journal articles in Nigerian and foreign journals. These publications were being taken up by other scholars from different disciplines and institutions in over sixty-two countries in the world, and especially scholars in other Nigerian post-secondary education institutions.

In the case of policy actors at FMARD, they implied that the research studies carried out at the NARIs were not amenable to be used because research was always carried out in bits and pieces, findings trickling in, and thereby could not be of much use that way. They also felt that the researchers were mainly conducting research relevant to farmers as well as for publications, which would enhance their promotion prospects.

Although the Nigerian agriculture researchers insisted that the farmers' needs should be their priorities, the policy actors however felt that researchers should carry out policy relevant research in order to enhance policy actors' likelihood of using research knowledge for decision making.

9.2 Recommendations

Given the findings noted above that the researchers in Nigerian agriculture institutes weren't making special efforts to translate their research knowledge for policy making as well as the fact that the policy actors weren't making use of research knowledge from the institutes, recommendations that could be used to improve the push and pull of agriculture research knowledge for policy making in Nigeria are proffered below. It should be noted that the recommendations are not mutually exclusive, but interrelated.

- Encouraging agriculture researchers to conduct policy relevant research studies and sensitizing policy actors to use research for agriculture policy making

The agriculture researchers in Nigeria need to be encouraged to conduct policy relevant research, and to be more alert as to how their research findings may influence existing policy decisions or introduce new policy directions for agriculture in Nigeria. There is a need to sensitize both researchers and policy actors about evidence-informed agriculture policy making in Nigeria. Future initiatives could focus on supporting KT activities that appear to increase the prospects of policy actors using research for policy making. One of such activities found in this study is the bringing of policy makers and researchers together at meetings, which serve as a discussion forum for policymakers and

researchers. This study suggests increasing targeted communication between policy actors and researchers through sensitization and awareness workshops on evidence-informed policy making as strategies to improve both the researchers' and policy actors' capacity to supply and demand research for evidence informed agriculture policy making in Nigeria.

- Providing training and capacity building for both policy actors and researchers

This study recommends training and capacity building for both researchers and policy actors to boost their ability to do more KT for agriculture policy making. Trainings and capacity building for both policy makers and researchers have been validated to facilitate KT and evidence informed decision making in several contexts. Literature shows that building the capacity of policy makers to locate and appraise the quality of research increases the prospect of their research use (Uneke et al., 2015b; El-Jardali et al. 2014). Nigerian health policy makers' knowledge and capacity to develop evidence informed policy briefs were enhanced via exposure to policy training workshops. (Uneke et al., 2015a). In addition, a report on 'Agricultural Policy Support Facility' in Nigeria noted the need to organize capacity building activities on policy analysis for agriculture policy making in Nigeria (Fan, 2008). There should also be capacity building for policy actors to access, assess and apply research evidence in policy making. In addition, creating capacity for KT could also be in the form of the integration of KT courses within curricula (El-Jardali & Fadlallah, 2015; Babu & Adebayo, 2008) for researchers, providing researchers with the capacity to undertake policy relevant research and carry out KT. This may especially be more applicable to junior researchers, as the findings

showed that senior researchers do KT more frequently. Agriculture researchers and policy actors should be provided with appropriate training to nurture KT and knowledge use.

- Encouraging more targeted interactions such as policy dialogues between the agriculture researchers and policy makers

Since the interaction between policy actors and researchers was a factor reported by both parties to be a facilitator for KT, it is recommended that some of the interactions between the policy actors and agriculture researchers be targeted towards the use of research knowledge for agriculture policy making in Nigeria. These meetings would be opportunities to enhance the communication and strengthen knowledge sharing between the researchers and policy actors. For instance, the policy dialogues implemented as KT tools in Lebanon, Nigeria, some Eastern Mediterranean countries, and low-and middle-income countries (El-Jardali et al., 2012; Moat et al., 2014; Yehia & El-Jardali, 2015; Schoff et al., 2015; Uneke et al., 2015) were purposeful meetings and capacity strengthening events where researchers and policy actors came to discuss policy relevant issues and how research could be used to address them. It is noteworthy that the authors of these studies noted positive outcome from the policy dialogues as a KT strategy to increase the use of health research in policy making. KT strategy such as dialogues on policy research needs could equally be adopted in the case of the agriculture researchers and policy makers in Nigeria to increase the use of research in policy decisions. Other efforts to link researchers to policy actors such as interactive workshops that bring policy makers and researchers, partnerships between policy makers and researchers in the

research process (IKT) could also be encouraged to promote evidence informed agriculture policy making in Nigeria. This is in agreement with Nwafor (2008), who noted the need for more regular interactions between the agriculture ministry in Nigeria and research community to improve the supply and demand for research output, thus bridging knowledge and policy.

- Providing agriculture researchers with the budget to do KT

A conscious attempt to reinforce KT activities among the agriculture researchers in Nigeria should provide researchers with the budget, time and training to do KT. The KT efforts of researchers especially to the policy actors in the FMARD need to be supported by increasing funding, or dedicating a percentage of the budget of the Ministry of Agriculture to KT. While the sending of reports is an acceptable KT practise, it appears to be insufficient to prompt the use of the NARI's research knowledge by the policy actors in the FMARD. Furthermore, considering that there were constant mentions of funding issues as a barrier for KT, which is consistent with the literature on KT, there arises the need to support KT efforts with adequate financial resources. Many KT efforts that have been implemented in other studies, and which have been noted to increase policy makers' use of research for decision, are not cheap strategies to implement. These efforts are time and money consuming, and need to be funded. It has also been noted that some funding agencies are open to sponsoring KT activities (El-Jardali et al., 2014). Studies show that the KT efforts to increase the use of health research by policy makers in low-and middle-income countries were sponsored and supported by international donor agencies such as WHO, in collaboration with the Ministries of Health of the

different countries (Cameron et al., 2010, El-Jardali et al., 2012; 2014; Guidon et al., 2010; Lavis et al., 2010; Moat et al., 2014; Onwujekwe et al., 2015; Shroff et al., 2015; Yehia & El-Jardali, 2015; WHO, 2006). Likewise, the International Food Policy Research Institute developed the IFPRI Malawi Strategy Support Program (MaSSP) that worked closely with the Ministry of Agriculture and Food Security (MoAFS) in Malawi to facilitate and promote evidence based dialogues and decision making in Malawi (http://massp.ifpri.info/, 2016). In addition, the United States Agency for International Development (USAID) funds the "Supporting Evidence-based Agriculture Policy" (SEBAP) program in Malawi. Similarly, the Ministry of Health in Lebanon secured a grant of a very huge amount from the European Union to strengthen public health services through KT (Yehia & El-Jardali, 2015). It is therefore recommended that international donor organizations help fund, sponsor or support capacity building initiatives for the Nigerian agriculture researchers to enable them undertake KT activities targeted to increase the use of agriculture research for policy making in Nigeria.

- Providing the agriculture researchers with incentives for KT for policy making

The policy actors often mentioned that the agriculture researchers were more interested in carrying out studies for publications and promotions than policy relevant studies. It does seem that individual researchers did not consider KT to the policy actors as a priority. They appeared to be complacent with the existing structure whereby the executive director sends research reports at the end of each year to the FMARD, while majority of the researchers carry on with their studies, producing scholarly publications. It is not contestable that publications is an avenue for KT as has been shown in many studies, and

is one of the opportunities for KT listed in the CIHR model. However, in the case of the agriculture researchers, publication is also one of the criteria for their promotion, and as such, they are more motivated to publish their research findings as journal articles. Perhaps if there were incentives attached to KT for policy making, such as its inclusion in the annual performance evaluation or the establishment of annual award for the KT researcher of the year, the researchers might be motivated to do KT for policy making.

- Encouraging researchers to have a KT plan for all relevant research studies

Taking a cue from the research and innovation division of the Ontario Ministry of Agriculture, Food and Rural Affairs, researchers at the NARIs could have a KT plan for all relevant research studies. Agriculture researchers could identify at the start of their research studies, which departments within the FMARD the study could be potentially important to, how the findings would be communicated to the policy actors, and how the policy actors might benefit from the research knowledge. Such a practice could build the capacity of researchers to conduct more policy relevant studies and build awareness for KT for agriculture research for policy making in Nigeria.

- Packaging reports such as policy briefs, specifically with policy implications for policy actors

Although neither the policy actors nor researchers complained about the reports as the sole KT strategy to the FMARD, it is recommended that similar to the use of health system research for health policy making in Nigeria (Uneke et al., 2015d), there is a need to package research data into policy briefs that will increase the chances of use by agriculture policy actors for decision making. This study recommends the development of

more useful, relevant, timely and optimally packaged document that aim to support the use of research findings by agriculture policy actors. Uneke et al. (2015d) noted that policy briefs are an effective mechanism which supports evidence-informed policy making, demonstrating that policy briefs can make it easier for policy makers to determine how available research knowledge can be contextualized with policy makers' own beliefs, values, interests, or political goals and strategies. Policy briefs describe a problem, what is known about the options for addressing the problem, and identify key implementation considerations (Lavis et al., 2005; Lavis et al., 2009). It is noteworthy that one future plan noted as part of the outcome of a stakeholder workshop on developing evidence for agricultural and rural development policies in Nigeria was to conduct analysis and prepare report/discussion papers and policy briefs from policy themes (Fan, 2008). Although the report did not specify who would be responsible for conducting the analysis or preparing the discussion papers and policy briefs from policy themes, and there is no report out there as to whether or how this mandate was achieved, it could still be realized by collaboration between agriculture researchers and policy actors.

