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Comparative assessment of agricultural technology generating practices in universities and research institutes in north central zone of Nigeria

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ABSTRACT

To understand the technology generating practices among universities and research institutes in north central zone of Nigeria, this study examined sources of funds for technology generating activities, compared agro-technology generating practices and identified constraining factors hindering technology generating practices. One hundred and fifty-two academic staff were randomly selected from universities and one hundred and thirty-six respondents were drawn from research institutes. Validated questionnaires with reliability coefficient of $r = 0.92$ were used to elicit data. Data were analyzed using descriptive statistics, Likert-scale, T-test and Factor analysis. Majority (93.4%) of universities' respondents used their personal funds to generate new technology compared to their counterparts in research institutes. The most widely employed mechanism for generating agricultural technologies was joint radio programmes (mean = 3.38) while the least was biotechnology (mean = 2.57). Major areas of differences in technology generation between the two institutions were the physical distance ($t = 13.54$; $P < 0.05$), farmers participation in field research trials ($t = 8.50$; $P < 0.05$), farmers co-finance of adaptive research trials ($t = 3.77$; $P < 0.05$) and adequate research facilities and incentives to workers ($t = 2.05$; $P < 0.05$). Factors constraining technology generation for universities were poor access to knowledge and information on new innovation ($r = 0.815$) while for research institutes it was limited physical resources (ICT, Telephone) ($r = 0.801$). It was recommended therefore that respondents should look into options of writing alternate fund proposals and submitting to a wider range of funding bodies. Governance of innovation could be strengthened through the formation of a formal technological linkage advisory council.

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1. Introduction

1.1. Background of the study

Agriculture is the main occupation of most Nigerians from ancient time. As a primary production section for foods and

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raw materials necessary to enhance other sectors of the nation's economy, research and technological improvements through research institutions are therefore crucial to increase agricultural production and thereby reduce poverty among farming households [29].

The agricultural innovation generating sub-system under the national agricultural research system in Nigeria consists of universities of agriculture, faculties of agriculture and veterinary medicine in other universities, international and national agricultural research institutes and experimental stations that focus on specific crops. Research in these institutions focuses on the technical aspects for generating useful agricultural technologies [26].

Globally, universities are recognized as centres of knowledge accumulation and knowledge transfer through research and scholarship [12]. Universities all over the world are mandated to perform three functions, namely teaching, research and community services [18]. Research institutes and universities are the prominent government funded agro-innovation transfer system in Nigeria. The success indices of a viable transfer system include: constant creation of technical knowledge, extension staff training and contacts, harmonious existence with other agencies, orienting technologies towards utilization and provision of information on necessary farm input [17,29].

The future of Africa should be based on technology, science and innovation [8,27] Yet, sub-Saharan Africa ranks the lowest in the world in terms of yield-enhancing practices and techniques [11]. Agricultural innovation is influenced by determination of needs, research and management of innovation generating institutions [30]. Previous study by Zaria et al. [33] had blamed ineffectiveness of technology generation in Nigeria on conventional research activities operated with poor consideration of farmers' problems and orienting research for journal publication. In developing countries such as Nigeria, most research efforts in technology generation are wasted due to their inadequate orientation to farmers' needs and utilization [6]. Farinde [13] added that the bureaucratic domination in the Ministry of Agriculture under which agricultural research institutes operate in Nigeria, contributes to the inability of research to meet the technology need of the farmers. Presently, the technology generation subsystem in Nigeria experiences poor and uncertain funding, frequent government administrative changes and lack of policy initiative in research.

The agricultural innovation effort should be oriented towards social desirability, economic feasibility and existing practices of the farmers as a priority [13,19]. The International Service for National Agricultural Research (ISNAR) [14] stated that farmer-driven research effort must be based on policy setting, utilization of research personnel, and continuous flow of information and evaluation of its activities. Also, Vengara [32] had stated that technology, which is capable of improving food productivity at farm level, should evolve from a well-funded autonomous research sub-system, so as to provide timely solutions to priority problems.

The findings in this study aim to inform policy makers of the appropriate strategies for designing and implementing policies for tackling the problems associated with technology generation to better meet the need of farm families in the rural communities.

1.2. *Objectives of the study*

The main objective of the study was to assess agricultural technology generating practices in universities and research institutes in the north central zone of Nigeria.

