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Knowledge Production through Indigenous and Exogenous Lens for Food Sufficiency: The Perspectives of Nigerian Agricultural Research Institutes

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ABSTRACT The study used a mixed methods research design to investigate knowledge production using indigenous knowledge for food sufficiency in Nigerian agricultural research institutes. The integration of indigenous agricultural practices is one of the critical areas that tends to be neglected in research and innovation in agriculture. The study found that the majority of the respondents neglected to expound on the socio-cultural practices associated with indigenous produce. The produce included among others cassava, yam, sweet potato and cocoyam. Knowledge generation in the five study research institutes was limited to modern approaches to biotechnology, weed control, value-addition techniques, soil fertility; fish production and management practices and product development. The study recommends (i) the integration of indigenous agricultural practices with modern research and innovation in the Nigerian agricultural sector and, (ii) establishment of a national agricultural research database to enhance awareness, documentation, access and utilisation of agricultural information and knowledge for overall national development.

INTRODUCTION

As today's economy becomes more knowledge and information driven, so does the necessity for effective information and knowledge management strategies in all human endeavors. During the 1950s, 1960s and early 1970s, agriculture was the mainstay of the Nigerian economy and contributed to over ninety-four percent of government revenue and sixty-seventy percent of total exports (Daramola et al. 2008). Since the discovery of Nigerian oil in the 1970s, agriculture's significance has declined, and oil now totals ninety-five percent of exports and forty percent of government revenues (EIA 2012). Agriculture now only accounts for 0.2 percent of exports (Daramola et al. 2008). Declining agricultural production has relegated the role played by the agricultural sector in innovation development and knowledge discovery which is now characterized by a myriad of problems. This is evident in the nation's agricultural sector contribution to the GDP, which was down to 30.9 percent in the year 2013. Nigeria is therefore increasingly becoming dependent on food imports to feed the rapidly growing population of 174 507 537 million people (CIA World FactBook 2014). According to Shehu (2013), Nigeria spends 16.7 percent of GDP (N1.3 trillion) on food imports and this trend is not sustainable. Nigeria must become self-sufficient in feeding its own people by investing in agricultural sector and indigenous knowledge-based agricultural systems. Nigerian farmers have been experimenting and innovating on their farms for many years (Alders et al. 1993; Shrestha 1996; Worth 2002).

In assessing agricultural knowledge production from farmers' perspectives, Koutsouris and Papadopoulos (1998) stipulated that local knowledge was a requirement for understanding the complex farming systems of farmers. Although rural people's knowledge was, in the past, perceived to be primitive, unscientific and wrong, Scoones and Thompson (1993) and Warren (1991) felt that local knowledge was necessary for solving local problems. Supporting this argument, Oettie and Koelle (2003) pointed out that rural communities have a great strength - their local knowledge. They know about medicinal plants, environmental management and sustainable traditional agricultural practices. As observed by Hoffmann et al. (2007), farmers have been developing agricultural practices and innovations without the contributions of modern science. It is indeed acknowledged that farmers' local

knowledge was gaining importance (Warren 1991; de Villiers 1996; Von Liebenstein 2000; McDowell 2004).

Agricultural research institutions are engaged in developing technologies, finding new ways of improving agricultural production and the value of agricultural products. Research helps to solve specific scientific problems and provides policy-makers with methods and tools that help to formulate policies. In this regard it is vital to integrate indigenous agricultural practices with modern research and innovation in agriculture. This makes knowledge management critical in innovation, research and development. Ngulube (2002) indicated that the current approach to research and innovation leaves little room for indigenous knowledge (IK) of the local communities to be integrated into the exogenous knowledge system. The lack of knowledge management in this context has the following implications; (i) neglect of indigenous knowledge system (ii) poor agricultural research and development in the country (iii) low productivity and income in the sector (iv) inadequate farmers' skills and innovations for enhanced output (v) declined government revenue and impede national development and, (vi) high importation of food and other agricultural products.