9.3 Contributions of the study

One of the contributions made by this study in terms of methodology is in the aspect of the application of bibliometric and web content analysis to the study of KT. To the best of the investigator's knowledge, this is the first KT study that has used quantitative and qualitative methods to collect data from both the research producers and research users, as well as incorporated citer analysis as a method to assess the spread of research output

in a KT study. It is also important to note that no previous study had investigated the KT practices of agriculture researchers for policy making and the use of research knowledge by policy actors in developing countries. In addition, some studies that have been carried out with respect to information behavior of agriculture researchers in Nigeria (Mohammed & Ozioko, 2015; Oladele, 2010; Okocha, 1995; Uganneya, et al., 2012; 2013) have typically focused on the researchers in one NARI, or few of the NARIs in a particular geo-political region in Nigeria. The uniqueness of this study is that it surveyed the KT practices of agriculture researchers with representatives from all the 15 NARIs in Nigeria. Hence, the findings from the study can serve as the baseline data for KT practices in agriculture research institutes in Nigeria.

This study contributes to theory as it explicated that the agriculture researchers' demographics and the NARI (institutional) environment influenced the agriculture researchers' KT activities. The agriculture researchers' sex, age, length of service and position within the NARI were factors that were found to contribute to, or determine the frequency with which the researchers carried out KT activities. Similarly, the NARI's institutional environment manifested through mentorship, funding, culture and leadership, within the different NARIs also accounted for a difference in the frequency of the agriculture researchers' KT activities, especially to the policy actors in the FMARD.

This study on KT related to agriculture in Nigeria is very timely considering the current state of Nigeria's economy. The country is currently experiencing crisis as a result of the instability of the petroleum/oil sector, which the country has come to depend on economically in the recent past. Meanwhile, agriculture used to be the bedrock of

Nigeria's existence. Hence, it is possible that consciously promoting KT for evidence informed agriculture policy making in Nigeria can result in potentially improving the agriculture sector in Nigeria, which could yield the overall goal of strengthening the socio-economic situation in Nigeria. According to Chigbu (2014), good agricultural policies and implementation is still the only "big fish" that can transport Nigeria's economy to the path of recovery and boom.

9.4 Limitations of the study

This study, like many other research studies has limitations manifested in its conceptualization and execution. The questionnaire was originally designed for KT in health but despite the careful attempt to modify it for KT in agriculture, some of the responses might not have been totally accurate as the concept of knowledge translation seemed relatively new to some of the researchers. In addition, the questionnaire was self-administered and the inherent bias in self-reporting cannot be overlooked. The findings from the bibliometric analysis were greatly reliant on the source of data from only two research institutes which are not necessarily representative of the other thirteen. The limitation to this is that the findings may have been different if the original data intended for the bibliometric study was used. Having asked the researchers to list up to five of their published journal articles, it was assumed that the 208 researchers who answered this question would have written down their best (and possibly most impactful) articles. These publications might have received more citations than the publications obtained from CRIN and NSPRI websites. The investigator could have searched for publications by researchers in the other 13 NARIs using Google Scholar, but this would have been

very time consuming, and given that the bibliometric study was a minor aspect of the entire study, it was not considered justifiable to expend such efforts.

9.5 Areas of future research

Future research could be carried out from the farmers' perspective. This is because even though agriculture researchers reported more instances of KT to farmers, it would be important to explore how well the current extension structure works as a knowledge brokering activity from the perspective of farmers. A future study could also carry out the bibliometric analyses with the complete publication list from researchers in all 15 agriculture research institutes. From the literature on KT and also as a result of findings from the interviews, future studies in KT (generally) should aim to understand what comes first, the chicken or the egg? Where does the cycle emanate? Should research inform practice / policy? Or should policy / practice influence research?

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Appendix A: Data collection Instruments at NARI

Project Title: Investigating the Knowledge Translation Practices of Agriculture Researchers in Nigeria

Dr. Isola Ajiferuke (Principal Investigator) and Isioma Elueze (PhD Candidate / research student)
Western University

Letter of Information

1. Invitation to Participate

You are being invited to participate in this research study aimed at investigating the knowledge translation practices of researchers in the National Agriculture Research Institutes (NARIs) in Nigeria because you are a researcher in one of the NARIs

2. Purpose of the Letter

The purpose of this letter is to provide you with the information you require to make an informed decision on participating in this research.

3. Purpose of this Study

The purpose of this study is to investigate the KT practices in the agricultural sector of Nigeria, and to contribute to the research on KT. It aims to understand the KT practices of the researchers in the National Agriculture Research Institutes (NARIs) in Nigeria as well as the FMARD public policy actors' research knowledge use.

4. Inclusion Criteria

Full-time researchers in the 15 NARIs supervised by the Agriculture Research Council of Nigeria (ARCN) of the Federal Ministry of Agriculture and Rural Development (FMARD), Nigeria.

5. Exclusion Criteria

Personnel who work at the NARIs, but do not carry out agriculture research.

6. Study Procedures

If you agree to participate in the study, it will consist of filling a questionnaire pertaining to your knowledge translation practices. The questionnaire will take about 15 minutes to complete.

7. Possible Risks and Harms

There are no known or anticipated risks or discomforts associated with participating in this study.

8. Possible Benefits

You may not directly benefit from participating in this study. However, questions in the questionnaire may suggest areas for improvement of your KT practices. And you will be more familiar with contemporary KT practices.

9. Compensation

Participants who complete the study will be compensated with a Western University branded stationery, in appreciation for their time. Participants who do not complete the study will not be compensated.

10. Voluntary Participation

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your employment.

11. Confidentiality

All data collected will remain confidential and accessible only to the investigators of this study. If the results are published, your name will not be used. In the event that you withdraw from the study, the data collected from you will be destroyed. You will be identified using numeric codes in the data collected from you. All the information that is collected during the study will be stored securely in my supervisor's professor's office (Prof Isola Ajiferuke) and will be destroyed 5 years after the study is completed.

12. Contacts for Further Information

If you have questions about this study, please contact Isioma Elueze by email at [redacted].

If you require any further information regarding this research project or your participation in the study, you may also contact the Principal Investigator, Professor Isola Ajiferuke at [redacted].

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics [redacted], email: [redacted].

13. Publication

If the results of the study are published, your name will not be used. If you would like to receive a copy of any potential study results, please contact Isioma Elueze by email at [redacted].

14. Consent

You indicate your voluntary agreement to participate by completing the consent form.

Consent Form

Project Title: Investigating the Knowledge Translation Practices of Agriculture Researchers in Nigeria

Study Investigators' Names: Dr. Isola Ajiferuke and Isioma Elueze

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Participant's Name (please print):

_____

Participant's Signature:

_____

Date:

_____

Person Obtaining Informed Consent (please print):

_____

Signature:

_____

Date:

_____

THE UNIVERSITY OF WESTERN ONTARIO
FACULTY OF INFORMATION AND MEDIA STUDIES
Questionnaire for investigating the knowledge translation practices by researchers in the National Agriculture Research Institutes in Nigeria

Dear Respondent,
I am a doctoral candidate in the Faculty of Information and Media Studies, University of Western Ontario, Canada carrying out a study ***investigating the knowledge translation practices of researchers in the National Agriculture Research Institutes in Nigeria*** as part of the requirements for the award of a degree of doctor of Philosophy in Library and Information Science. Kindly assist in filling out this questionnaire as candidly as possible. All the data you supply will be used only for research purposes, your responses will be kept confidential and data will not be reported in ways that could potentially identify you or your organization.

Isioma Elueze (E-mail: [redacted] / [redacted])

Researchers undertake a variety of activities to communicate their research findings to potential users with the aim that research knowledge will be considered and/or acted upon outside the scholarly community (i.e., by individuals other than researchers). Historically these efforts have had a variety of titles including: research transfer, technology transfer, communications, dissemination, knowledge mobilization, and knowledge translation. I use the term *knowledge translation* (KT) throughout this questionnaire for consistency but not to imply an endorsement of any one term or approach.

As an information scientist, I hope to learn more about how researchers in the National Agriculture Research Institutes in Nigeria currently communicate their research findings to decision makers and policy actors in the Federal Ministry of Agriculture and Rural Development (FMARD). My interest is in what you have done, not what you considered doing or planned to do. And the purpose of this questionnaire is to learn about how you have undertaken and viewed these activities and about the context in which you undertook them.