The specific objectives were to:

1. Describe the socio-economic characteristics of the respondents in the study area.
2. Examine the sources of funds for technology generating activities.
3. Compare agro-technology generating practices of Agricultural Research Institutes (ARIs) and University.
4. Identify constraining factors hindering technology generation.

2. Methodology

This study was conducted in the north central agro-ecological zone of Nigeria. The zone comprises of six states namely: Kwara, Niger, Nasarawa, Plateau, Benue, Kogi and the Federal Capital Territory. The zone occupies a total land area of 296,898 km^2 representing about 32% of the land area of the country. It is located between latitude $6°30^1N$–$11°20^1N$ and Longitude $2°30^1E$–$10°30^1E$. The zone has two main seasons; namely dry and wet seasons. The vegetation of the zone consists of the Forest Savanna Mosaic, Southern Guinea Savanna and the Northern Guinea Savanna.

Niger and Kwara States were purposively selected for the study. The selection was based on the existence of universities with agro-transfer outreach programmes and functional research institutes. A validated questionnaire which was subjected to Cronbach's Alpha reliability test ($r = 0.92$) was used for data collection [28]. A total of 288 questionnaires were analyzed out of the established sampled frame of 353 using Yamane's formula. Data were collected on the respondent's socio-economic characteristics, sources of funds for technology generating practice, mechanisms employed for generating agricultural technologies and constraining factors hindering technology generating practices. Age and research experience were measured in years. Sources of funds for technology generation were measured by asking the respondents to indicate their sources of research funding. Technology generating practices were measured by asking the respondents to rate nine possible technology generating practices on a four point Likert-type scale of non-existent (4) weak (3) somewhat strong (2) quite strong (1). Constraining factors to technology generating practices were measured by identifying twenty-eight possible constraining variables on four possible factors. Factor one (1) was political and/or policy related constraints, which includes pressure from policy and its effect on value, reward and sanctions; factor two (2) was organizational/institutional constraints; factor three (3) attitude related factors, and factor four (4) was motivational factors. Data collected

were analyzed with descriptive statistics (frequency, percentage and mean), *T*-test and Factor analysis.

3. Results and discussion

3.1. Socio economic distribution of respondents

Data presented in Table 1 showed that the mean age of university respondents was 41 years while that of respondents in research institutes was 39 years. This implies that respondents in the universities were relatively older than respondents in the research institutes. Although staff from both universities and research institutes was sufficiently young and active age to face challenges associated with research activities. This finding is consistent with [21] who found that universities staff were older than staff in non-university based agricultural research institutes in Nigeria.

Table 1 also indicated that the mean years of research experience of universities respondents was 11 years while that of respondents in the research institutes was 9 years. This finding corroborates [15] who found in a similar study that university staff respondents had longer years of experience in research compared to their counterparts in research institutes. Majority (66.2%) of the universities respondents had a PhD as their highest qualification while most of the research institutes respondents had BSc/BTech and MSc/MTech (34.9% and 38.8% respectively) as their highest qualification. This study agreed with the findings of [23] who reported that universities in Nigeria have higher number of qualified researchers than the agricultural research institutes.

The results illustrated in Table 1 further showed that majority of the universities (98.5%) and research institutes (60.5%) respondents were member of professional bodies. The higher percentage of membership may be attributed to its necessity for researchers in both institutions of study and its needfulness for assessment in promoting researchers. Also, most of the universities (86.0%) and research institutes (81.6%) respondents were male. This finding is consistent with [21] who reported that majority of university based scientists were male.

3.2. Sources of funds for technology generation

The data presented in Table 2 showed the sources of funds for universities respondents to include personal funds (93%), universities/research institutes (75%), direct government funding (11.8%), loans (10%), private sector sponsorship (8.%) and support from farmers (1.5%). Among respondents in research institutes, the descending order of sources of funds were universities/research institutes (73.7%), direct government funding (59%), private sector sponsorship (44.7%), personal fund (40.8%), support from farmers (23%) and loans (3%).

Comparatively, about 59% of respondents in research institutes received funding directly from government as compared to only about 12% of respondents from universities. Also, high percentage of respondents in the universities and research institutes indicated their establishments (universities/research institutes) as sources of funds. It is important to note that universities and research institutes under this study were government owned. In other words, the research funds were from government to staff through research institutions.

