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Scale Development and Validation for Farmers' Knowledge Exchange: Implication for Agricultural Extension in Nigeria

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ABSTRACT

The aim of the study was to develop and validate farmers' knowledge exchange scale. This was accomplished by establishing specific domain for the construct, generating scale items, scale purification, and scale validation. Accordingly, twenty-one knowledge exchange items were initially listed. After being reviewed and revised by experts, it was pruned to 17 items which was used to collect data from 300 farmers in 16 communities within Kwara State, Nigeria. Four emerging constructs of 10-item knowledge exchange scale, including clarity, reliability, usefulness and reciprocity components were identified by performing an exploratory factor analysis. Subsequently, a confirmatory factor analysis was conducted for validating the scale. The results of the model showed good fit with the data ($\chi2$ = 172.87, df = 59, p-value < 0.001, and RMSEA = 0.047). In addition, the scale was found to be highly reliable (with a Cronbach's alpha value of 0.92). The study concluded that knowledge exchange assessment scale has the capacity to serve as an analytical tool, which can help researchers and extension practitioners assess the quality of information farmers share among themselves.

Introduction

Information is vital in agricultural development because it is a tool for communication between stakeholders and serves as a medium for assessing trends and sharpening decisions (Chisita, 2012; Whitfield, 2017). Knowledge emerging from information are essential in order to respond to the opportunities and challenges of social, economic and technological changes including those that help to improve agricultural productivity, food security and rural livelihood (Ajayi and Gunn, 2009; Ngongi and Urassa, 2014). In order to be useful, knowledge and information must be effectively communicated to the people.

In Nigeria, farmers hardly feel the impact of agricultural innovations due to poor access to vital information (Obidike, 2011). This is largely due to widened gap of the extension to farmer ratios, constraining the delivery of extension messages. For farmers to be successful, knowledge is considered a crucial resource. Farmers need adequate knowledge of relevant agronomic practices, weather and marketing. This knowledge is acquired through information diffused using channels that are regularly accessed by local communities (Adolwa, *et. al.,* 2018). One of such channels is through fellow farmers. Farmers are known to exchange information, ideas and experiences within their social system. This channel which can be referred to as "indigenous channel" facilitates information sourcing from farmers who are more experienced and/or knowledgeable (Demet, *et al.,* 2016). Previous studies in the field of knowledge management indicated that information received from experts (Scientist/Extension Agents) are through knowledge transfer process but information obtained through fellow farmers are through the process of knowledge exchange (Bullock and Hughes, 2016). In addition, current thinking is moving from a model of knowledge transfer (Garforth *et al.,* 2004) toward a model of knowledge exchange (Phillipson *et al.*, 2012; Wood *et al.,* 2014).

Knowledge exchange is the most suitable concept to describe the knowledge shared and acquired during farmer to farmer interaction. Although research literature uses terms such as diffusion, dissemination,

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knowledge transfer, knowledge translation, knowledge utilization and knowledge exchange as synonyms to describe similar processes (Garcia, 2006; Graham *et al.,* 2006). Knowledge exchange differs from other concepts as it implies a two-way dialogue for information exchange while most others appear unidirectional (Gravois, *et al*., 2003; Garcia, 2006).

The term knowledge exchange has been used and defined in various ways by researchers studying health related issues, and inter university exchange programmes. There is a dearth of literature on assessment of knowledge exchange among farmers. Understanding how to measure the quality of knowledge exchange among farmers is a way to improve exchange efforts. In spite of the belief that farmers' interaction can serve as important route through which individuals learn about, and are then convinced to adopt, new technologies, not much effort has been put into the development of a valid and reliable instrument to measure knowledge exchange that occur among farmers. Hence, the study explored measures to develop and validate scale to measure farmers' knowledge exchange. The main objective was to develop and validate the Knowledge Exchange Scale (KES) as a measure of knowledge exchange among farmers.