Please check or circle the most appropriate response for each question. If you have specific comments on any issues raised in particular questions, please identify the question by number and add your comments in the space provided on the final page of the questionnaire.

1) What is your sex? ☐ Male ☐ Female

2) What is your age range? ☐ < 26 ☐ 26 – 30 ☐ 31 – 35 ☐ 36 – 40 ☐ 41 – 45 ☐ 46 – 50 ☐ 51 – 55 ☐ 56 – 60 ☐ 61 – 65 ☐ > 65

3) What is your highest academic degree?
☐ Ordinary National Diploma
☐ Higher National Diploma
☐ Bachelor's degree
☐ Master's degree
☐ Doctorate degree
☐ Other degree (Please specify)
_____

4) What is your current position / rank within your research institute? ☐ Research officer II ☐ Research officer I ☐ Senior Research Officer ☐ Principal research officer ☐ Chief research officer ☐ Assistant director ☐ Director ☐ Other, please specify_____

5) How long have you worked in your research institute? ☐ < 1 year ☐ 1 – 5 years ☐ 6 – 10 years ☐ 11 – 15 years ☐ 16 – 20 years ☐ 21 – 25 years ☐ > 25 years

6) What are your area(s) of specialization in agriculture research? _____

7) Please indicate how often you and/or your research institute undertook knowledge translation activities related to your agriculture research for each of the following categories of potential research users.

		Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5
a.	Federal Ministry of Agriculture and Rural Development (FMARD) public policy-actors (i.e., elected officials, political staff, and civil servants)	1	2	3	4	5
b.	Agricultural goods / service providers (e.g. farmers, poultry owners, food stuff traders etc.)	1	2	3	4	5
c.	Managers in agricultural institutions, agro technology companies, non-governmental organizations	1	2	3	4	5
d.	General public	1	2	3	4	5
e.	Members of staff in other supervisory / affiliated / donor agencies (e.g., Agriculture Research Council of Nigeria, State Ministries of Agriculture, Local Governments) and International Organizations (FAO, IFAD, UNDP, World bank ADP, CGIAR Consortium, IITA, IFPRI)	1	2	3	4	5
f.	Other(s) – please specify: _____	1	2	3	4	5

8) If you answered anything other than "never" for question 7a, **please answer all remaining questions specific to KT activities with FMARD**. If you have never conducted KT activities with FMARD, please answer all remaining questions specific to the next most important audience defined in question 7.
What is this more important (non-FMARD) audience?
_____

The following questions ask how often you undertook particular KT activities, and the possible response categories range from *never* to *always*. When answering these questions, please keep in mind that how often you undertook a KT activity may depend on how often it was feasible for you to do so, given the nature of the activity and the context in which you work.

- If you undertook a particular KT activity whenever it was feasible to do so, please indicate:
  - *always* if you undertook the activity every single time it was feasible or
  - *frequently* if you did so almost every single time it was feasible.
- If you undertook a particular KT activity at least once but much less often than it was feasible to do so, please indicate:
  - *occasionally* if you undertook the activity more often than not or
  - *rarely* if you hardly ever did so.
  - If you never undertook a particular KT activity whether it was feasible to do so or not, please indicate *never*.

Please answer all questions about knowledge translation based on your *usual* practices and your research institute's *usual* practices, and not what you and/or your research institute considered doing or planned to do.

9) Please indicate how often you (and/or your institute working in conjunction with you or on your behalf) performed each of these knowledge translation (KT) activities.

	Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5
a.	Provided full reports on research projects to your target audience, either in hard copy or electronically	1	2	3	4	5
b.	Provided brief summaries of research reports to your target audience, either in hard copy or electronically	1	2	3	4	5
c.	Mailed or emailed full reports on research projects to your target audience	1	2	3	4	5
d.	Mailed or emailed brief summaries of research reports to your target audience	1	2	3	4	5
g.	Developed messages for your target audience that specified possible action (i.e., recommendations, take-home messages, actionable messages)	1	2	3	4	5

10) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) performed each of the following knowledge translation activities.

	Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5
a.	Obtained or updated contact information for your target audience	1	2	3	4	5
b.	Obtained or reviewed information about your target audience concerning their needs and goals	1	2	3	4	5
c.	Developed reports, summaries or messages that were appealing to your target audience by using language appropriate to your target audience	1	2	3	4	5
d.	Developed reports, summaries or messages that provided examples or demonstrations of how your target audience could use the research	1	2	3	4	5
e.	Tailored other aspects of your KT approach to your target audience	1	2	3	4	5
f.	Spent time with your target audience discussing your research reports	1	2	3	4	5
g.	Spent time with your target audience discussing ideas based on research findings for possible action	1	2	3	4	5

11) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) performed each of these knowledge translation (KT) activities.

	Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5
a.	Worked with knowledge translation specialists in your research institute	1	2	3	4	5
b.	Reviewed the research literature about effective approaches to knowledge translation	1	2	3	4	5
c.	Reviewed information from websites about effective approaches to KT	1	2	3	4	5
d.	Participated in KT skill-building activities, such as conferences or courses about KT	1	2	3	4	5
e.	Shared experiences with people performing KT roles in other organizations like your own	1	2	3	4	5
f.	Identified and worked with KT specialists outside your research institute	1	2	3	4	5
g.	Identified and worked with people outside your research institute who bring researchers and their target audiences together and build relationships among them that make knowledge translation more effective (knowledge brokers / intermediaries)?	1	2	3	4	5

h.	Identified and worked with the most credible messengers for your target audience (i.e., those who, regardless of their role, are seen as credible by members of your target audience)	1	2	3	4	5
i.	Developed relationships with print, radio and/or television journalists	1	2	3	4	5

12) Please provide about five (5) references to publications of some salient findings from your own research at the research institute, if possible.

1. _____
2. _____
3. _____
4. _____
5. _____

13) Please list up to five (5) most recent presentations that you have made at a workshop or conference.

1. _____
2. _____
3. _____
4. _____
5. _____

14) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) performed each of the following knowledge translation activities.

Never 1	**Rarely 2**	**Occasionally 3**	**Frequently 4**	**Always 5**				
a.	Provided *at a cost* and upon request articles, reports, syntheses or formal systematic reviews as a result of your research for your target audience	1	2	3	4	5		
b.	Provided *free* upon request articles, reports, syntheses or formal systematic reviews for your target audience	1	2	3	4	5		
c.	Provided *free* upon request *brief summaries* of articles, reports, syntheses formal systematic reviews or *messages* that specified possible action for your target audience	1	2	3	4	5		
d.	Mailed or e-mailed to your target audience *notices* that new material of potential interest to them as a result of your research had been posted to a website	1	2	3	4	5		
e.	Mailed or e-mailed to your target audience articles, reports, syntheses or formal systematic reviews *without an explicit request* from some or all members of your target audience	1	2	3	4	5		
f.	Mailed or e-mailed to your target audience *brief summaries* of articles, reports, syntheses or formal systematic reviews and/or *messages* that specified possible action for your target audience *without an explicit request* from some or all members of your target audience	1	2	3	4	5		
g.	Mailed or e-mailed to your target audience a *newsletter* containing brief summaries or messages or dedicated sections for your target audience	1	2	3	4	5		
h.	Submitted *media releases* from your research to print, radio or television journalists	1	2	3	4	5		
i.	Published research in non-scholarly publications read by your target audience (e.g., general interest magazines for the general public)	1	2	3	4	5		

15) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) interacted with members of your target audience *in each of the following stages of the research process* for your research projects.

Never 1	**Rarely 2**	**Occasionally 3**	**Frequently 4**	**Always 5**

a.	Interacted when developing a specific research question, objectives or hypotheses	1	2	3	4	5
b.	Interacted when establishing the preferred research design and methods	1	2	3	4	5
c.	Interacted when executing the research	1	2	3	4	5
d.	Interacted when analyzing / interpreting the research findings	1	2	3	4	5
e.	Interacted when developing research products (e.g., research reports, brief summaries or messages)	1	2	3	4	5
f.	Interacted when undertaking KT activities for your target audience	1	2	3	4	5
g.	Interacted when responding to individual queries resulting from your research products or knowledge translation efforts	1	2	3	4	5

16) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) interacted with members of your target audience about your research in the following contexts *outside of the research process per se*.

Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5				
a.	Interacted through government-sponsored meetings involving your target audience	1	2	3	4	5		
b.	Interacted through an expert committee or group involving your target audience	1	2	3	4	5		
c.	Interacted through conferences and workshops involving your target audience	1	2	3	4	5		
d.	Interacted through formal private or public networks involving your target audience	1	2	3	4	5		
e.	Interacted through events organized by you or your research institute	1	2	3	4	5		
f.	Interacted through events organized by your target audience	1	2	3	4	5		
g.	Interacted through events organized by print, radio or television journalists	1	2	3	4	5		
h.	Interacted through informal conversations with your target audience	1	2	3	4	5		
i.	Interacted through events organized by bilateral, regional or international organizations (e.g., IFAD, FAO, CGIAR research centres – IITA, IFPRI, CIAT, CIFOR, AfricaRice, etc.)	1	2	3	4	5		
j.	Interacted through other mechanism - please specify: _____	1	2	3	4	5		

17) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) performed each of these knowledge translation activities to make it easier for your target audience to obtain research findings when they needed it.

Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5				
a.	Posted on your website reports from your research studies	1	2	3	4	5		
b.	Provided access to a searchable database of articles, reports, syntheses, and or formal systematic reviews on relevant agriculture research	1	2	3	4	5		
c.	Provided access to a searchable database of summaries of articles, reports, syntheses or formal systematic reviews or messages that specified possible action for your target audience	1	2	3	4	5		
d.	Clearly identified in websites, newsletters the specific individual(s) who was involved in the development of a report, summary or message	1	2	3	4	5		

e.	Clearly identified in websites, newsletters the specific individual(s) who could answer questions about research	1	2	3	4	5
f.	Maintained some reserve capacity (i.e., financial or human resources that can be redirected when required) to conduct short-term research projects in response to requests from your target audience	1	2	3	4	5
g.	Other – please specify: _____	1	2	3	4	5

18) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) conducted workshops or seminars to increase the capacity of your target audience to use your research knowledge.

Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5				
a.	Developed capacity of target audience to *acquire* research through searchable databases	1	2	3	4	5		
b.	Developed capacity of target audience to *assess* the quality and applicability of research	1	2	3	4	5		
c.	Developed capacity of target audience to *adapt* research to increase its perceived relevance	1	2	3	4	5		
d.	Developed capacity of target audience to *apply* research knowledge (e.g., by combining research with other types of information relevant to the decisions they face)	1	2	3	4	5		

19) Please indicate how often you (and/or your research institute working in conjunction with you or on your behalf) performed each of the following KT activities.

Never 1	Rarely 2	Occasionally 3	Frequently 4	Always 5				
a.	Established or maintained long term *partnerships* with representatives or members of your target audience (e.g., through an advisory board)	1	2	3	4	5		
b.	Involved members of your target audience in conducting a *needs assessment* for your target audience	1	2	3	4	5		
c.	Involved members of your target audience in establishing the *overall direction of research* conducted by you and your research institute	1	2	3	4	5		
d.	Involved members of your target audience in establishing the *overall direction of KT activities* undertaken by you and your research institute	1	2	3	4	5		
e.	Involved members of your target audience in *assessing the progress of research* conducted by you and your research institute	1	2	3	4	5		
f.	Involved members of your target audience in *assessing the progress of KT activities* undertaken by you and your research institute	1	2	3	4	5		

20) Please estimate the percentage of your own total work time during a *typical 12-month period* in which you spent performing KT activities. _____ %

21) Please indicate the degree to which you agree or disagree with the following statements concerning the state of research knowledge when you were involved in your research and knowledge translation activities.

Strongly Disagree 1	Disagree 2	Neither agree nor disagree 3	Agree 4	Strongly agree 5				
a.	No synthesis was possible because there was too much research available	1	2	3	4	5		
b.	One or more syntheses were available for use by your target audience	1	2	3	4	5		
c.	No synthesis was possible because research was confidential	1	2	3	4	5		

d.	No synthesis was possible because research was out of date	1	2	3	4	5
e.	One or more syntheses were available but not in language appropriate to your target audience (e.g., non-technical language for the general public and civil society groups)	1	2	3	4	5
f.	No synthesis was possible because research was lacking on important issues	1	2	3	4	5

22) Please indicate the degree to which you agree or disagree with the following statements concerning the barriers and facilitators of knowledge translation when you were involved in your research and KT activities.

Strongly Disagree 1	**Disagree 2**	**Neither agree nor disagree 3**	**Agree 4**	**Strongly agree 5**

a.	The cost for translating research knowledge from my agriculture research into action was very low	1	2	3	4	5
b.	KT activities could be paid for through research grants for which I was eligible to apply	1	2	3	4	5
c.	Structures and processes existed to link researchers and your target audience	1	2	3	4	5
d.	Personal and organizational contacts among your target audience were quite stable over time	1	2	3	4	5
e.	Perceived crises in the agriculture system drew attention away from agriculture research	1	2	3	4	5
f.	Target audience lacked the expertise for translating research knowledge into action	1	2	3	4	5
g.	Target audience had access to technical support for translating research knowledge into action	1	2	3	4	5
h.	Target audience did not make decisions about the agriculture issue on the basis of research	1	2	3	4	5
i.	Target audience created opportunities to develop joint research initiatives with them	1	2	3	4	5
j.	Target audience invested financial and/or human resources in joint research initiatives	1	2	3	4	5
k.	Target audience created events for knowledge translation related to the agriculture research (e.g., forums that bring researchers and target audiences together for discussion)	1	2	3	4	5
l.	Target audience invested financial and/or human resources in knowledge translation activities (e.g., hired staff to identify and make available relevant research)	1	2	3	4	5

23) Please indicate whether you had access to the following information sources when you were involved in your research and knowledge translation activities.

Yes	**No**	**Don't Know**

a.	Had access to at least five scientific journals indexed in international reference databases	Yes	No	Don't know
b.	Had access to at least five scientific journals published locally, nationally or regionally	Yes	No	Don't know
c.	Had access to the internet at least once a month to conduct and download searches	Yes	No	Don't know
d.	Had access to a personal computer with a functional internet connection at all times to conduct and download searches	Yes	No	Don't know

24) Please indicate the extent to which you agree or disagree with the following statements concerning support for KT within your research institute when you were involved in your research and KT activities.

Strongly Disagree 1	Disagree 2	Neither agree nor disagree 3	Agree 4	Strongly agree 5

a.	The translation of research was hampered by a lack of academic rewards for KT activities	1	2	3	4	5
b.	The translation of research was helped by requirements within my institute to publish findings	1	2	3	4	5
c.	The translation of research was helped by the mix of researchers and target audience within my research institute	1	2	3	4	5
d.	My research institute made available financial and human resources to assist me with KT activities	1	2	3	4	5
e.	My research institute assumed responsibility for undertaking KT activities on my behalf	1	2	3	4	5
f.	My research institute was not seen as a credible source of agriculture research knowledge	1	2	3	4	5

25) Please indicate the degree to which you agree or disagree with the following statements concerning the level of support you have received for your research and knowledge translation activities over time.

Very unsupportive 1	Unsupportive 2	Neither supportive nor unsupportive 3	Supportive 4	Very supportive 5

a.	How supportive was the agriculture research environment in Nigeria when you began conducting your agriculture research of individuals who *conducted your type of research*?	1	2	3	4	5
b.	Over the time you conducted your research, how supportive has the *agriculture research environment in Nigeria* become of individuals who *conducted your type of research*?	1	2	3	4	5
c.	How supportive was the *agriculture research environment in Nigeria* when you began conducting your research of individuals who *undertook KT activities* related to your research?	1	2	3	4	5
d.	Over the time that you undertook your KT activities, how supportive has the *agriculture research environment in Nigeria* become of individuals who *undertook KT activities* related to your research area?	1	2	3	4	5
e.	How supportive was your *research institute* when you began conducting your research of individuals who *conducted your type of research?*	1	2	3	4	5
f.	Over the time that you conducted your research, how supportive has your *research institute* become of individuals who *conducted your type of research?*	1	2	3	4	5
g.	When you began conducting your research, how supportive was your *research institute* of individuals who *undertook KT activities* related to your research area?	1	2	3	4	5
h.	Over the time that you undertook KT activities, how supportive has your *research institute* become of individuals who *undertook KT activities* in your research area	1	2	3	4	5

26) Please indicate the degree to which you agree or disagree with the following statements concerning your research at the time you were conducting it and your views about who should be responsible for KT.

Strongly Disagree 1	Disagree 2	Neither agree nor disagree 3	Agree 4	Strongly agree 5

a.	My research was not considered relevant by target audience	1	2	3	4	5
b.	My research coincided with Nigeria's priorities (e.g., with a National Research Agenda)	1	2	3	4	5
c.	My research coincided with the needs and expectations of target audience	1	2	3	4	5
d.	My research lacked credibility among target audience	1	2	3	4	5
e.	My research was not yet ready for use	1	2	3	4	5
f.	Researchers who conduct agriculture research are primarily responsible for KT activities related to their agriculture research	1	2	3	4	5
g.	Target audience for agriculture research are primarily responsible for KT activities related to the agriculture research	1	2	3	4	5
h.	Both researchers and target audience are jointly responsible for KT activities related to the agriculture research	1	2	3	4	5

27) Who acts as intermediaries for the translation of your research knowledge to the policy actors in the Federal Ministry of Agriculture and Rural Development in Nigeria or your target audience?

_____

28) Please describe other knowledge translation activities that you performed for policy actors in the Federal Ministry of Agriculture and Rural Development or your target audience that were not covered in this questionnaire.

_____

_____

_____

_____

_____

Do you have any additional comments?

_____

_____

_____

_____

_____

Thank you for completing the questionnaire.

