COLLABORATION, NETWORKING AND RESEARCH PRODUCTIVITY IN NIGERIA'S RESEARCH INSTITUTES: EMPIRICAL EVIDENCE

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ABSTRACT

This article establishes the effect of collaboration/networking on research productivity among researchers in the Federal Ministry of Science, Technology and Innovation (FMSTI). The study utilises a large cross-sectional survey data collected from senior researchers, scientists and engineers (1611) in the seventeen Agencies of FMSTI. The results showed that internal collaborations among researchers and scientists were high and the purpose of collaboration includes research engagement, grantsmanship writing and journal publications. Most researchers also engage in external collaboration, particularly with other research institutes, Universities and Polytechnics. A few researchers reported collaborations with the industry. The analysis further showed a significant and positive effect of collaboration on research productivity. The results suggested that collaboration, whether internal or external, has a strong potential to improve research productivity. The article concludes that the management of these institutions needs to provide adequate platforms/incentives for researchers to collaborate and network to improve performance.

Keywords: Collaboration; Research productivity; Training; Researchers; Nigeria

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1. Background to the Study

There is consensus on the roles of research, innovation and creativity in attaining sustainable development goals and national competitiveness, particularly through the application of scientific research and technological efforts (Adelowo et al., 2019; GII, 2020). Today's global currency is knowledge; and it has to be deployed to proffer solutions to the wicked problems confronting humanities-poverty, hunger, unemployment, environmental

degradation and many more. To generate requisite scientific and technological knowledge and to commercialise them, there is a need for huge financial commitment and a robust policy framework (Siyanbola, 2019). Apart from the commitment to build critical research capacity and infrastructure, more is required to be spent on market-driven research and development (R&D). Nations that have invested heavily in R&D are at the forefront of development, creating disruptive technologies with global dominance, maintaining strong connections between R&D institutions and industry through robust policy instruments; and leveraging global talent through attractive/targeted incentives. While government efforts and industry commitment to research improve research activities within a system, collaboration is equally important to enhance research productivity. Productivity itself is the archetypal indicator of efficiency in any production system (Abramo and D'Angelo, 2014; 2022).

Research activity is seen as a production process in which the inputs consist of human, tangible and intangible resources, and where output, the new knowledge, has a complex character of both tangible and intangible nature (Adelowo and Surujlal, 2020). The new knowledge production function has therefore a multi-input and multi-output character. The principal efficiency indicator of any production unit (individual, research group, department, institution, field, country) is productivity and it is the output produced in a given period per unit of production factors (Abramo and D'Angelo, 2014). Various metrics have been employed to capture research productivity such as the number of publications per researcher, the impact of publications (generally measured using citation index) and the potential application of research outcomes (Abramo et al., 2013). Abramo and D'Angelo (2014) argued that performance should be evaluated concerning the specific goals and objectives that research intends to achieve. This is because objectives and goals of research vary across research organisations and over time, recommending a sole indicator of performance would be inappropriate, although, combining many unrelated indicators could amount to comparing apples to mangoes. To map and compare science, technology and innovation performance across countries, several African countries including Nigeria have received capacity-building and funding support from international institutions to support the adaptation of existing indicators (AIO, 2010; 2014). These indicators could be classified into input indicators, facilitating or process indicators and output indicators. The inputs most often determine the outputs of the system and a major measure of research outputs includes publications and patents. Apart from these two indicators of scientific progress, the outcome and impact of scientific R&D include spin-offs, new products and processes or services and improved

living standards among the populace. Therefore, we pose a crucial question about what influences research productivity in this paper. By productivity, the study meant an estimated number of articles published by the individual researcher, though subjective.