The World Bank (1998) pointed out some good practices, such as zero tillage and biochar, which were beneficial to farmers and the environment that tapped on both local knowledge and external information. Mchombu (2007) and Munyua (2011) have shown that the culture of a community determines how local knowledge is shared and how it is communicated (Styhre 2003). Mchombu (2007) explained that local knowledge is part of the culture and heritage of the community. Using local people's knowledge could thus ensure success in development (Brokensha et al. 1980). Millar (2004) pointed out that, despite the many generations of colonial influence in Africa, decisions about agriculture, natural resources management (NRM) and health are heavily dependent on local traditions and cultures. This knowledge is passed on to younger generations by earlier generations, to guide them in decision-making, problem-solving, innovation and understanding (Stefano et al. 2005). Nevertheless, Briggs (2005) contended that as a unitary knowledge, local knowledge had not quite attained the social and economic progress it was expected to attain among peasants and small-scale farmers.

According to Alex et al. (2002), sustainable intensification will require knowledge, information, skills, technologies, and attitudes. For the technologies to provide new opportunities, farmers need to access information and knowledge from knowledge production organisations such as research institutes and universities. However, it is in light of these prevailing circumstances that, the present study investigates the role of Nigerian agricultural research institutes in knowledge production for sustainable national development and food sufficiency in the country, since the external knowledge is a broad base of non-traditional knowledge that local people draw from their interaction with non-local people and institutions, television and other media, formal education, and adoption of western scientific thinking, values, and philosophies (Karlsson 1995). Furthermore, research shows that the more the local people experiment with exogenous elements, the more they strengthen their own knowledge and practices.

Indigenous Knowledge is socio-economically viable and effective, involves minimum risk to rural farmers, and is an important asset for their livelihood and for conserving natural resources. IK is an important part of various fields, including agriculture, health, veterinary services, and arts and crafts. For instance, agricultural activities have been increasingly productive, sustainable and ecologically sound, even under difficult conditions, due to the utilization of IK in developing countries (Mugurusi 2001). In reality, the agricultural sector is the backbone of many economies in Africa. It is unfortunate that IK has largely been marginalized, neglected and suppressed due to ignorance and arrogance, politics, and the dominant ideology of a particular historical period (Ocholla and Onyancha 2005). Farmers do not earn high incomes because their innovations and practices are mostly organised and accumulated through experience, and these indigenous technologies are applied in isolation (Mascarenhas 2004). Hence, IK has not been fully utilised for agricultural development purposes.

METHODOLOGY

The study uses a mixed methods research design to investigate knowledge production through indigenous and exogenous lens for food sufficiency; the perspectives of Nigerian agricultural research institutes (Babbie and Mouton 2001; Creswell 2003). Mixed methods both

qualitative and quantitative allowed the researcher to collect qualitative data through interviews with directors and heads of information and documentation units, while quantitative data was collected using questionnaires administered to researchers in the five research institutes (Brewer and Hunter 1989). The study sample included the following respondents and institutions; National Root Crops Research Institute (NRCRI), Umudike, Abia State (South-East), covering Abia, Akwa Ibom, Anambra, Bayelsa, Cross-Rivers, Ebonyi, Enugu, Imo and Rivers States; Institute for Agricultural Research and Training (IAR & T), Ibadan, Oyo State (South-West) covering Ogun, Oyo, Osun, Ondo, Ekiti, Edo and Delta States; National Cereals Research Institute, Badeggi, Niger State (North-Central), covering Niger, Abuja FCT, Kwara, Kogi and Benue States; Institute for Agricultural Research (IAR), Zaria, Kaduna State (North-West), covering Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto and Zamfara States; Lake Chad Research Institute (LCRI), Maiduguri, Borno State (North-East), covering Gombe, Bauchi, Adamawa, Taraba, Yobe and Borno States.

Generally, the interview questions for the group that included directors (CEOs) and the heads of information and documentation units of the five research institutes covered themes such as; type of knowledge generated and managed; generation of explicit knowledge versus tacit knowledge; extent of knowledge production; knowledge sharing and dissemination. The questionnaire was organised in sections A-H, covering questions 1-45. The issues covered the following themes; knowledge generated; knowledge sharing among researchers; explicit knowledge generation versus tacit knowledge generation; KM activities performed; knowledge creation/production processes. The population of this study is 1363. If the population is 1363 at ±5 percent precision, the sample should be 286 at the ninety-five percent confidence level. In this regard, 214 research scientists participated and returned questionnaire, while five directors and five heads of information and documentation units were interviewed.