Interview guide for understanding the knowledge translation practices of the researchers at the National Agriculture Research Institutes

The purpose of this interview is to learn more about how you and the researchers in your research institute transfer your research findings to the directors at the Federal Ministry of Agriculture and Rural Development.

1) Tell me about the type of research you do at your research institute.
2) Can you briefly describe to me how your research institute is affiliated to the FMARD?
   Suggested probes
   a. How does the ministry typically provide funding for the NARIs?
   b. Who decides what research studies are carried out at your research institute?
3) How does your research institute go about getting your research results to the FMARD?
   Suggested probes
   a. Who does what?
   b. How often do you send your research findings to the FMARD?
   c. In what formats do you typically send these findings?
   d. Do you usually include actionable messages / implications for policy in your findings?
   e. Have you / do you at any point use intermediaries in your interactions with the FMARD?
4) Can you walk me through a recent example of how your research institute transferred the results / findings from your research to the FMARD?
   Suggested probes
   a. How soon after the completion of the research were the findings sent?
   b. Who did what?
   c. In what formats did you send these findings?
   d. What worked well? What didn't?
5) If a research study was not commissioned by the FMARD, do you still make attempts to transfer your findings to FMARD? How? Or why not?
6) Apart from the FMARD, who are the potential users of your research? Please explain the connection between your research and them (i.e., why they are the potential users)
7) How does your research institute go about getting your research to these potential users? – can you walk me through an example?
   Suggested probes
   a. How soon after the completion of the research were the findings sent?
   b. Who did what?
   c. In what formats did you send these findings?
   d. What worked well? What didn't?
8) What support does the research institute provide for knowledge translation activities?

Appendix B: Instruments for interviews at FMARD

Project Title: Investigating the Knowledge Translation Practices of Agriculture Researchers in Nigeria

Dr. Isola Ajiferuke (Principal Investigator, Western University) and Isioma Elueze (PhD Candidate / research student, Western University)

Letter of Information

1. Invitation to Participate

You are being invited to participate in this research study aimed to investigate the knowledge translation practices of researchers in the National Agriculture Research Institutes (NARIs) in Nigeria because you work in a technical department in the Federal Ministry of Agriculture and Rural Development (FMARD) of Nigeria.

2. Purpose of the Letter

The purpose of this letter is to provide you with the information you require to make an informed decision on participating in this research.

3. Purpose of this Study

The purpose of this study is to investigate the KT practices in the agricultural sector of Nigeria, and to contribute to the research on KT. It aims to understand the KT practices of the researchers in the National Agriculture Research Institutes (NARIs) in Nigeria as well as the FMARD public policy actors' research knowledge use.

4. Inclusion Criteria

Full-time researchers in the 15 National Agriculture Research Institutes supervised by the Agriculture Research Council of Nigeria (ARCN); and the heads of the technical departments in the FMARD, Nigeria.

5. Exclusion Criteria

People working at the NARIs who do not carry out agriculture research; and personnel who do not work in the technical departments of the FMARD.

6. Study Procedures

If you agree to participate in the study, it will consist of an interview session concerning how you acquire, assess, adapt and use research knowledge in the context in which you work.

7. Possible Risks and Harms

There are no known or anticipated risks or discomforts associated with participating in this study.

8. Possible Benefits

You may not directly benefit from participating in this study.

9. Compensation

Participants who complete the study will be compensated with a Western University branded stationery, in appreciation for their time. Participants who do not complete the study will not be compensated.

10. Voluntary Participation

Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your employment.

11. Confidentiality

All data collected will remain confidential and accessible only to the investigators of this study. If the results are published, your name will not be used. In the event that you withdraw from the study, the data collected from you will be destroyed. You will be identified using numeric codes in the data collected from you. All the information that is collected during the study will be stored securely in my supervisor's professor's office (Prof Isola Ajiferuke) and will be destroyed 5 years after the study is completed.

12. Contacts for Further Information

If you have questions about this study, please contact Isioma Elueze by email at [redacted].

If you require any further information regarding this research project or your participation in the study, you may also contact the Principal Investigator, Professor Isola Ajiferuke at [redacted].

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Research Ethics [redacted], email: [redacted].

13. Publication

If the results of the study are published, your name will not be used. If you would like to receive a copy of any potential study results, please contact Isioma Elueze by email at [redacted].

15. Consent

You indicate your voluntary agreement to participate by completing the consent form.

Consent Form

Project Title: Investigating the Knowledge Translation Practices of Agriculture Researchers in Nigeria

Study Investigators' Names: Dr. Isola Ajiferuke and Isioma Elueze

I have read the Letter of Information, have had the nature of the study explained to me and I agree to participate. All questions have been answered to my satisfaction.

Participant's Name (please print):

_____

Participant's Signature:

_____

Date:

_____

Person Obtaining Informed Consent (please print):

_____

Signature:

_____

Date:

_____

Interview Guide for Assessing Research Knowledge Use by the Policy actors in the Nigerian Federal Ministry of Agriculture and Rural Development

The purpose of this interview is to learn more about if, and how you use research knowledge generated from the National Agriculture Research Institutes (NARIs) in the context of your work.

1. Can you describe to me what your present role is in the FMARD?
   Suggested probes
   a. What does it entail?
   b. How long have you been doing it?
   c. What were previous (relevant) roles?

2. Can you describe the relationship between the FMARD and the NARIs?
   Suggested probes
   a. How does the ministry typically provide funding for the NARIs?
   b. Can you describe this using a particular NARI?

3. Can you describe to me a situation when you have had to use knowledge from the research generated from any of the NARIs? Say in the past 3 years
   a. Suggested probes – barriers/facilitators? Outcomes?

4. Can you now describe to me a situation where you could have used research knowledge generated at the NARIs in your work, but you did not.
   a. Suggested probes - why? What happened?

5. Have you, or has anyone you know of in your ministry requested for any research studies to be carried out by any of the researchers at any of the NARIs?
   Suggested probes
   a. Can you give me a brief description of these studies and what necessitated them?
   b. When this request was made, what were your expectations from the researchers / research institutes?
   c. What triggered/motivated such request?

6. How often do you receive findings from the National Agriculture Research Institutes?
   Suggested probes
   a. In what formats do you receive these findings?
   b. From which institute(s)?
   c. What do the findings contain?
   d. Do you find that you are able to understand the research findings from the NARIs?
   e. Opinion about the quality of research that is being done at the NARIs?

7. Based on your experience, how do the research studies carried out at the NARIs meet or not meet your ministry's present needs / priorities / the agriculture policy agenda of Nigeria? Example?

8. Do you have events that bring you in contact with researchers at the NARIs?
   Suggested probes
   a. What types of events?
   b. Who organizes these events?

9. How could interaction between the Ministry and the NARIs be improved?
   Suggested probes - is this a priority? (why/why not?)

Appendix C: Research Ethics Approval Notice

Western Research

Research Ethics

Western University Health Science Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. Isola Ajiferuke
Department & Institution: Information and Media Studies,Western University

NMREB File Number: 106389
Study Title: Investigating the knowledge translation practices of agriculture researchers in Nigeria
Sponsor: Western Graduate Research Scholarship

NMREB Initial Approval Date: April 30, 2015
NMREB Expiry Date: April 30, 2016

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Instruments	Interview guide for heads of agriculture research institutes	2015/02/09
Instruments	Interview guide for policy actors in FMARD	2015/02/09
Instruments	Questionnaire for agriculture researchers	2015/02/09
Revised Letter of Information & Consent		2015/03/13
Letter of Information	Information letter for policy actors	2015/03/13
Letter of Information	Information letter for researchers	2015/03/13
Revised Western University Protocol	Revised Western Research ethics protocol _ Clean copy	2015/04/16

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.

...ics Officer, on behalf of Riley Hinson, NMREB Chair or delegated board member

Ethics Officer to Contact for Further Information

Erika Basile	Grace Kelly	Mina Mekhail	Vikki Tran

This is an official document. Please retain the original in your files.

Western University, Research,
London, ON, Canada

Appendix D: Brief overview of the different National Agricultural Research Institutes under the purview of the FMARD

National Root Crops Research Institute (NRCRI) has the responsibility of conducting research into genetic improvement of root and tuber crops of economic importance in Nigeria, such as cassava, yam, cocoyam, sweet potato, Irish potato, ginger, rizga, Hausa potato, sugar beets and turmeric. It is also involved in research concerning the agronomy of root and tuber crop production including farming systems development for the South-East agro ecology. Researchers at this institute investigate socio-economic problems related to root and tuber crop production, storage, processing and utilization of root and tuber crops. They also design and fabricate simple agricultural farm tools and equipment. The NRCRI has the zonal mandate for the total farming systems research and extension covering nine states of the South-Eastern Nigeria, in addition to carrying out agricultural extension liaison with relevant federal and state ministries, primary agricultural producers, industries and other users of their research findings (http://www.nrcri.gov.ng/, 2014).