As earlier noted, several factors contribute to researchers' productivity within a given system including available funding and facilities for research, the capacity of research organisations, state-of-the-art infrastructure and the depth of collaborations among researchers and institutions among others. This article pays special attention to how collaboration and cooperation among researchers in the Federal Ministry of Science, Technology and Innovation contribute to research productivity in the Ministry. The study explores a large cross-sectional survey conducted among the senior level researchers, scientists and engineers in the seventeen Agencies under FMSTI. The study is anchored on the innovation system approach which advanced that important interactions are needed among the actors/players in any sector to adapt, import and modify technologies for improving the system. We argued that in a resource constraints environment like Nigeria, one of the ways to improve R&D productivity is for researchers and institutions to collaborate, both in the use of research facilities and in maximising the limited research funds. The specific objectives of the study are three-fold as stated below:

1. Examine the frequency, types and purposes of internal and external collaborations among researchers at STI-related research institutes in Nigeria
2. To examine the extent of productivity among researchers in the Nigerian STI landscape
3. Evaluate the influence of collaboration on research productivity

2. Literature Review

Cutting-edge researches are on the increase, being a product of collaboration among rightly composed teams (Adams *et al.*, 2005; Wuchty *et al.*, 2007; Ahmadpoor and Jones, 2019) and it opens up further opportunities such as division of labour, cross-fertilization of knowledge and increased productivity (Ductor, 2015; Abramo and D'Angelo, 2021; 2022). Research collaboration is also on the rise and this rise is attributable to attempts directed at solving global problems such as climate change that span disciplines and nations and advances in information and communication technology (Walsh and Maloney, 2007; Ayo-Lawal et al., 2022).

Several authors have discussed various forms of collaboration and their various impacts on the research community. For example, Katz and Martin (1997) discussed how research collaborations have been encouraged and aided by various agents in the science policy circles even though they concluded that the term 'collaboration' is very difficult to define. They agreed that what constitutes a collaboration varies across institutions, fields, sectors and countries, and is not static as they probably change over time. Muriithi *et al* (2018) discussed factors influencing research collaborations citing resource dependence as a major factor and they cited "inadequate policies, high levels of bureaucracy, competition among local institutions, weak links with industry, focus on teaching at the detriment of research" as barriers to collaborative research in Kenya. This is in line with the findings of Katz and Martin (1997). Other factors they mentioned, which motivate collaboration include the need for funding agencies to save money, the growing access and reducing the (real) cost of transport and communication, the desire for intellectual interactions with other scientists, the need for a division of labour in more specialised or capital-intensive areas of science, the requirements of interdisciplinary research, and government encouragement. Most of these factors have a significant impact on the high intensity of African researchers' collaboration with non-African countries, especially the researchers from countries that are scientifically more active (Guns and Wang, 2017).

One of the ways of measuring collaboration is through multi-author or multi-address papers, although it has been argued that such analysis has to be done and interpreted with caution. The co-authorship is only a rather approximate partial indicator of collaboration. Nonetheless, several pieces of evidence have linked productivity to collaboration. For instance, Lee, S., & Bozeman, B. (2005) and Abramo, and D'angelo (2014; 2022) have established a strong link connection between research productivity and collaboration among researchers, particularly where the former is measured by the total number of publications. Ductor (2015) also concluded that greater collaboration leads to higher academic productivity, even after discounting the number of authors who worked on an article. The forgoing suggests important connections between collaboration, networking and research productivity, particularly in developed countries (Abramo et al., 2021) while limited studies exist in developing African countries. This study, therefore, seeks to fill this gap by examining how collaboration influences research productivity in the research-intensive sector of the most populous country in Africa- Nigeria. The next section highlights the research design and methodology adopted in this study.

3. Methodology

3.1 Research Design

A census approach was designed to gather quantitative data through a cross-sectional survey among the research institutes in Nigeria's Science Technology and Innovation (STI) landscape. Data were collected at the level of individuals and from organizational records. Participants were the senior level researchers, scientists and engineers who were actively involved in research activities in the research agencies under the Ministry. The main instrument used was a set of questionnaires that sufficiently obtained relevant information to address the research objectives. It elicited information on competencies, collaboration effort and productivity. The research institutes under the Federal Ministry of Science, Technology and Innovation (FMSTI) were covered with consideration for headquarters and zonal offices across the country.