RESULTS AND DISCUSSION

Profile of Respondents

Demographic analysis was conducted to determine the department/unit/programme, educational status, gender, age, years of working experience and position/rank of the respondents in the research institutes.

The study revealed that the majority of the respondents were males at 151 (70.6%), while females stood at 57 (26.6%) working in various departments/units/programmes of the institutes, as follows; 18 (8.4%) were working in the Agric Econs and Extension Programme, 29 (13.6%) in the farming system, while 26 (12.1%) were working in the Biotechnology Department. The findings further revealed that 38 (17.8%) of the respondents were working in the product development programme and 24 (11.2%) were in the research outreach departments of the institutes, while 79 (36.9%) of the respondents were working in departments/programmes focusing on community-based produce such as the cassava programme, yam programme, sweet potato, cocoyam, ginger, post-harvest, technology, maize, banana, kenaf and jute, cereals, trypanotolerant livestock, grain legumes, land and water resource management, cowpea, groundnut, cotton, confectioneries, castor and tomato programmes. They neglected to expound the socio-cultural practices associated with these indigenous produce and practices.

According to Alene et al. (2007), agricultural research is now principally carried out by 17 NARIs. Six of these deal with arable crops, three with forestry and tree crops, three with livestock, two with fisheries and one each with extension, processing and storage. Each has a national mandate for specific major commodities in each agro-ecological zone. IITA, in partnership with NARIs and other collaborative institutions, has developed and released, to Nigerian and other farmers in SSA, numerous improved varieties of cassava, yam, maize, cowpea, plantain and banana and soybean. Nigeria is now the world's largest producer of cassava, yam, and cowpea (Manyong et al. 2005).

Further demographic data analysis showed that most of the respondents were in the age bracket of 29-49, with educational qualifications ranging from 62 respondents with Master's degree (29%) and 62 with PhD (29%), at the rank of Research Officer I and II. Despite the availability of high calibre manpower, Nigeria's agricultural research faces the challenge of responding to the new demands to contribute to poverty reduction, in the face of declining national research budgets. In 2000, for instance, although Nigeria employed the highest total number of

full-time equivalent researchers in SSA (11%), its share of spending was only seven percent of the total US$1.5 billion (US$10.5 million) (Beintema and Stads 2004). The International Institute for Tropical Agriculture (IITA) has been supplying improved germplasm to NARIs and has strengthened their research capacity, mainly through collaborative research, short courses and long-term training of their staff at MSc and PhD levels.

Knowledge Generated By the Nigerian Agricultural Research Institutes

Based on the Nonaka and Takeuchi (1995) theory of knowledge creation, knowledge generation refers to the capability of an organisation as a whole to create new knowledge, disseminate it throughout the organisation, and embody it in products, services and systems. They stress that organisational knowledge creation is fundamental to the distinctive ways through which organisations create innovations. Knowledge creation and generation take place through continuous interactions between the epistemological and ontological dimensions of knowledge (Nonaka 1991; Nonaka and Takeuchi 1995), whether tacit or explicit (Nonaka and Konno 1998; Nonaka and Takeuchi 1995).

The findings of this study revealed that the research institutes generated knowledge in the following areas; genetic improvement of varieties of cereals, crops, roots, tubers, barley; wheat, rice, soybeans, sugarcane, beniseed, millet; crop production, breeding, weed control, value-addition techniques, fertility of soil and mechanization; crop improvement and management practices; generation of agricultural technologies and management practices; pest management, agronomic practices and improved seeds; fish production and management practices. These findings show that knowledge generation and creation in the five research institutes were within their core mandates of conducting research in major categories of agricultural crops, products, equipment and services such as; cereal research; grain legumes and soil seed; cotton research; biotechnology research; agricultural mechanization; farming systems; and product development research for agricultural development in the country. Joshi et al. (2001), in a similar study on the impact of Indian agricultural research found, that the Indian agricultural research institutes generated knowledge in the areas of; yield enhancement of sugarcane, hybrid rice, wheat and potato; pigeon pea, genetic enhancement of crops and tubers; resource management in agriculture; integrated pest management techniques; agricultural implements and versitol technology; social welfare and conservation of natural resources. The similarity in the results of the two studies (current study and that of Joshi et al. 2001) may be attributed to the fact that both India and Nigeria are developing economies, hence the need to generate agricultural knowledge that could add value to their quest for food security. Revenue enhancement and overall development of the agricultural sector of the two nations is of paramount importance.