Table 1 – Socio Economic distribution of respondents.

Variables	Universities *n* = 136	Research Institutes *n* = 152
Age (years)		
21–30	18 (13.2)	18 (11.8)
31–40	45 (33.1)	84 (55.3)
41–50	59 (43.4)	40 (26.3)
>50	14 (10.3)	10 (6.6)
Mean	41	39
Research experience (years)		
1–5	20 (14.7)	66 (43.4)
6–10	74 (54.4)	52 (34.2)
11–15	21 (15.4)	8 (5.3)
>15	21 (15.4)	26 (17.1)
Mean	11	9
Educational qualification		
HND	–	31 (20.4)
BSc/BTech	7 (5.1)	53 (34.9)
MSc/M.Tech	39 (28.7)	59 (38.8)
PhD	90 (66.2)	9 (5.9)
Membership of association		
Member	134 (98.5)	92 (60.5)
Non-member	2 (1.5)	60 (39.5)
Gender		
Male	117 (86.0)	124 (81.6)
Female	19 (14.0)	28 (18.4)

Table 2 – Distribution of respondents by sources of fund for technology generation.

Sources of research funding	Universities $n = 136$ Frequency* (%)	Research institutes $n = 152$ Frequency* (%)
Direct government funding	16 (11.8)	90 (59.2)
From Universities/research institutes	102 (75.0)	112 (73.7)
Private sector sponsorship	11(8.1)	68 (44.7)
Personal fund	127 (93.4)	62 (40.8)
Loans	14 (10.3)	5 (3.3)
Support from farmers	2 (1.5)	35 (23.0)

Field survey, 2014.
* Multiple responses.

This finding conformed to [1] that reported government provides about 94% of fund for universities in Nigeria.

Use of personal funds for technology generation took the lead among respondents in the universities as compared to respondents in the research institutes where this source was less prominent. It can be inferred that the high percentage of universities respondents who utilized their personal funds for research were working for their personal academic and intellectual advancement as their promotion criteria were largely based on published research findings. The desire to meet the required number of published articles before the next promotion is likely to be the driving force for using personal funds. Uzuegbunam [31] also found that majority of the universities researchers used their personal funds for research. This finding is in line with findings of [24] who reported that the bulk of university researchers are driven by demand for publication towards career advancement. Also, Bogoro [7] stated that the slogan in the universities now is "Publish or Perish" rather than orientation of research towards technological development. Oloruntoba and Ajayi [22] further stressed that research publication in the universities is a major significant indicator of academic staff productivity.

Very few (1.5%) of the universities respondents received support from farmers. Earlier study by Agbamu [3] and Madukwe [16] reported similar weak financial involvement in research with universities staff as compared to farmer's participation with staff in research and advisory institutes that work with them directly. This finding is evidence of limited involvement of farmers in technology generation. Similar finding of failure to involve poor farmers was reported by Adugna [2] as challenges to improve research, extension and education linkage in Ethiopia.

Results illustrated in Table 2 further showed that other stakeholders such as private sector and financial institutions where respondents obtained loans participated in funding agricultural research in universities and research institutes. This finding is in line with the opinion of Obayan [20] that the practice in some part of the world is basically the responsibility of all stakeholders to contribute substantially to funding university education. Similarly, Bogoro [7] noted that change in diversity of funding research and development which had been largely a government affair with very little private sector participation in Nigeria. The emergence of Tertiary Education Trust Fund (TET Fund) in Nigeria is a response to the voice of the academic community led by the university academic union for increased private sector participation in the technological development process in Nigeria.

3.3. *Comparison of agricultural technology generating practice of universities and research institutes*

The results in Table 3 revealed a significant difference ($t = 8.50$; $P < 0.05$) in the level of farmers participation in field research trials by the universities and research institutes in generating agricultural innovations. Researchers in the universities (mean = 3.17) involved more farmers in research trials as compared to their counterparts in the research institutes (mean = 2.13). This practice of active participation of farmers according to Adugna [2] gives farmers adequate opportunity to decide on research and extension priorities. Farmers' participation in field research trials contributes largely to orienting innovation towards sustaining farmers' interest.