Table 1: List of Research institutes covered in the study

S/No	Names	Location
1.	National Board For Technology Incubation (NBTI)	Abuja
2.	National Centre for Genetic Resources and Biotechnology (NACGRAB)	Ibadan
3.	The Nigerian Institute of Science Laboratory Technology (NISLT)	Ibadan
4.	Nigerian Institute For Trypanosomiasis And Onchocerciasis (NITR)	Kaduna
5.	National Biotechnology Development Agency (NABDA)	Abuja
6.	National Centre For Technology Management (NACETEM)	Ile-Ife
7.	National Office For Technology Acquisition And Promotion (NOTAP)	Abuja
8.	Nigerian Natural Medicine Development Agency (NNMDA)	Lagos
9.	National Space Research & Development Agency (NARSDA)	Abuja
10.	Raw Materials Research and Development Council (RMRDC)	Abuja
11.	Nigerian Building and Road Research Institute (NBBRI)	Abuja
12.	National Institute of Leather Science and Technology (NILEST)	Zaria
13.	National Research Institute for Chemical Technology (NARICT)	Zaria
14.	Sheda Science and Technology Complex (SHESTCO)	Abuja
15.	Project Development Institute (PRODA)	Enugu
16.	Federal Institute of Industrial Research, Oshodi (FIIRO)	Lagos
17.	National Agency for Science and Engineering Infrastructure (NASENI)	Abuja
18.	**Federal Ministry of Science and Technology Secretariat**	**Abuja**

3.2 Study Respondents

Our study respondents were senior-level staff of the research institutes, from grade level 8 to 15. The study respondents consist of all researchers and core staff of the research institutes and they represent the target respondents for the survey conducted using a semi-structured questionnaire.

The Data were collected on respondents' socio-demographics, existence or non-existence of collaborations, frequency of collaborations, types of collaboration, the purpose of collaboration and productivity of researchers in terms of their research outputs, and the number of conference papers presented (see Table 2).

Table 2: Variables and their Measurement

	Domains/Measures	**Data Sources**
	Research Output/Productivity	
1	The number of scholarly journal publications	Survey
2	The number of conference papers presented	Survey
3	Number of patents and prototype	Survey
4	Number of institutional monographs	Survey
5	Number of staff mentored	Survey
	Collaboration	
8	Types of collaboration	Multi-choice Questionnaire
9	Purpose of collaboration	Multi-choice questions
10	Frequency of collaborations	Likert scale questionnaire

3.3 Sampling

This survey strictly covered members of staff of the Federal Ministry of Science, Technology and Innovation (FMSTI) and its 17 research agencies. The Ministry is one of the key ministries of the Federal Government of Nigeria, saddled with the responsibility of ***"facilitating the development and deployment of Science, Technology and Innovation to enhance the pace of Socio-economic development of the country"***. The Ministry supervises the seventeen (17) Research and Development (R&D) Agencies covered in this study. The study investigated the variables of interest among senior members of staff as they are key to the achievement of the mandates of the Ministry.

The study instrument (self-administered questionnaire) was distributed among the study participants in the Ministry, both at the headquarters and zonal offices. The survey was carried out between May and September 2019. A total of one thousand six hundred and eleven (1611) core staff of the institutes with job duties directly related to the mandates of the institutions were selected as target participants for this study. These staffs include all the researchers - scientists, engineers, and planning officers who completed the research

instrument. Data collected were analysed using descriptive and inferential statistics (see Table 3 for the details of how the data were analysed by objectives).

Table 3: Methodology Matrix and Data Analysis

S/N	**Objective**	**Data Needs**	**Data Sources**	**Method of Data Analysis**
1	To investigate the factors motivating researchers at STI research institutes?	Information on motivating factors driving productivity among researchers in research institutes.	Structured questionnaires	Quantitative analysis using descriptive statistics
2	To assess the frequency, extent and types of collaboration among researchers in STI-related research institutes	Information on internal and external collaborations within and outside the research institutes	Structured Questionnaire and Secondary sources	Quantitative analysis using descriptive statistics
3	To investigate the relationship between collaboration and research productivity among researchers	Information on the linear relationship between the frequency of collaboration and research productivity (journal publications and conference attendance)	Structured Questionnaire	Quantitative Analysis using linear regression model

Ethical Considerations:

Studies done with human subjects are bound to observe certain ethical guidelines. Central to this study, issues are ranging from informed consent, voluntariness, anonymity, and risk-benefit ratio. All participants are adults, hence, verbal and written consent was obtained as appropriate. Also, the objectives of the research were made available to participants, such that only participants that agreed to participate were included. The right to withdraw at any point in the study was also communicated and respected. Personal information such as names, phone numbers or any other information that could be traceable to participants was not collected. The study did not ask any sensitive questions to the participants; hence they were not exposed to any risk at all.