A study by Hahn et al. (2006) on knowledge generation and organizational innovation in wetland landscape on small, flexible municipal organizations in southern Sweden, identified the following knowledge that was generated; scientific and local knowledge on ecosystem and landscape management; adaptive governance; adaptive management; and resilience in social-ecological system techniques. Even though the locations of the organisations/institutes studied differ, the similarity in the findings of the present study and that of Hahn may be due to the fact that both the organisations are focused on generating knowledge that could improve practices, products and services and, most importantly, meet up with their statutory responsibilities and obligations. Both studies used semi-structured interviews to collect data. Kaniki and Mphahlele (2002) posited that local knowledge emanate, from research conducted in areas unique to a given culture or society and is based on innovation and practical experimentation.

To sustain and improve the knowledge generation processes in knowledge-intensive organisations, Jing et al. (2009), in a study of knowledge creation in academia and research institutes at the Japan Advanced Institute of Science and Technology (JAIST), recommended that the following issues need to be addressed; language barrier in discussing research questions with colleagues from other countries; making sharing tacit knowledge easier; developing a mechanism for critical feedback, in group discussions; training on how to organise and plan research activities; support in preparing presentations for seminars and conferences; support in designing and planning experiments; training

on how to do experiments; guidance from one's supervisor and frequent communication within the group. The Resource-Based Theory (Barney 1991; Peteraf 1993; Amit and Schoemaker 1993) focuses explicitly on the continuous creation of knowledge as the ultimate resource for the firm performance and attainment of competitive advantage.

Addom (2010), in a PhD study titled 'Knowledge brokering in the digital age: The case of an agricultural innovation system', sought to understand the phenomenon of knowledge creation and sharing within the agricultural innovation system of Ghana. In order to understand this complex phenomenon within an agricultural innovation system, interview and focus group discussion techniques were used to gather data from multiple sources. The results showed two sources of knowledge generation (local and scientific), such as; indigenous traditional irrigation practices, knowledge on weather forecasting, biological control of diseases and pests in soybean, production of new pesticide formulations and use of different plants and roots for soil fertility improvement. These findings are similar to results obtained from the semi-structured interviews about the types of knowledge generated in the research institutes in the current study, which showed that the knowledge generated was mostly scientific data, knowledge on agriculture; information on science and nature; findings from scientific investigations; results of experiments aimed at addressing the needs of farmers and other stakeholders; and technological packages for optimum productivity in agriculture. Interviewees noted that:

Research in to genetic improvement of root and tuber crops; agric extension services in liaison with states and federal agencies; provide technical/vocational training to farmers, students and other stakeholders; farming systems based research for south eastern Nigeria….National genetic mandate on nine crops; cotton, cowpea, ground nut, maize, sorghum, artemisia, jatropha, castor; dissemination of agricultural research-based information to stakeholders.

Generation of Explicit Versus Tacit Knowledge in the Institutes

Based on the Nonaka and Takeuchi (1995) model, there are two types of knowledge which include explicit knowledge and tacit knowledge. Explicit knowledge is knowledge that can be expressed in words and numbers and easily communicated and shared in the form of hard data, scientific formulae, codified procedures, or universal principles. The knowledge is synonymous with a computer code, a chemical formula, or a set of general rules normally found in documented form. Tacit knowledge has two dimensions. The first is the technical dimension, which encompasses the kind of informal and hard-to-pin-down skills or craft captured in the term 'know-how'. The second is the cognitive dimension which consists of schemata, mental models, beliefs and perceptions. Though they cannot be articulated very easily, these implicit models shape the way we perceive the world around us. The Knowledge Category Theory (Boisot 1987) supports Nonaka's model by classifying knowledge based on the ease of transmission and readiness to share. Boisot's (1987) theory regards knowledge as either codified or uncodified and as diffused or undiffused.