National Horticultural Research Institute (NIHORT) is the only horticultural research institute in Nigeria and in West African with a mandate to carry out research on fruits, vegetables, spices and ornamental plants. NIHORT has at its apex an executive director, who is the research and administrative head of the institute. Their research activities include; citrus, fruit, vegetable, spices and floriculture improvement, farming systems research and extension, and product development (ARCN, 2014).

Researchers at the Nigerian Institute for Oil Palm Research (NIFOR) carry out studies into the genetic improvement, production and processing of oil palm, raphia date, coconut and ornamental palms (http://nifor.org/, 2014), while their colleagues at the Rubber Research Institute of Nigeria (RRIN) study the genetic improvement, production and processing of rubber and other latex producing plants (ARCN, 2014).

Cocoa Research Institute of Nigeria (CRIN) was established in Ibadan, Oyo State, Nigeria on the 1st of December, 1964 as a successor autonomous research organization to the Nigerian substation of the then West African Cocoa Research Institute (WACRI). Not long after its establishment, the scope of CRIN was expanded to include research on kola

and coffee in addition to cocoa. Later in 1975, the reach of CRIN research activities was further broadened to include cashew and tea. Consequently, researchers at CRIN have the mandate to conduct research on cocoa, kola, coffee, cashew and tea throughout the country (http://www.crin-ng.org/, 2014).

The Institute of Agricultural Research & Training (IAR&T) carries out agriculture research, services and training activities. It equally serves as a national centre for the integrated improvement of the genetic yield and nutritional quality of major food and agro-industrial crops, livestock and other commodities adapted to the agro-ecological zones of South-Western Nigeria. Research at this institute investigates, develops, evaluates, validates and promotes farming systems that would increase and maximize the overall agricultural productivity of Nigeria. The institute functions to provide adequate and relevant manpower training for national agricultural development. It also collaborates with other universities, national, regional and international institutions in the validation and practical application and adoption of improved agricultural production technologies (http://www.iart-ngonline.org/, 2014).

National Institute for Freshwater Fisheries Research (NIFFR) was set up in 1968 by the Federal Government of Nigeria with assistance from the United Nations Development Programme (UNDP), and it was formerly known as Kainji Lake Research Projects. The Institute was one of the twenty-five Agricultural Research Institutes under the supervision of the Federal Ministry of Science and Technology. However, because of the re-organization of some of the research institutes within the Federal Ministry of Science and Technology in 1987, the mandate of the institute changed from the multi-commodity institution, to a mono-commodity research institute based on freshwater fisheries and aquatic resources, with emphasis on hydrology, fish biology, fisheries management, limnology, environment, fisheries technology, hatchery management, aquaculture, socio-economics, extension liaison services and training. The name of the institute was changed in 1988 to NIFFR to reflect the new mandate.

National Veterinary Research Institute (NVRI) conducts research into all aspects of animal diseases, their treatment and control, develops and produces animal vaccines, provides surveillance and diagnosis of animal diseases, and presents exotic stock for improved egg, meat and milk production. Researchers at this institute provide extension

services to poultry and livestock farmers, as well as train workers in veterinary laboratory technology, animal health and production technology. The Institute has the following technical divisions - research, production, diagnostic services and extension, livestock investigation, planning, monitoring and evaluation, and quality control (http://www.nvri.gov.ng/, 2014).

Nigerian Stored Products Research Institutes (NSPRI) was established in 1954 to conduct research in all aspects of post-harvest handling of agricultural crops and their products, pesticide development, residue analysis and mycotoxin surveys on food items in Nigeria. Although, the institute's initial focus was on export crops, their mandate has further been expanded to include research into local food crops, extension and training (http://nspri.org.ng/, 2014). They aim to be a leading provider of agricultural postharvest solution in Nigeria and the West African sub-region.

National Cereals Research Institute is the oldest research institute in Nigeria, originally founded by the Lagos colonial protectorate administration of Governor Alfred Moloney in 1898. It was named the Federal Agricultural Station by the Lugard administration in 1915. It later metamorphosed into the Federal Department of Agricultural Research in 1945 with a mandate to carry out research on all agricultural crops and farming systems throughout the country. But in 1975, it assumed its present name; National Cereals Research Institute (NCRI) and was given the mandate to conduct research into the genetic improvement and production of the major stable grains like rice, maize, cowpea and sugarcane. The re-organization of the agricultural research system in 1987 gave NCRI new mandate crops which were rice, soybean, beniseed, sugarcane, and to oversee the farming system in the middle belt zone comprising of Benue, Kogi, Kwara, Nassarawa, Niger, Plateau, Taraba states and the Federal Capital Territory, Abuja (ARCN, 2014).

Institute for Agricultural Research (IAR), Samaru, was established in 1922 as the research division of the Department of Agriculture for the then Northern Provinces of Nigeria. Since its establishment, IAR has been the bed-rock of crop research and improvement in the savannah region of Nigeria. Research at IAR is organized into research programme teams headed by a leader. And each team is comprised of at least one plant breeder, an agronomist, a soil scientist, a crop protectionist, an agricultural

engineer, an agricultural economist/rural sociologist and an extension specialist. IAR is mandated to conduct research into genetic improvement of cowpea, cotton, groundnut, maize, sorghum, castor and sunflower, and the problems of production of all agricultural food crops grown in the North-West agricultural zone covering Kaduna, Kano, Jigawa, Katsina, Kebbi, Sokoto and Zamfara states of Nigeria. IAR, Samaru, gave rise to the National Animal Production Research Institute (NAPRI) and the National Agricultural Extension and Research Liaison Services (NAERLS). The primary objective of NAPRI is to conduct applied research on food animal species as well as forage, and to develop appropriate technologies in breeding and reproduction, nutrition and management with the ultimate aim of improving the productivity of the animals for milk, meat, eggs, and traction power. NAPRI is the only research institute in Nigeria charged with the mandate of research in animal production. (http://www.napri-ng.org/, 2014). NAERLS, on the other hand, is concerned with the development, collation and dissemination of appropriate agricultural technologies, and the monitoring and evaluation of agricultural technology and its dissemination (http://www.naerls.gov.ng/index.php, 2014).

Lake Chad Research Institute (LCRI) on the other hand was institutionalized with the multidisciplinary mandate of conducting research on crops, fisheries, livestock, agro-forestry, wildlife and public health. However, following a re-appraisal of the mandates and functions of national research institutes in Nigeria in 1987, LCRI became a crop based research institute, charged with a new research mandate into genetic improvement of wheat, barley and millet. Researchers also look into the production problems of all agricultural food crops grown in the broad ecological zone covered by Borno, Yobe, Adamawa, Bauchi and Gombe States of Nigeria, with emphasis on farming systems including integration of livestock, tree crops and agro-forestry into production systems. Similarly, they provide agricultural extension and research liaison services with the relevant federal and state ministries, primary agricultural producers, industries and other users of research. They also provide laboratory and technical services to farmers and agro-based industries.

Nigerian Institute for Oceanography and Marine Research (NIOMR) is charged with responsibilities to conduct research into the resources and physical characteristics of the Nigerian territorial waters and the high seas beyond (ARCN, 2014).

Appendix E: Units of surveyed researchers in 13 NARIs

CRIN	**IAR&T**	**NIFOR**	**NAERLS**	**NAPRI**	**NVRI**	**NIOMR**
Agronomy	Grain Legumes Improvement	Agric Economics	Agricultural Engineering and Irrigation	Artificial Insemination	Agriculture Extension	Aquaculture
Economics & Statistics	Kenaf & Jute Improvement Research	Agronomy	Agricultural Media	Beef	Avian Influenza	Biological Oceanography
Entomology	Land & Water Resources Management Research	Biochemistry	Agriculture Extension and Economics	Dairy	Bacteria Production	Biotechnology
Extension	Maize Improvement	Chemistry	Crop and Forestry	Equine and Camel Research	Bacteria Research	Fish Technology & Product Development
Farming Systems Research	Product Development Research	Coconut Research	Food Technology and Rural Home Economics	Forage Research	Biochemistry	Fisheries resources
Pathology	South West Farming System Research and Extension	Date Palm Research	Livestock and Fisheries	Livestock System Research	Foot and Mouth Disease	Marine Geology / Geophysics
Plant Breeding	Trypanotolerant Livestock Improvement	Entomology		Poultry	Molecular Biology	Physical & Chemical Oceanography
Product Development		Extension		Small Ruminant	Quality Control	
Soil & Plant Nutrition		Oil Palm Research		Swine	Viral Production	
		Pathology				
		Plant Breeding				
		Raphia & Other Palms Research				
		Shea / Jojoba Tree Research				