4. Results and Discussion

4.1 Socio-demographics of Study Participants

A total of one thousand six hundred and eleven (1611) researchers, scientists, and engineers participated in the survey and are distributed across four departments comprising six hundred and four (604) scientific officers, five hundred and one (501) research officers, three hundred and seventy-seven (377) engineers, and one hundred and twenty-nine (129) planning officers. The selected members of staff are regarded as core staff of the research institutes who

perform the job responsibilities and duties directly related to the mandates of the institutions. They are also principally the Scientists and Engineers in the Science, Technology and Innovation (STI) ecosystems. Our findings also revealed that about 68% of study participants are males which supports studies that suggested a low percentage of Nigerian women are represented in STEM courses and career paths when compared with their male counterparts (NACETEM, 2020). Furthermore, our findings revealed an interesting age distribution of respondents, as over 85% of them are within the age bracket of 26 to 45 years, suggesting that they are young and can contribute significantly to the development of the ministry. The results also showed that most (90%) of staff possessed a minimum degree with Master's and PhD degrees in principally core science, engineering and technology disciplines.

Table: 4: Basic Demographic Information of the Participants

Cadre	**Frequency**	**%**
Scientific Officer	604	37.5
Research officers	501	31.1
Engineers	377	23.4
Planning Officers	129	8
Gender		
Male	1096	68
Female	515	32
Age (group)		
Young (26-45years)	1369	85
Old Adult (Above 45)	242	15
Highest Qualifications		
Postgraduates (M.Sc/PhD)	1450	90
B.Sc./B.Tech/B.Eng	160	10

Objective 1: Examine the frequency, types, and purposes of internal and external collaborations among researchers at STI-related research institutes in Nigeria

Knowledge creation which is a key component of Science and Technology (S&T) activities requires human interaction as research cannot be effectively done in isolation (Kale, 2017). Studies have suggested that collaboration is important for research and research collaboration networks can contribute to HEI's research capacity and productivity. From anecdotal evidence, there are at least five reasons that make researchers collaborate: the need for capacity building, the need to address complex research issues; the need for learning and productivity in research; the need to reduce research costs and the need to share research resources such as laboratories, and equipment.

The dynamics of networking and collaboration in this study were examined by measuring the frequency, types and purpose of collaboration. In terms of frequency of collaboration, study participants responded to a five-point Likert rating question with "Never", "rarely", "Sometimes" "usually", and "Always" ranging between "0 to 4" respectively. Figure 1 shows that about 70% of respondents positively affirmed always engaging in collaborative efforts across departments within the research institution. Collaborative engagements among researchers and scientific officers were outstanding, as well over 80% of them reported that they regularly collaborate and network with peers within and outside their departments to write scholarly articles for journal publications, research proposal development, and research project execution among others.

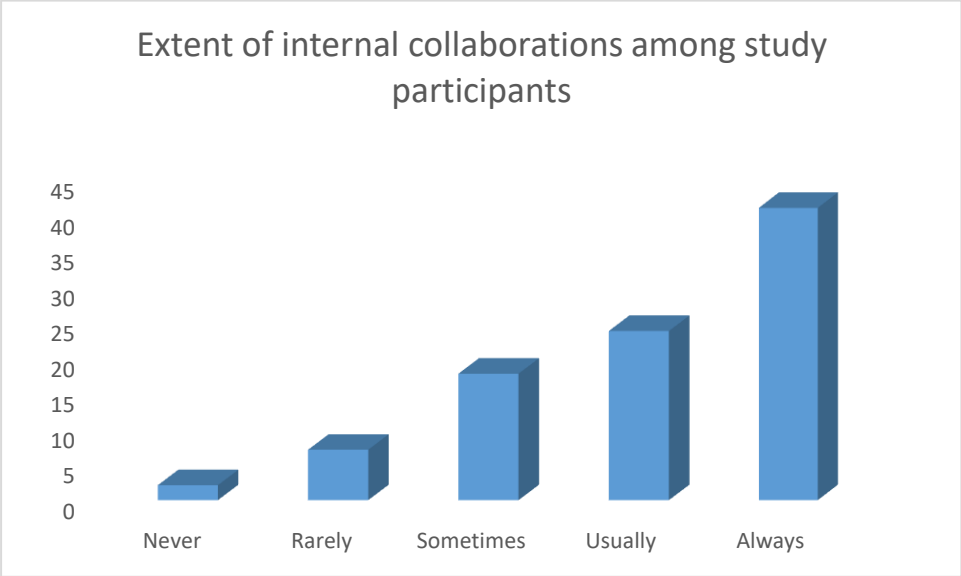

Figure 1: Internal collaborations among study participants
Source: Authors' survey