The findings of the present study revealed a high generation of explicit knowledge in the five research institutes. One hundred and two (47.7%) respondents viewed the generation as high, while 54 (25.2%) thought it was very high. The perception for the high generation of explicit knowledge may largely be due to constant research and development activities, seminars, workshops and conferences taking place in the institutes and documentation of findings and knowledge generated in the form of research reports, seminar papers, manuals and other research guides and protocols. In a sharp contrast to the findings of the present study, Miguel et al. (2006) examined knowledge management issues in knowledge-intensive SMEs, in two knowledge-intensive SMEs in the South Yorkshire region, UK, using interpretive paradigm and interview as data collection instrument, and found that owner/managers of SMEs did not perceive KM as a business critical function. While both small and medium companies collected and stored explicit knowledge in the form of training materials, newsletters, databases and company's websites, they did not seem to make active use of them as a source of knowledge.

Furthermore, findings from the present study show that the generation of tacit knowledge by the five institutes was high, considering that 99 (46.3%) of the researchers opined that it was

high, while 52 (24.3%) said the generation was very high. These findings conform to the principle of knowledge generation and creation in organisations by Nonaka and Takeuchi, which showed that organizations cannot create knowledge on their own without the initiative of the individuals and the interaction that takes place within a group. Knowledge can be amplified or crystalised at the group level through dialogue, discussion, experience sharing and observation. According to Nonaka (1991), knowledge sharing amongst employees contributes to the creation of new knowledge in the organisation, which is a critical activity that contributes to the success of the organisation, as new knowledge becomes available for everyone in the organisation to take advantage of. This may lead to innovative initiatives within the organisation, giving the company an advantage in the competitive world. This thinking is consistent with the Knowledge-based view (Grant 1996), which postulates that practices and routine interactions between and among employees produce tacit knowledge in organizations (Inkpen and Dinur 1998; Lam 2000; Malan and Kriger 1998; Robertson and Swan 1998).

Mudege (2005) established that agricultural knowledge was primarily social and its production was a social process; thus, gender dynamics, politics, power, conflicts, resistance, religious beliefs and government policies determined the production and socialisation of knowledge production in Zimbabwe. Shan et al. (2013), drawing from the Nonaka and Takeuchi (1995) knowledge creation theory, studied the impact of quality management practices on knowledge creation process in the Chinese aviation industry using a comprehensive literature review and field survey. The findings revealed that the use of cross-functional teams enabled employees to share ideas in light of their experience and promote the sharing of tacit knowledge. High generation of tacit knowledge by the institutes makes more sense to the knowledge-based theory, because its central feature is the notion of 'tacitness' (Grant 1996), as tacit knowledge is a potential source of competitive advantage due to its limited transferability.

Generally, the findings of the present study revealed that both explicit knowledge and tacit knowledge were generated in high proportion through research and development activities, seminars, workshops, conferences and sharing of experience, ideas and expertise, which became a norm in the institutes. To further elucidate the generation of the two types of knowledge in the institutes, findings from the semi-structured interviews revealed that both types of knowledge were generated by the institutes. Knowledge generated through regular interaction between scientists and management was documented. By and large, the two types of knowledge were found interwoven and complementary. In a related study, Herman (2013) used a knowledge-based view in a study titled 'Three shapes of organisational knowledge'. The study aimed at developing a typology of knowledge that could be fruitful in facilitating research in a knowledge-based production environment.The findings showed that differences between the tacit, codified and encapsulated shapes of knowledge carried strategic implications for the firm along six important dimensions, which included a locus or knowledge substrate, transferability, expression, acquisition process, source of economic value and observability. The findings revealed that different types of knowledge resources required different corporate strategies to maximize their value. Both the Herman's study and the present study recognize the importance of the two types of knowledge, which are pertinent in the organizations' quest for attaining competitive advantage. In this regard, an interviewee noted that:

Both types of knowledge are generated by my institute. Knowledge generated by regular interaction between scientists and management are documented. Documented knowledge is disseminated among scientists sometimes through interaction. The two types of knowledge are interwoven and complimentary.