Materials and Methods

Study Area

The study was carried out in Kwara State, Nigeria, where drought tolerant maize varieties and associated agronomic practices were being promoted by various research organizations especially International Institute for Tropical Agriculture (IITA). The state like other north central states in Nigeria is experiencing lesser rainfall, which, coupled with the increase in temperature, have reduced soil moisture availability, and there have been droughts and desertification processes.

The state has 16 Local Government Areas (LGA). Agricultural Development project (ADP) classified the 16 LGAs into four Agricultural zones, 23 blocks and 184 cells in consonance with ecological characteristics and cultural practices. The zones comprise Zone A (with headquarters at Kaiama), Zone B (with headquarters at Lafiaji), Zone C (with headquarters at Ilorin East) and Zone D (with headquarters at Igbaja). Selected communities in Zone C and D have witnessed various maize improvement programmes especially the IITA on-farm trials. These communities include Alapa, Tafatafa and Balla (Asa LGA), Lajiki and Oke Oyi (Ilorin East LGA), Isanlu-isin (Isin LGA) Kajola, Omupo and Amodu (Ifelodun LGA), Arandun and Ajasse (Irepodun LGA).

Population and sampling technique

This is an empirical study that is quantitative in nature as it involves the validation of a survey instrument. The population for this study comprised of all maize farmers in Kwara State, Nigeria. A three-stage sampling technique was adopted in selecting respondents for the study. In the first stage, two ADP zones (C and D) were purposively selected from the four zones in the state due to the presence of communities where DTMA on-farm trials were conducted (this guarantees the availability of farmers with knowledge of the innovation).

The second stage involved the random selection of 80% of the communities where the on-farm trials were conducted in zones C and D (that is; Alapa, Lajiki, Oke Oyi, Kajola, Isanlu-isin, Omupo, Amodu and Arandun) and a random selection of one additional community within the neighborhood of the trial communities to make a total of 16 communities.

Lastly, a probability proportionate sample to size method was used to select the respondents from a list of farming households in each community. Information on the number of the total households in each village was obtained through the assistance of the village council (as used by Omotesho and Muhammad-Lawal., 2010). This was used in preparing the list of the households that formed the sampling frame from which the random selection of the households was carried out. The plot manager for each household who grow maize were interviewed. A total of 300 respondents were used for the study. This sample size was deemed enough to achieve a high level of statistical power and sufficient for exploratory factor analysis.

Measurement

Data were collected through personal interviews for unlearned respondents and questionnaire for the learned ones. The instrument featured the knowledge exchange assessment scale with items gathered from existing literature. In constructing the instrument, short, concise and meaningful questions were taken into consideration and abbreviations were avoided. Also, the questions were carefully drafted to elicit answers from participants ensuring they give sincere responses. Responses to the items on the instrument were generated using a 5-point Likert-type scale ranging from 0 = 'not applicable', 1= 'to a very little extent', 2 = 'to some extent' 3 = 'to a great extent', and 4 = 'to a very great extent'. The major interest of this study was to develop a measurement scale for knowledge exchange to assist in evaluating farmers' interpersonal communication. The main steps taken in developing the scale were adapted from the scale development procedures outlined by MacKenzie *et al.,* (2011). The steps included items generation, purification, domain creation, domain confirmation and construct reliability check.

Results and Discussion

Validation of Knowledge Exchange Assessment Scale (KEAS)

Items Generation

The conceptualization process was done by identifying the dimensionality to explain the latent variable (Knowledge Exchange) which hinges on sharing of knowledge and information. In generating items for this study, studies carried out by experts were reviewed.
From literature review it became clear that the 'flow of information' and 'knowledge exchange' are closely connected and almost inseparable from the concepts of 'communication'. Logical reasoning will conclude that there is no meaningful knowledge exchange if there is no communication.