The benefits of collaboration are enormous and wide-reaching from time-saving to capacity building. Efficient and productive collaboration allows individual researchers to eventually overcome his/her deficiencies (He, Geng & Campbell-Hunt, 2009; Beaver, 2001). In addition, collaboration allows the opportunity for multiple authorship in a scholarly article, thereby encouraging multi- and inter-disciplinary research ideas cross-breeding and efficient use of time, as each researcher focuses on their areas of strength (Barnett, Ault & Kaserman, 1988; Johari, Zaini, & Zain, 2012). Our results corroborate the findings of Savic et al. 2017, who affirmed that researchers at a university in Serbia involved in inter-department collaborations tend to be more productive (by all considered productivity measures). The collaboration in their context was measured in terms of the number of co-authorship relations. Also, Dawn (2009) reiterated that scientists and researchers must adopt a cooperative culture

to increase productivity. This form of cooperation has been reported to foster knowledge sharing, improve skill acquisition, problem-solving ability, and cordial relationships among colleagues and peers. This is considered to be very important and advantageous to a developing country like Nigeria with scarce and limited research resources. Moreso, knowledge sharing and collaborative efforts are also pertinent in scientific research that harness equipment, facilities, and laboratories available to other researchers, even if they belong to another institution.

Furthermore, the increasing multi-disciplinary complexity that characterizes recent scientific research requires competencies not usually possessed by sole scientist/researcher (Beaver, 2001). Collaboration provides a means to overcome these shortcomings by involving scientists who are specialists in the missing competencies. External collaboration is usually with educational institutions (Universities, Polytechnics, and monotechnics), industries, non-governmental organisations (NGOs), and international institutions among others. International collaborations are known to further facilitate the benefits of teamwork as they provide complementary competencies, as well as distinct background and ideas that are useful for cutting-edge scientific advancement.

About external collaborations, relationships are a lifeline for organisational success as the internal resources and capabilities are not necessarily sufficient to drive organisational goals and mandates (Lechner and Dowling, 2003). The purpose of external collaboration examined in this study includes training, research, consultancy, funding, and the use of facilities. Knowledge flows within networks (OECD, 2005), and it is important to create an enabling environment for members of staff to collaborate and establish networks with other institutions. From the foregoing, strengthening external collaborations is as important to scientific institutions as internal networking and resources.

The results presented in Figure 2 show the type and intensity of external collaborations that exist among researchers and scientists. A high level of external collaboration has been observed with educational institutions, while collaboration with the industry is at the lowest level. The collaboration with educational institutions is largely driven by training and research, which are the core functions of STI-related research institutions. The weak collaboration with industry as observed from the analysis is consistent with previous research by Oyewale (2005) and Oyelaran-Oyeyinka and Adebowale (2012) who already established weak interactions between research institutes and industrial firms in Nigeria. This indicates

that not much progress has been made to strengthen research-industry interactions in the country. The prevalent type of collaboration is training, while funding is the least common reason for collaboration. The highest level of funding collaborations is with international organisations and NGOs. The results further showed that international organisations account for 38% of the funding collaborations. This indicates a relatively high potential among staff to attract international funds for science and technology. For the collaborations with NGOs and industrial firms, they are mostly driven by consultancy purposes. The result is similar when collaboration with non-FMSTI agencies was considered. Generally, the data revealed an even spread of these external collaborations across different staff designations.