The results also showed that universities and research institutes differed in terms of adequate research facilities to workers ($t = 2.05$; $P < 0.05$). Universities researchers (mean = 1.98) received more adequate research facilities and incentives as compared to their counterparts in the research institutes (mean = 1.73). According to Banmeke and Ajayi [5], non-availability of facilities necessary for effective implementation and functioning have resulted in low morale and poor performance among agricultural experts in Nigeria. To attract and retain competent experts, [4,25] affirmed the need to create work conditions that promote and sustain employee motivation and well-being.

Also, research institutes differed from the universities in the physical distance between technology generation and technology transfer ($t = 13.54$; $P < 0.05$). The results further showed that researchers in research institutes (mean = 3.49) were nearer in distance between technology generation and technology transfer to farmers than their counterparts in the universities (mean = 1.97). The distance between innovation generation and transfer sub-system had been identified as a major factor influencing the quality and time of providing innovation to participating farmers [6,16].

Table 3 also shows that universities and research institutes differed in farmers co-financing of adaptive research trials ($t = 3.77$; $P < 0.05$). The results further showed that researchers in research institutes (mean = 2.76) co-finance more adaptive research trials than their counterparts in the universities (mean = 2.31). "This finding clearly shows that, universities'

Table 3 – T-test results showing differences in Agricultural Innovation Generating Practice between University and Research Institutions.

Innovation generating practices	Universities (max. = 4)	Research institutes (max. = 4)	t-cal
Autonomy in technology generation	3.11 (.857)+	3.18 (.958)	1.07
Technology generation base on field problem	3.38 (.731)	3.48 (.825)	1.10
Farmers participate in field research trial	3.17 (.985)	2.13 (.951)	8.50*
Technology generating activities keep pace with current field practices	3.50 (.779)	3.53 (.719)	0.38
Adaptive research trials are located in farmers field	2.10 (.871)	1.97(.973)	1.23
Extension agents participate in field research trial	3.28 (1.05)	3.34 (.929)	0.84
Adequate research facilities and incentives to workers	1.98 (.843)	1.73 (.942)	2.05*
Distance between technology generation and technology transfer	1.97 (.910)	3.49 (.807)	13.54*
Farmers co-finance adaptive research trial	2.31 (.963)	2.76 (1.110	3.77*

Field survey, 2014.

+ Data in parenthesis are standard deviation.

* $P < 0.05$.

Table 4 – Factors constraining the linkage activities of the respondents.

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Rank
Overlapping mandate/objectives	**.580**	.172	.232	**.327**	–
Limited qualified human resources in the agencies for linkage leadership	.241	.636*	.074	.254	9th
Lack of adequate sources of finance	**.567**	**.490**	.236	.095	–
Limited physical resources (ICT, Telephone)	**.410**	**.517**	**.331**	.251	–
Poor access to knowledge and information on new innovation	.158	.815*	.167	.239	1st
Low mobility of expert/professionals	.196	.804*	.049	.125	2nd
Poor logistics support and incentives for linkage	**.369**	**.655**	.200	.043	–
Organizational rigidities	**.466**	.292	**.455**	.156	–
Long administrative procedure/administrative bottleneck associated with public agencies	.214	.136	.765*	.041	4th
Weak legal frame work/lack of rule for interaction/linkage	**.308**	.002	**.770**	.248	–
Poor macro system linkages	.278	.274	.675*	.195	–
Excessive organizational fragmentation	.247	.125	.793*	.060	3rd
Inappropriate government policy on agriculture	**.597**	.041	**.309**	.199	–
Poor/differences in orientation of personnel of agencies	.164	**.312**	.261	**.553**	–
Influence of international/donor mandates	**.450**	−.177	−.119	**.375**	–
Lack of farmer's interest in extension	−.070	**.590**	.167	**.607**	–
In equality in qualification and salary scale of staff of the agencies	**.528**	.224	−0.023	**.493**	–
General poor attitude and low morale of extension workers	.208	**.357**	−0.017	**.703**	–
Poor training opportunities for professionals	.277	.054	.184	.758*	5th
Traditional public characteristics of most extension information.	.044	**.300**	.243	**.741**	–
Poor government commitment to extension	.754*	.032	.183	.115	7th
Wrong view of famers incapable of taking rational decision	.000	**.557**	.102	**.395**	–
Unequal status among agencies	**.520**	.109	**.346**	**.330**	–
Top down decision making procedure	**.678**	**.387**	.135	.024	–
Unclear delineation of Function	.702*	.282	.233	.074	8th
Multiplicity of organization with varying ideologies	.756*	.190	.277	.031	6th
Management policy	**.655**	.266	**.408**	.075	–
Bureaucratic bottleneck	**.659**	.286	**.399**	.182	–

Extraction method: principal component analysis.