NSPRI	**NIFFR**	**NIHORT**	**RRIN**	**NRCRI**	**IAR**	
Cereals and Pulses	Biotechnology & Aquaculture	Farming Systems and Extension	Agronomy	Cassava	Agricultural Mechanization Research	
Equipment Design and Fabrication	Extension & Farming Systems	Fruits and Biotechnology	Crop Improvement, Management & Biotechnology	Cocoyam	Cereal Research	
Fish and Meat	Natural Resources Management	Socioeconomics	Research Operations	Extension	Farming System Research	
Food Packaging	Nutrition & Health	Spices Improvement	Research Outreach	Farming Systems Research	Fiber Research	
Fruits and Vegetables	Products Development	Vegetables and Floriculture	Research Support	Ginger	Horticultural Research	
Oil Seeds and Beverages				Minor Root Crops	Legume and Oil Seeds Research	
Roots and Tubers				Post-harvest Technology		
				Potato		
				Sweet Potato		

Appendix F: Name and frequency of Journal appearance for researchers' publications

Name of Journal	Frequency
Advanced Crop Science	1
Advances in Environmental Biology	2
African Journal of Agricultural Research	4
African Journal of Biotechnology	6
African Journal of Food Science	2
African Journal of General Agriculture	4
African Journal of Plant Science	3
African Scientist	5
Agricultural Journal	3
Agricultural Sciences	2
Agrosearch	2
Albanian Journal Of Agricultural Science	1
American- Eurasian Journal of Agricultural and Environmental Sciences	4
American Journal of Experimental Agriculture	1
American Journal Of Research Communication	1
American-Eurasian Journal of Scientific Research	1
Applied Tropical Agriculture	5
Archives of Applied Science Research	1
ARPN Journal of Agricultural and Biological Sciences	6
Asia Academic Research Journal of Social Science & Humanities	1
Asian Journal of Agricultural Biology	3
Asian Journal of Agricultural Extension, Economics & Sociology	1
Asian Journal of Agricultural Science	4
Asian Journal of Agriculture and Food Science	1
Bioscience Research Communication	4
Bitlis Eren University Journal of Science & Technology.	1
Bowen Journal of Agriculture	1
British Journal of Applied Science & Technology	2
Bulletin of Science Association of Nigeria	2
Cocoa Mirror	1
Communications in Soil Science and Plant Analysis	1
Comprehensive Research Journal of Agricultural Science (CRJAS)	1
Elixir Applied Botany	1
Elixir Bioscience	1
Environtropica	1
European Journal of Applied Sciences	2
European Journal of Nutrition & Food Safety	1
Global Journal of Environmental Research	2

Greener Journal Of Agricultural Sciences	2
Ife Journal of Science	1
International Journal of Plant, Animal and Environmental Sciences	1
International Journal of Agriculture and Food Systems	1
International Journal of Advance Agricultural Research	2
International Journal of Agriculture and Rural Development	1
International Journal of Applied Research	1
International Journal of Applied Research and Technology	5
International Journal of Biochemistry Research	1
International Journal of ChemTech Research	1
International Journal of Current Research	1
International Journal of Engineering and Technology	2
International Journal of Food Research	1
International Journal of Plant & Soil Science	2
International Journal of Plant, Animal and Environmental Sciences	2
International Journal of Science and Nature	2
International Journal of Scientific & Engineering Research	1
International Journal of Scientific & Research Publication	1
International Journal of Sustainable Crop Production	1
International Journal of Tea Science	1
International Journal of Tropical Agriculture and Food Systems	1
International Research Journal of Agricultural Science	1
International Research Journal of Agricultural Science and Soil Science	3
International Research Journal of Plant Science	1
International Research Journal of Pure and Applied Chemistry	1
International Rice Research Notes	1
IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)	1
Journal of Agricultural Biotechnology and Sustainable Development	1
Journal of Agricultural and Biological Sciences	1
Journal of Agricultural and Veterinary Science	1
Journal of Agricultural Biosciences	2
Journal of Agricultural Production and Technology	1
Journal of Agricultural Science	8
Journal of Agricultural Science and Technology	2
Journal of Agricultural Sciences and Natural Resources	1
Journal of Agrobiotech	1
Journal of Animal Science Advances	1
Journal of Applied Biosciences	11
Journal of Asia-Pacific Entomology	1
Journal of Basic and Applied Scientific Research	3
Journal of Biopesticides	1

Journal of Chemical and Pharmaceutical Research	2
Journal of Chemical, Biological and Physical Sciences	2
Journal of Crop Protection	1
Journal of Food Technology	2
Journal of Food Technology in Africa	2
Journal of Food, Agriculture & Environment	1
Journal of Human Ecology	1
Journal of Innovation and Development Strategy	2
Journal of Interdisciplinary Science and Technology	1
Journal of Life Sciences	1
Journal of Microbiology and Food Science	1
Journal of Natural science	1
Journal of Pharmacy and Biological Sciences	2
Journal of Research in Bioscience	1
Journal of Scientific Research and Reports	2
Journal of Soil and Nature	5
Journal of Stored Products Research	1
Journal of World Association of Soil and Water Conservation	1
Libyan Agriculture Research Center Journal International	1
Middle-East Journal of Scientific Research	1
Moor Journal of Agricultural Research	7
Natural Science	1
Nigeria Journal of Agriculture, Forestry and the Social Sciences	1
Nigeria Journal of Weed Science	1
Nigerian Journal of Applied Science	1
Nigerian Journal of Botany	1
Nigerian Journal of Ecology	1
Nigerian Journal of Entomology	1
Nigerian Journal of Farm Management	1
Nigerian Journal of Horticultural Science	2
Nigerian Journal of Mycology	1
Nigerian Journal of Plant Protection	2
Nigerian Journal of Soil Science	21
Nigerian Tree Crops Research	1
NISEB Journal	1
Obeche Journal	7
Pakistan Journal of Nutrition	1
Pakistan Journal of Plant Pathology	1
Publication of Nassarawa State University, Keffi (Patnsuk Journal)	1
Research Indian Journal	1
Research Journal of Agricultural and Environmental Management	4

Research Journal of Applied Sciences	1
Research Journal of Applied Sciences, Engineering and Technology	1
Scholarly Journal of Agricultural Science	1
Science Focus	1
Scientia Africana	1
Scientific Journal of Pure Applied Sciences	1
Scientific Research and Essay	1
SMU Medical Journal	1
South Asian Journal of Experimental Biology	1
Tropical Agriculture	1
Tropical Science	2
World Academy of Science Engineering and Technology	1
World Applied Sciences Journal	1
World Journal of Agricultural Sciences	6
World Journal of Biology and Biological Science Research	1

Appendix G: Affiliations of CRIN citers from Nigerian institutions

CRIN Citer affiliation - name of department / faculty / institution / organization (excluding duplicates)
Alesinloye Market Environmental Health Project, Alesinloye Market, Jericho Road, Ibadan, Oyo State, Nigeria
Cocoa Research Institute of Nigeria, Agronomy and Soil Division, Ibadan, Nigeria
Cocoa Research Institute of Nigeria, Cashew Research Programme, Ibadan, Nigeria
Cocoa Research Institute of Nigeria, Crop Improvement and Protection Division, Ibadan, Nigeria
Cocoa Research Institute of Nigeria, Entomology Section, Ibadan, Nigeria
Cocoa Research Institute of Nigeria, Farming System and Extension Division, Ibadan
Cocoa Research Institute of Nigeria, Plant Breeding Division, Ibadan, Nigeria
Cocoa Research Institute of Nigeria, Plant Pathology Division, Ibadan, Nigeria.
Cocoa Research Institute of Nigeria, Soil and Plant Nutrition Section, Ibadan, Nigeria
College of Agriculture, Gujba, Yobe State, Nigeria
College of Agriculture, Landmark University, Kwara State, Nigeria
College of Plant Science, University of Agriculture, Abeokuta, Nigeria
Cross River University of Technology, Obubra Campus, Nigeria
Department of Agric Economics and Extension Kogi State University, Anyigba, Kogi State, Nigeria
Department of Agricultural Administration, University of Agriculture Abeokuta, Ogun State, Nigeria
Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University, Bauchi, Nigeria
Department of Agricultural Economics and Extension Technology, Federal University of Technology Minna, Niger State, Nigeria
Department of Agricultural Economics and Extension, Federal University of Technology, Akure, Nigeria.
Department of Agricultural Economics and Farm Management, University of Ilorin, Ilorin, Nigeria
Department of Agricultural Economics and Resources Management, Akwa Ibom State University, Ikot Akpaden, Mkpat Enin, Uyo, Akwa Ibom State, Nigeria
Department of Agricultural Economics, Ahmadu Bello University, Zaria. Nigeria
Department of Agricultural Economics, Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria
Department of Agricultural Economics, Obafemi Awolowo University, Ile-Ife, Osun state, Nigeria
Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria
Department of Agricultural Engineering, Federal University of Technology, Akure, Nigeria
Department of Agricultural Extension & Economics, National Agricultural Extension and Research Liaison Services (NAERLS), Ahmadu Bello University,Zaria
Department of Agricultural Extension and Rural Development Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria