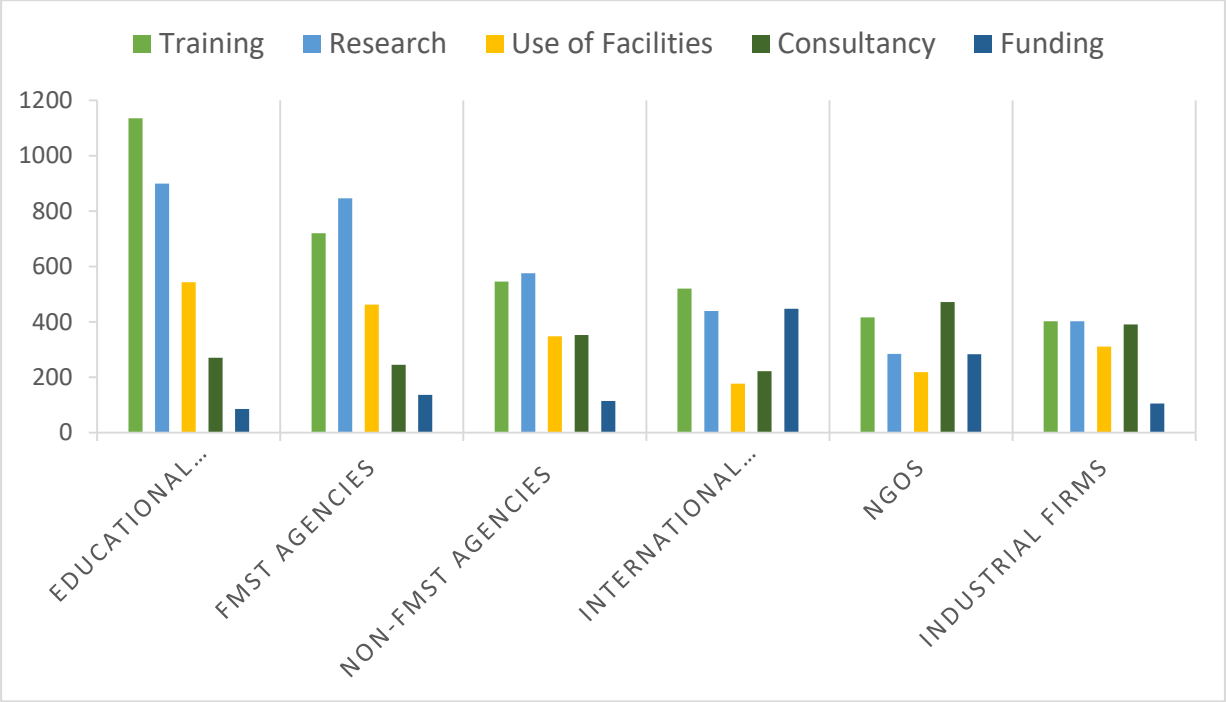

Figure 2: Type and Purpose of external collaborations

Objective 2: To examine the extent of productivity among researchers in Nigerian STI landscape

Table 4: The number of journal publication by researchers

S/N	Designation	Respondents	(%)	Number of Publication	(%)	Ratio of Publication to Researcher
1	Scientific Officer	182	28.2	691	20.3	1.14
2	Research Officer	335	51.9	2308	67.7	4.61

3	Engineer	115	17.8	376	11.0	1.00
4	Planning Officer	13	2.0	34	1.0	0.26
	Total	**645**	**100.0**	3409	100.0	

The results, as shown in Table 4 provided information on research productivity and cadres among the survey participants in the study area. Out of the total researchers surveyed, about 645 of them have published at least one journal article, except those within the planning cadre whose publication ratio is less than one. The most prolific among the cadres is the research officer who accounts for the highest number of researchers and has the highest number of published articles. Moreso, their publication ratio is 4.61 to a researcher, indicating the highest among the cadres still. The result is as expected as all researchers in the Ministry and its agencies are mostly responsible for the research activities in the system. However, the number of journal publication produced by the Scientific Officers are considered moderate (20.3%) while the planning officers recorded the lowest output (1.0 %). The results further showed that Research Officers and Scientific Officers are more prolific than other researchers.

In addition, **Figure 3** shows the distribution of the researchers with publications among the research agencies. The National Agency for Science and Engineering Infrastructure (NASENI) has the highest percentage of respondents with a journal of at least one publication out of the 645 researchers who have at least one journal publication, while the National Office for Technology Acquisition and Promotion (NOTAP) has the lowest percentage. FMSTI has the highest and NOTAP has the lowest ratio of respondents without journals to the total number of researchers from these agencies.