Table 1. Initial Items Generated for Knowledge Exchange Scale

Items	Indicators
T1	I am comfortable responding to other people's ideas
T2	The source allowed me give proactive feedback to what was discussed
T3	The knowledge shared was easily translated to action
T4	The concept was explained in a way I can understand
T5	The interaction made me confirm with others what I know
T6	The knowledge shared was consistent with that received from other sources
T7	The knowledge shared was brief and clear
T8	The information was available when needed
T9	The knowledge acquired was concise and straight forward
T10	The source made a clear presentation with great confidence
T11	The conversation allows me to get my ideas across
T12	The knowledge shared was decisive
T13	The knowledge shared had specific examples
T14	The interaction allowed me to share what I know
T15	The interaction contributed to my knowledge
T16	The knowledge acquired was applicable
T17	The discussion was practical based
T18	I Seek help from others when needed
T19	Discussing what I know with others makes me know more
T20	Discussing the innovation was motivating
T21	I could easily relate the information received to my work

Source: Author, 2019

The concept of knowledge exchange is hard to capture because the components involved, i.e., information, knowledge, and exchange, are subject to multiple meanings. There is no agreement among researchers on how to define what is being shared, i.e., information or knowledge (Case, 2012). For instance, Wilson (2010) approaches knowledge as a set of mental processes involving understanding and learning. Therefore, 'knowledge is knowledge only to the knower', while information can only ever be 'an incomplete substitute for the knowledge' (Wilson 2000). In contrast, Wang and Noe (2010) define knowledge as 'information processed by individuals including ideas, facts, expertise advice, and judgments relevant for individual or collective performance'. This definition suggests that information and knowledge are analytically different but in practice intertwined constructs. Upon closer examination of these characteristics and building on previous studies, literature review on subjects related to knowledge and information was conducted to provide an initial basis for selecting items, of which 21 descriptive indicators that closely related to knowledge exchange were generated (Table 1).

Purification and domain creation

The 21 items generated for the knowledge exchange scale in Table 1 were pruned to 17 after experts' review. The 17 items scale were used in the pilot study on 300 respondents and the emerging data were subjected to scale dimensionality using Exploratory Factor Analysis (EFA) to identify items that were not or were the least-related to the domain under study for deletion or modification. Before conducting principal component analysis (PCA), the size of the sample was checked with the Kaiser-Meyer-Olkin test for adequacy and was found to be sufficient (KMO =0.574). The criterion for KMO sample adequacy was determined as 0.50 (Tabachnick and Fidell, 2013). Also, the equality of variance for the sample distribution was checked with the Bartlett test and was sufficient ($\chi 2$ = 4848.01, df = 136, p <0.001). These are shown in Table 2.

Table 2. Validity of Preliminary Measurement Scale: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.574
Bartlett's Test of Sphericity	Approx. Chi-Square	4848.01
	df	136
	Sig.	0.001

Source: Computed from Field Data, 2019

The principal component analysis (PCA) indicated an extraction of four components (factors). The criterion of eigenvalue ≥1 was used for determining the number of the factors to retain. Among the 17 items as shown in Table 3, the load values of item T1; 0.584, and 0.484 performed on factor 1, and 2 sequentially, these were very close to each other and hence deleted. Child (2006) recommends the removal of any item with a communality score less than 0.2 for cross loaded items. Also, item T2 had closely related load values of 0.443, 0.436 and 0.536 on factors 1, 2 and 4 successively. Similarly, item 9 shows close cross loads of 0.544 and 0.674 on factors 1 and 2. Likewise, item 17 with cross loads of 0.323, 0.383 and 0.333 on factors 1, 3 and 4 respectively. In view of this, items T1, T2, T9 and T17 were removed from the scale.

The rotated component matrix in Table 3 shows that the first component was measured by T7, T12, T13 and T10. These codes as shown in Table 1 were for questions: 'The knowledge shared was brief and clear' (T7), 'The knowledge shared was decisive' (T12), 'The knowledge shared had specific examples' (T13), and 'The knowledge acquired was easy to implement' (T10). All these questions relate to the respondents' getting clear knowledge. Therefore, variables in this first component were named "knowledge clarity" since clarity is the underlying trait measured by the items (T7, T12, T13, and T10).