Department of Agricultural Extension and Rural Development, Faculty of Agriculture and Forestry, University of Ibadan, Nigeria.
Department of Agricultural Extension and Rural Development, University of Agriculture Abeokuta, Ogun State, Nigeria
Department of Agricultural Sciences, Adeyemi College of Education, Ondo State, Nigeria
Department of Agricultural Technology, Oyo State College of Agriculture, Igbo Ora, Oyo State, Nigeria
Department of Agricultural Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria
Department of Agronomy, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria
Department of Agronomy, Federal College of Agriculture, Akure, Nigeria
Department of Agronomy, University of Ibadan , Ibadan, Nigeria
Department of Animal and Environmental Biology, University of Benin, Benin City, Nigeria
Department of Animal Science, University of Ibadan, Ibadan, Oyo State, Nigeria
Department of Applied Science, Osun State Polytechnic, Iree, Nigeria.
Department of Basic Sciences, Federal College of Animal Health and Production Technology, National Veterinary Research Institute, Vom, Jos, Nigeria
Department of Biochemistry, Federal University of Technology, Minna, Niger State, Nigeria
Department of Biochemistry, Federal University of Technology, Owerri, Imo State, Nigeria
Department of Biochemistry, Imo State University, Owerri, Imo State, Nigeria
Department of Biological Sciences, College of Natural and Applied Sciences Oduduwa University Ipetumodu, Ile- Ife, Nigeria
Department of Biological Sciences, College of Sciences, Afe Babalola University, Ado Ekiti, Nigeria
Department of Biological Sciences, Cresent University, Abeokuta, Nigeria
Department of Biological Sciences, McPherson University, Seriki-Sotayo, Ogun State, Nigeria
Department of Biological Sciences, Microbiology Unit, School of Natural and Applied Sciences, College of Science and Technology, Covenant University Ota, Ogun State, Nigeria
Department of Biological Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria
Department of Biological Sciences, Ondo State University of Science and Technology, Okitipipa, Ondo State, Nigeria.
Department of Bioscience and Biotechnolgy, College of Pure and Applied Science, Kwara State University, Malete, Nigeria
Department of Bioscience, Federal University of Agriculture, Abeokuta. Nigeria
Department of Botany and Microbiology University of Ibadan, Ibadan, Nigeria
Department of Botany, Lagos State University, Ojoo, Lagos State, Nigeria
Department of Botany, Obafemi Awolowo University, Ile-Ife, Nigeria
Department of Botany, University of Lagos, Akoka, Lagos State
Department of Chemical Engineering, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria
Department of Chemical Engineering, University of Ilorin, Ilorin, Nigeria
Department of Chemical Science, Federal University Wukari, Taraba State, Nigeria
Department of Chemical Science, Olabisi Onabanjo University, Ago-Iwoye, Nigeria
Department of Chemical Sciences, Adekunle Ajasin University, Akungba-Akoko, Ondo-

State, Nigeria
Department of Chemical Sciences, College of Natural Sciences, Redeemer's University, Redemption City, Mowe, Ogun State , Nigeria
Department of Chemistry, Adekunle Ajasin University, Akungba Akoko, Nigeria.
Department of Chemistry, Ahmadu Bello University, Zaria, Nigeria
Department of Chemistry, Faculty of Science , University of Ibadan , Ibadan , Nigeria
Department of Chemistry, Federal University of Technology, Akure, Nigeria
Department of Chemistry, Obafemi Awolowo University, Ile-Ife, Nigeria.
Department of Community Medicine, College of Medicine, University of Nigeria Enugu-Campus, Enugu, Nigeria
Department of Crop and Environmental Protection, Ladoke Akintola University of Technology, Ogbomoso, Nigeria
Department of Crop and Soil Science, Faculty of Agriculture. University of Port Harcourt, Rivers State. Nigeria
Department of Crop and Soil Sciences, Landmark University, Omu-Aran, Kwara State, Nigeria
Department of Crop Production and Protection, Obafemi Awolowo University, Ile-Ife, Nigeria
Department of Crop Production, Kwara State University, Malete, Ilorin, Nigeria
Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria
Department of Crop Protection, Faculty of Agriculture, University of Maiduguri
Department of Crop Protection, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria,
Department of Crop Protection, University of Agriculture, Abeokuta, Nigeria
Department of Crop Science and Horticulture, Federal University Oye, Ekiti State, Nigeria
Department of Crop Science, Adamawa State University, Mubi, Nigeria
Department of Crop Science, Ambrose Alli University, Ekpoma, Edo State, Nigeria
Department of Crop Science, Faculty of Agriculture, University of Abuja, Abuja, Nigeria
Department of Crop Science, Landmark University, Omu-Aran
Department of Crop Science, University of Benin, Benin-City, Edo State, Nigeria.
Department of Crop Science, University of Calabar, Calabar, Nigeria
Department of Crop, Soil and Pest Management , Federal University of Technology, Akure, Nigeria
Department of Environmental Health Sciences, Ogun State College of Health Technology, Ilese-Ijebu, Nigeria
Department of Environmental Management and Toxicology, University of Benin, Benin City, Nigeria
Department of Fisheries and Aquatic Sciences, Faculty of Agriculture and Forestry, Cross River University of Technology, Nigeria
Department of Fisheries, Faculty of Agriculture University of Benin, Benin City, Edo State, Nigeria
Department of Fisheries, Lagos State University, Lagos, Nigeria
Department of Food Science and Technology, Federal University of Agriculture Abeokuta, Abeokuta, Ogun State, Nigeria
Department of Food Science and Technology, Osun State Polytechnic, Iree, Nigeria.

Department of Food Technology, Lagos State Polytechnic, Ikorodu, Nigeria.
Department of Food Technology, Moshood Abiola Polytechnic, Ogun State, Nigeria
Department of Forest Resources Management, University of Ilorin, Ilorin, Nigeria
Department of Forestry and Environmental Management, Michael Okpara University of Agriculture Umudike, Umuahia, Abia State, Nigeria
Department of Forestry and Wildlife Technology, Federal University of Technology Owerri, Owerri, Imo State, Nigeria
Department of Forestry and Wildlife, University of Uyo, Akwa Ibom State, Nigeria.
Department of Genetics and Biotechnology, University of Calabar, Calabar, Nigeria
Department of Geography, University of Lagos, Akoka - Yaba, Lagos, Nigeria
Department of Health Administration and Management, College of Medicine, University of Nigeria Enugu-Campus, Enugu, Nigeria
Department of Horticulture, COLPLANT, Federal University of Abeokuta, Ogun State.
Department of Horticulture, University of Agriculture, Abeokuta, Nigeria
Department of Human Anatomy, Faculty of Medicine, Ahmadu Bello University, Samaru, Zaria, Nigeria
Department of Mathematics and Statistics, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.
Department of Medical Biochemistry, School of Basic Medical Science, College of Medicine, University of Benin, Benin City, Edo State, Nigeria
Department of Medical Laboratory Sciences, Ogun State College of Health Technology, Ilese-Ijebu, Nigeria
Department of Microbiology and Biotechnology, Western Delta University, Oghara, Delta State, Nigeria
Department of Microbiology, Abia State University, Uturu
Department of Microbiology, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria.
Department of Microbiology, Ibrahim Badamasi Babangida University, Lapai
Department of Microbiology, Lagos State Polytechnic, Ikorodu, Nigeria
Department of Microbiology, School of Sciences, Federal University of Technology, Akure, Ondo State, Nigeria
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Appendix H: Coding scheme for qualitative data analysis

- Knowledge Translation
- Policy formulation
- Agricultural policy
- Research Integration
- Value chain
- Research institutes
- End user
- Information gaps
- Collaboration (lack of it)
- Research utilization
- Information utilization
- Anecdotal evidence
- Policy Review
- Information exchange
- Challenges (Research Institutes)
- Lack of awareness (procedures)
- Lack of awareness (Research findings)
- Research needs

- Collaboration (and Lack of it)
- Adaptation and adaptability (Research information)
- Challenges faced (Research institutes)
- Researchers
- Research needs
- Research based policies
- Relationships
- Information needs and policy formulation

- Collaboration
- Research Analysis
- Implementation
- Centre of knowledge
- Knowledge creation
- Challenges (Funding)
- Agriculture Research Council of Nigeria (ARCN)
- Food chain
- Information packaging/repackaging
- Agricultural Extension
- Policy making
- Training
- Relationship between the FMARD and the NARIs
    - RIs established to meet needs of FMARD
- Could but did use NARI research knowledge & why

- Policy formulation role
    - what informs policies or policy making
- Collaborate with NARIs
- References or Uses NARIs' research findings
    - Barriers
    - Facilitators
    - Outcomes
- FMARD department carry out research
- NARI send research findings to FAMRD department
    - Format of findings from NARI
    - Frequency of research findings received from NARI
- Events bringing NARIs' researchers and FMARD policy actors together
    - What type of events
    - How often are the meetings
    - Who organizes the events
- RIs meet priority
    - Research demand driven
    - Research for promotion - driven by personal agenda of researchers
- Status of interaction
    - Could interactions be improved
- Funding problem
- Request research studies
- Collaborate with other FMARD department
- Read research findings from NARIs
    - Frequency of reading research findings from NARI

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