Out of the 645 research publications from the researchers, the agency that has the highest number of publications is NASENI while NOTAP has the lowest. However, it should be noted that the number of respondents among the agencies differs. NASENI has the highest respondents of 342 while NOTAP has just one respondent.

Figure 4 represents the number of journal publications of researchers from agencies. Out of the 3409 journal publications from the researchers, the agency that has the highest number of publications is FIIRO (578) followed by NASENI (471) while NOTAP has the lowest (2).

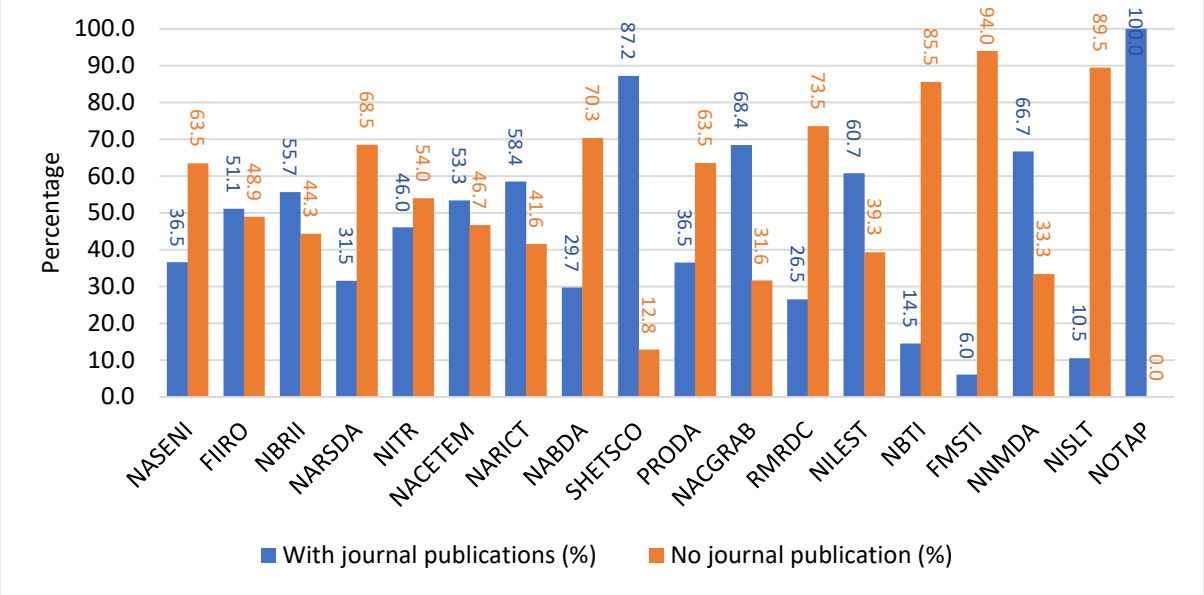

Figure 3: Percentage of researchers with publications from agencies

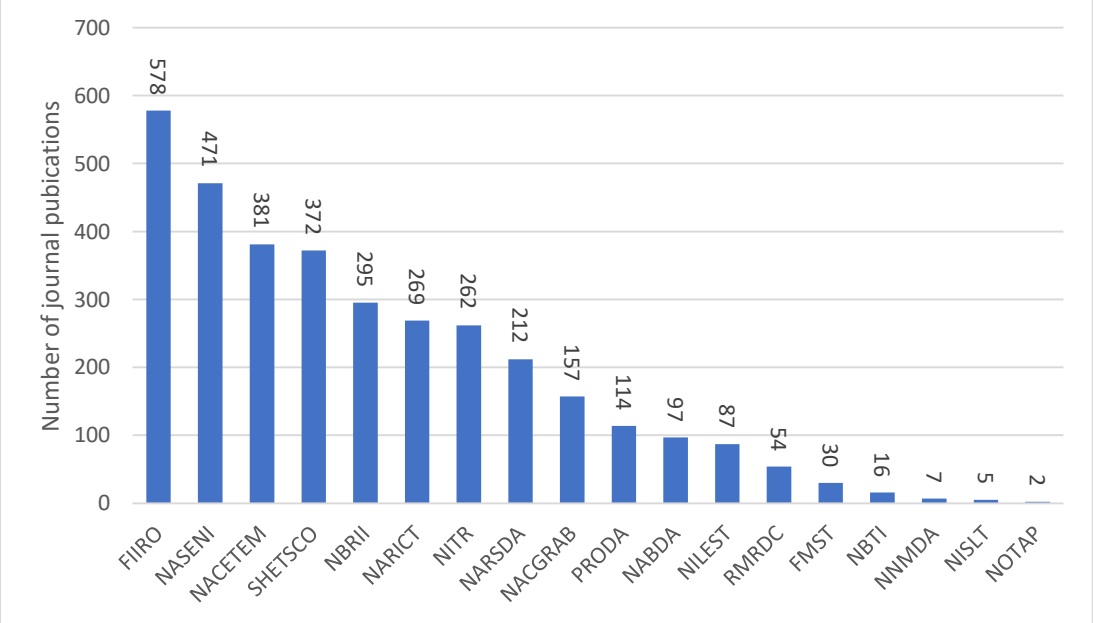

Figure 4: Number of journal publications from agencies

Table 5 shows the number of conference papers, book chapters and monographs published by researchers in all the agencies. Research officers have the highest portion (74.8%) of the 2548 conference papers written by 481 researchers. Similarly, research officers provided the majority (55.3%) of the 320 book chapters written by 133 researchers. In contrast to the earlier findings, scientific officers contributed the most (48.0%) to the 171 monographs published by 67 researchers. In the same vein, research officers have the highest percentages

of survey respondents (57.6%, 53.4%, and 44.8%, respectively) for conference papers, book chapters, and monographs.

Table 5: The number of conference papers, book chapters and monographs published by researchers

Designation	Conference Papers	(%)	Book Chapters	(%)	Monographs	(%)
Scientific Officer	429	16.8	111	34.7	82	48.0
Research Officer	1906	74.8	177	55.3	72	42.1
Engineer	200	7.8	27	8.4	16	9.4
Planning Officer	13	0.5	5	1.6	1	0.6
Total	2548	100.0	320	100.0	171	100.0

Designation	Respondents	(%)	Respondents	(%)	Respondents	(%)
Scientific Officer	127	26.4	47	35.3	27	40.3
Research Officer	277	57.6	71	53.4	30	44.8
Engineer	71	14.8	13	9.8	9	13.4
Planning Officer	6	1.2	2	1.5	1	1.5
Total	481	100.0	133	100.0	67	100.0