In the same vein, another interviewee stated as follows;

Mostly scientific data, knowledge in agriculture; Information on science and nature; Research findings from scientific investigations; National and international information in agriculture……Results of experiments aimed at addressing the needs of farmers and other stakeholders; technological packages for optimum productivity.

Modes of Knowledge Production in the Institutes

According to Bagshaw (2000), knowledge workers are valuable in organisations because

they look for innovation which increases choices and thereby increase the organisations' knowledge asset.

Findings of the present study revealed that knowledge in the research institutes was produced through; formal and informal interactions; mentoring; research, teaching and experiments; workshops, seminars and conferences; training and re-training; annual review meetings; adaptive research; cropping scheme meetings. The findings seemed to suggest that knowledge production was largely achieved through interaction, learning by doing and knowledge sharing in the five research institutes. The knowledge production process seemed to start with tacit knowledge and subsequently converted into explicit knowledge production. This confirmed the earlier findings about explicit knowledge and tacit knowledge generation, which was high in the five institutes.

The findings are consistent with the Nonaka and Takeuchi epistemological dimension of knowledge production, in which knowledge creation starts when tacit and explicit knowledge interact with each other in what is referred to as epistemological dimension/knowledge conversion. Knowledge conversion is made up of four modes; socialisation (tacit to tacit), a process by which knowledge is synthesized; externalisation (tacit to explicit), a process where conceptual knowledge is created; combination (explicit to explicit), where systematic knowledge is created; and internalisation (explicit to tacit), where operational knowledge is created. All these modes of knowledge creation are not independent, but interact to create a knowledge spiral, which produces new products and innovations.

Ha et al. (2008) seeking to determine knowledge creation and dissemination in Sub-Saharan Africa, used a free broadband service Knowledge Centre in the Ihiala village of southern Nigeria. The findings of the study revealed farmers used broadband technology, especially when it was available to them for free. The farmers evaluated positively the postings on the centre's web space. Ha et al. (2008) demonstrated the influence of interaction and social networking (both online and offline) on knowledge production, creation and dissemination. Yang et al. (2009), in a study of organisational knowledge-creation strategies, guided by knowledge-based theory and knowledge creation theory, proposed four modes of knowledge creation strategies, encapsulated in the EICE model - exploration, institutional entrepreneurship, combination and exploitation. The exploration strategy is concerned with converting new private personal knowledge through firm-specific unique knowledge to organisation-specific unique knowledge. It is a strategy through which an organisation increases its intellectual capital, by creating its unique private knowledge within its organisational boundaries (Ichijo 2002).

The institutional entrepreneurship strategy is concerned with articulating private knowledge into public knowledge. The combination strategy is concerned with converting public knowledge (that is, knowledge not unique to any one firm but also exists in the outside environment) into more complex and advanced sets of public knowledge. It focuses on the synthesis and application of current and acquired public knowledge (Kogut and Zander 1992; Nahapiet and Ghoshal 1998). The exploitation strategy focuses on transforming public knowledge into firm-specific private knowledge. It is also concerned with enhancing the intellectual capital of a firm with existing public knowledge (Ichijo 2002). The variation in the findings of the two studies, with regard to the modes of knowledge production, may be as a result of the different approaches used in the two studies. While the present study used a mixed methods approach to obtain empirical data, the Yang et al. (2009) study was based on conceptual framework and literature review.