After interpreting all components in a similar manner, the following descriptions were reached:
Component 1 - "Clarity"
Component 2 - "Reliability"
Component 3 - "Usefulness"
Component 4 - "Reciprocity"

Domain confirmation

To allow accuracy in evaluating the scale, as suggested by MacKenzie et al. (2011), confirmatory factor analyses (CFA) was conducted using LISREL 9.30. LISREL was used to assess the quality of the factor structure by statistically testing the significance of the overall model and of item loadings on factors. The purpose of the analysis was to assess the goodness-of-fit. CFA was conducted to test the relationship between the observed variables (loads) and their underlying latent constructs (factors). The overall model goodness of fit resulted in an excellent fit ($\chi 2/df = 2.93$, $p < 0.001$). The RMSEA for the four-factor solution was 0.047, which is appropriate for a relatively good fit of the factor model (Yang and Montgomery, 2011). These are indicated in Figure 1.

Construct reliability check

Cronbach's alpha was used to assess the internal consistency of the 13 remaining items on the scale. An alpha coefficient value of 0.60 to 0.70 has often been regarded as an acceptable threshold for reliability. The average Cronbach's α value of the 13 items was 0.855, which indicates a high level of reliability (McKinney, *et. al.,* 2002). As illustrated in Table 4, the reliability analyses show that each of the dimension's Cronbach's α is above 0.60. Nevertheless, items T10, T11, and T4 (as highlighted on the table) negatively contribute to the reliability of their sub-scales since the corresponding Cronbach's α value will increase by deleting these items, which indicates that they fail to pass the reliability test. Therefore, the decision to remove or retain an item was made based on "alpha if deleted" value. In view of this, item T10, T11, and T4 were removed from the measurement scale. The final knowledge exchange measurement scale with 10 items was highlighted in Table 5.

Table 3: Rotated Component Matrix

Coded Items	Components			
	1	2	3	4
T7	0.846		0.337	
T12	0.808	0.314		0.319
T13	0.793			
T10	0.668			
T1*	0.584	0.484		0.314
T6		0.803	0.327	
T8	0.361	0.800		
T3		0.789	0.337	
T11		0.685		
T9*	0.544	0.674		
T15			0.830	0.350
T16			0.811	0.368
T4	0.413	0.378	0.614	
T17*	0.323		0.383	0.333
T14				0.884
T5				0.877
T2*	0.443	0.436		0.536

Extraction Method: Principle Component Analysis; Rotation Method: Varimax with Kaiser Normalisation

Table 4. Reliability test of knowledge exchange assessment scale

Dimension	Cronbach's Alpha	Coded Item	Corrected Item- Total Correlation	Cronbach's Alpha If Item Deleted
A		T7	0.852	0.837
	0.897	T12	0.815	0.838
		T13	0.671	0.883
		T10	0.669	0.914
B		T6	0.832	0.805
	0.878	T8	0.770	0.831
		T3	0.682	0.865
		T11	0.673	0.868
C	0.981	T15	0.766	0.914
		T16	0.790	0.913
D		T4	0.231	0.888
	0.665	T14	0.629	0.352
		T5	0.638	0.363

Source: Computed from field data, 2019

Table 5. Dimensions and Indicators of Knowledge Exchange Assessment Scale

Dimension	Coded Item	Indicators
	T7	The knowledge shared was brief and clear
Clarity	T12	The knowledge shared was decisive
	T13	The knowledge shared had specific examples
Reliability	T6	The knowledge shared was consistent with that received from other sources
&	T8	The information was available when needed
Timeliness	T3	The knowledge shared was easily translated to action
Usefulness	T15	The interaction contributed to my knowledge
	T16	The knowledge acquired was applicable
Reciprocity	T14	The interaction allowed me to share what I know
	T5	The interaction made me confirm with others what I know