Rotation method: Varimax with Kaiser normalization.

Note: Data in bold loaded high in more than one factor and were not considered in the process of extracting factors because they overlapped.

* Sig.

researchers were more involved in innovation generation practices, work more closely to farmers and rely less on research funding from farmers. However, more involvement of farmers in research funding by AIRs and farmers' willingness to contribute may be one of the contributing factors for the less involvement of farmers in innovation generation practices through AIRs despite their nearness to farmers at the grassroots."

3.4. *Factors constraining the technology generation activities of the respondents*

The factor matrix illustrated in Table 4 showed the factors constraining the technological generation activities of respondents in the universities and research institutes. The factor matrix identified and named four factors.

Items that loaded high in factor 1 were poor government commitment to extension (.754), unclear delineation of function (.702) and multiplicity of organizations with varying ideologies (.756). Items that loaded high in factor 2 (organizational/institutional constraints) were limited qualified human resources in the agencies for linkage leadership (.636), poor access to knowledge and information on new innovation (.815) and low mobility of expert/ professionals (.804). Items that loaded high in factor 3 (attitude related factors) were long administrative procedures/administrative bottlenecks associated with public agencies (.765), poor macro system linkages (.675) and excessive organization fragmentation (.793). Items that loaded high in factor 4 (poor motivational factors) included poor training opportunities for professionals (.758). These findings are consistent with Chiemeke et al. [9] who argued that the foundations for research are good research training and motivation, availability of equipment and good library facilities; and, Echeme and Nwachukwu [10] who identified several issues associated with project implementation to include low level of government support, low capacity building and poor project funding.

4. Conclusion and recommendations

4.1. *Conclusion*

Findings of this study suggest four main conclusions:

1. There was little difference between institution types in the mean age of their staff.
2. University staff were better qualified than their counterparts in ARIs. The number of PhD holders in the universities was greater than that of the research institutes.
3. Use of personal funds to resource research was more common among universities respondents than their counterparts in the research institutes. This was most likely linked to the need to generate research publications for university promotion, and therefore gain access to higher salary levels.
4. For technology generating activities to keep pace with current field practices the universities and research institutes need to form greater linkages in the generation of innovative practice. ARIs differed with the universities in the physical distance between technology generation and technology transfer. Poor access to knowledge and information on new innovations, rather than qualified human resources, was identified as a major constraint to technology generation by universities respondents. For ARIs, limited physical resources (ICT, Telephone) rather than motivational or financial limitations, was the major constraint to technology generation practices.

4.2. *Recommendations*

Based on findings in this study, the following recommendations were made to improve the technology generating practices of respondents in the study area.

1. The percentage of PhD holders among respondents in ARIs was low. This study recommends that staff in research institutes should be encouraged to undertake postgraduate doctoral studies to acquire advanced knowledge and research skills.
2. University researchers should look into options of applying for funding to a wider range funding bodies to help alleviate the drain on researcher's personal funds to generate agricultural technologies.
3. The formation of a formal technological linkage advisory council would help strengthen the governance of innovation in Nigeria to alleviate limitations in research facilities and qualified human resources.
4. Institutions should provide improved access to high speed internet facilities for researchers and should encourage attendance at international conferences to improve interaction and cross fertilization of ideas. This would help to counter the poor access to knowledge and information on new innovation, which was identified as the top ranked constraining factors to technology generation among respondents.
5. Innovation policies and governing rule should be revised and updated to enable effective technological generation and linkages. This approach would help overcome factors constraining effective technology generation among respondents. Among these factors poor government commitment to extension, unclear delineation of function, multiplicity of organization with varying ideologies, lack of adequate sources of finance, top down decision making procedure, management policy and bureaucratic bottle neck were identified as most critical.

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