Frequency of Knowledge Production in the Institutes

According to the Knowledge-based Theory (Grant 1996), continuous knowledge production in organisations is the only way to the successful attainment of competitive advantage. One hundred and ten (51.4%) respondents believed that knowledge production was frequent, while 96 (44.9%) thought knowledge production was very frequent. These findings suggest that knowledge production was a common practice in the institutes. Related to the findings of the present study, Zehrer (2011) studied KM in Australian tourism organisations, based on Grant (2005) knowledge management model. The study found that knowledge production was frequent in the organisations through knowledge-sharing and the documentation of knowledge. The study made use of a four-point Likert Scale, rang-

ing from 4=very frequent, 3=frequent, 2=rarely, and 1=never. In the study, a total of 73.5 percent respondents (n=36) very frequently make use of emails to store information and 18.4 percent (n=19) do not use this tool often. However, internal newsletters are used very frequently by fifty-one percent of the tourism organisations, whereas smaller organisations, with fewer than 25 employees, only rarely or never used internal newsletters. It was revealed that written protocols and documentation are used very frequently and frequently by 85.7 percent of the tourism organisations, while electronic discussion forums were rarely or never used by the majority of the respondents (81.6%).

The convergence in the findings of the present study and that of Zehrer may be attributed to the fact that research institutes and tourism organisations are regarded as knowledge-intensive organisations (Hjalager 2002; Knight and Harland 2005). Also consistent with the findings of the present study was that of Assefa et al. (2011), who assessed the agricultural KM in dairy production improvement in the Amhara region of Ethiopia using semi-structured questionnaires and a literature review. The study found frequent knowledge production through experience sharing sessions, on-farm demonstration, learning by doing, listening to the radio and farm visits by officials of the Woreda Agricultural and Rural Development Office (WARDO). In line with the Capability Perspective Theory (Teece et al. 1997), R&D capability of organisations enables them to invent new technology, as well as to convert existing technology to develop new products and services. R&D capability helps a firm develop new technical knowledge and use this knowledge to design superior products and services (Teece et al. 1997). An interviewee commented on mode of knowledge production thus:

Knowledge is produced on regular basis through research and results are documented on a regular basis through annual reports published by the institute and through journals published by scientists.

Activities of Knowledge Production in the Institutes

Nonaka and Takeuchi's theory of knowledge creation asserts that knowledge production in organisations starts with knowledge sharing among employees and continuous research and development activities. In line with the theory of Nonaka and Takeuchi, the present study investigated activities that generate knowledge production and sharing in the institutes. These activities included; interpersonal discussion with colleagues; workshops, seminars and conferences; research and consultancy; memos, reports and files; magazines and newsletters; online and offline databases. Table 1 depicts the activities of knowledge production in the institutes.

The results in Table 1 identify the activities that led to the production of knowledge in the institutes. Based on the activities; interpersonal discussion with colleagues was cited by 65 (30.4%) as very frequently, while 115 (53.7%) said frequently, 29 (13.6%) occasionally, 4 (1.9%) sometimes; workshops, seminars, and conferences 67 (31.3%) very frequently, 104 (48.6%) frequently, 39 (18.2%) occasionally and 1 (0.5%) sometimes; research and consultancy 107 (50%) very frequently, 83 (38.8%) frequently, 18 (8.4%) occasionally, 2 (0.9%) sometimes; memos, reports and files 55 (25.7%) very frequently, 84 (39.3%) frequently, 18 (8.4%) occasionally, 2 (0.9%) sometimes; publications such as magazines, newsletters, bulletins etc. 42 (19.6%) very frequently, 81 (37.9%) frequently, 67 (31.3%) occasionally, 21 (9.8%) sometimes, while 1 (0.5%) responded never; online and offline database search 40 (18.7%) very frequently, 85 (39.7%) frequently, 56 (26.2%) occasionally, 25 (11.7%), while 2 (0.9%) opined never happened.

The results show that all the activities that lead to knowledge production are performed frequently, especially interpersonal discussion with colleagues, workshops, seminars and conferences, research and consultancy and memos, reports and files management. These findings corroborate the findings of the semi-structured interviews, where most of the respondents confirmed the performance of these activities that lead to the production and sharing of knowledge in their institutes. The researcher established that performance of such activities helped to generate the production of tacit and explicit knowledge in the various institutes and these findings corroborate the findings obtained through semi-structured interviews in which respondents claimed that knowledge was produced on a regular basis through knowledge sharing, research and development, annual reports and journal articles published by scientists. Related to these findings, a study of 431 US and European companies by Metaxiotis and Psarras (2003) found that companies were engaged in new knowledge generation by access-