Source: Author, 2019

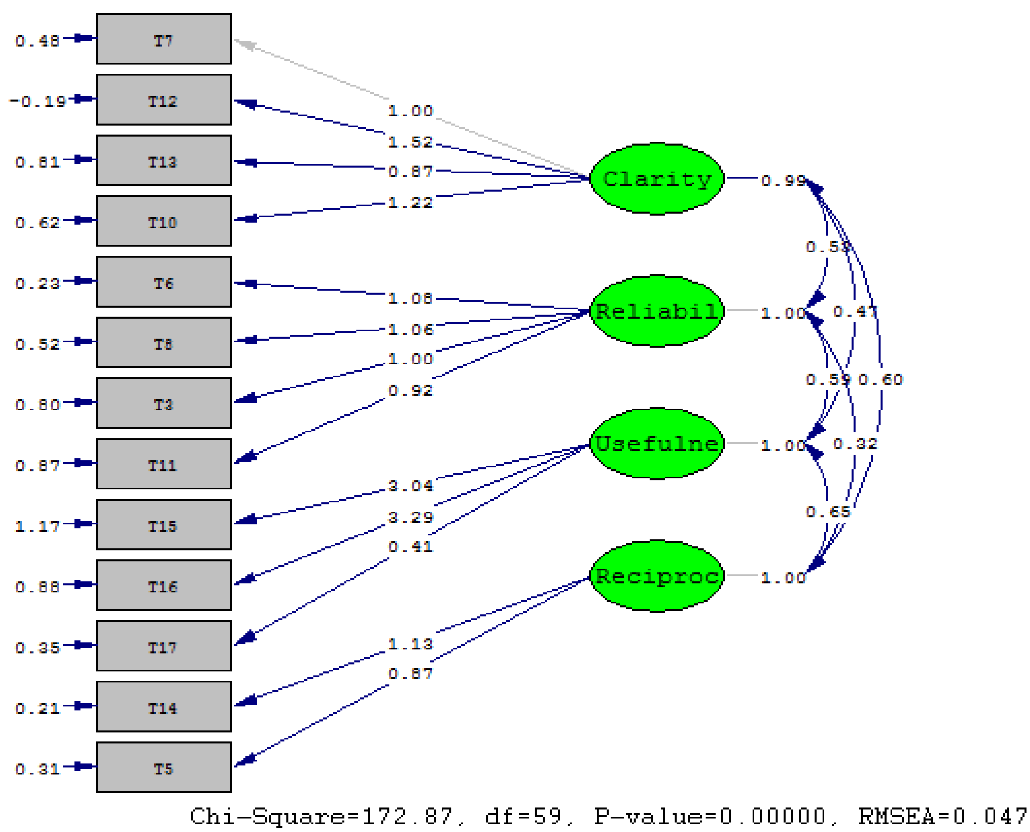

Figure 1. Confirmatory Factor Analysis Output

Conclusions and Recommendations

Measurement instruments can only be of value if they are proven to be reliable and valid. The findings of this study have empirically shown that the knowledge exchange assessment scale (KEAS) is a valid and reliable instrument. In terms of validity, this study has assessed content and construct validity. The measures were confirmed to be valid, as they surpassed all the necessary standards suggested by various researchers. They were also tested for reliability and they exhibited excellent Cronbach alpha's coefficient. From the foregoing, it can be concluded that the study reduces the problem of measuring and identifying the dimensions that shape knowledge exchange. Hence, this instrument can be suitably applied for measuring knowledge exchange among farmer specifically in the Nigerian setting.

The present scale has the advantage and potential of being widely applicable. Thus, the instrument has the capacity to serve as an analytical tool, which can help researchers and extension practitioners to assess farmers' knowledge exchange. It could be recommended that future researchers who intend to assess knowledge exchange among farmers should capture the aspects of knowledge that are not easily expressed or communicated via visual or verbal form as well as the aspects that are objective and can be codified. Also, to improve understanding of knowledge exchange, action research methodologies and embedding evaluation as a normal part of knowledge exchange research and practice need to be encouraged as it will foster more adaptive approaches to learning about knowledge exchange.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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