Table 1: Activities of knowledge production in the institutes

Responses	*Freq*	*%*	*Valid (%)*	*Cumulative (%)*
Interpersonal Discussion with Colleagues				
Never	0	0	0	0
Sometimes	4	1.9	1.9	1.9
Occasionally	29	13.6	13.6	15.5
Frequently	115	53.7	54.0	69.5
Very frequently	65	30.4	30.5	100.0
Missing value	1	0.5		
Total	214	100.0	100.0	
Workshops, Seminars and Conferences				
Never	0	0	0	0
Sometimes	1	.5	.5	.5
Occasionally	39	18.2	18.5	19.0
Frequently	104	48.6	49.3	68.2
Very frequently	67	31.3	31.8	100.0
Missing value	3	1.4		
Total	214	100.0	100.0	
Research and Consultancy				
Never	0	0	0	0
Sometimes	2	0.9	1.0	1.0
Occasionally	18	8.4	8.6	9.5
Frequently	83	38.8	39.5	49.0
Very frequently	107	50.0	51.0	100.0
Missing value	4	1.9		
Total	214	100.0	100.0	
Memos, Reports and Files				
Never	0	0	0	0
Sometimes	19	8.9	9.1	9.1
Occasionally	50	23.4	24.0	33.2
Frequently	84	39.3	40.4	73.6
Very frequently	55	25.7	26.4	100.0
Missing value	6	2.8		
Total	214	100.0	100.0	
Publications such as Magazines, Newsletters				
Never	1	0.5	0.5	.5
Sometimes	21	9.8	9.9	10.4
Occasionally	67	31.3	31.6	42.0
Frequently	81	37.9	38.2	80.2
Very frequently	42	19.6	19.8	100.0
Missing value	2	.9		
Total	214	100.0	100.0	
Online and Offline Database Search				
Never	2	0.9	1.0	1.0
Sometimes	25	11.7	12.0	13.0
Occasionally	56	26.2	26.9	39.9
Frequently	85	39.7	40.9	80.8
Very frequently	40	18.7	19.2	100.0
Missing value	6	2.8		
Total	214	100.0	100.0	

ing knowledge from outside sources (Singh 2010). As one interviewee put it:

Knowledge is produced through participatory approach with the stakeholders and management by all our scientists through knowledge sharing in both formal and informal for a…Through seminars, workshops, monthly meetings with ADPs in south west agro-ecological zone; Annual Workshop of Agricultural Research Extension Farmer Input Linkage Services (REFILS); Annual in-house review of programs in the institute.

CONCLUSION

The study investigated knowledge production through indigenous and exogenous lens for food sufficiency; the perspectives of Nigeri-

an agricultural research institutes. The following were the key findings; the majority of the respondents were males who researched on community produce which include; cassava, yam, sweet potato, cocoyam, ginger, maize, banana, kenaf, jute, cereals, trypanotolerant livestock, grain legumes, cowpea, groundnut, cotton, castor beans and tomatoes.

It was highlighted that in spite of the fact that agricultural research institutions were engaged in finding new ways of improving agricultural production and the value of agricultural products there was limited or no prevalence of indigenous knowledge and agricultural practices. The study showed that knowledge generation in the five study research institutes was limited to modern approaches to biotechnology research; agricultural mechanization; farming systems; genetic improvement, breeding, weed control, value-addition techniques, fertility of soil and mechanization; crop improvement and management practices; generation of agricultural technologies and management practices; pest management, agronomic practices and improved seeds; fish production and management practices and product development research for agricultural development in the country.

RECOMMENDATIONS

The study recommends the integration of indigenous agricultural practices with modern research and innovation in the Nigerian agricultural sector. This will enable local communities to be integrated into other knowledge systems. The present study recommends the establishment of a co-ordinated programme for the development of a National Information Infrastructure (NII) to facilitate the documentation, integration and promotion of indigenous knowledge systems in agriculture. Establishment of a national agricultural research database/databank to enhance awareness, documentation, access and utilisation of agricultural information and knowledge for overall national development.

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