Objective 3: Evaluate the influence of collaboration on research productivity

From the regression analysis conducted, the result showed that collaboration and linkages among researchers have a strong relationship/influence on research productivity ($r=0.51$, $p<0.01$). Linkage/collaboration accounts for 1% of the entire factors that significantly influence research productivity in the research FMSTI. This suggests that improving linkages among researchers has the potential of improving research productivity within the FMSTI. This finding corroborates the work of Abramo and D'angelo (2017; 2021) which indicated that collaboration has a positive effect on research productivity among Italian university researchers, using cross-lagged panel models and fractionalised bibliometric analysis. The second model (Model II) also shows that gender ($r=0.98$, $p<0.01$) has a high coefficient and strong relationship with productivity in the Ministry. In addition to linkage or collaboration, the gender factor improves the overall fitness of the model and explains nearly 2% of the factors influencing productivity in the Ministry. The result suggested that additional male

gender researchers in the ministry could trigger productivity by a factor of 0.9, which is considered to be a significant improvement. Literature has affirmed that women are more at a disadvantage when it comes to research productivity, due essentially to gender roles factor and the need for them to care for the family (Abramo, D'Angelo and Caprasecca, 2009; Larivière, et al., 2011). In terms of access to research resources, particularly at the early career stage, it has been established that the female gender is mostly at a disadvantage (D'Angelo and Murgia, 2013b).

Table: 6: regression analysis

Independent Variables	Model I	Model II	Model III	Model IV
Constant	3.37*	$1.537^{n.S}$	-9.375*	-0.9811
Linkages	0.514*	0.526*	$0.237^{n.S}$	$0.217^{n.S}$
Gender	-	0.979*	1.33*	1.299*
HAQ	-	-	3.051*	2.973*
Training			-	1.195*
R	0.09	0.126	0.412	0.424
R^2	0.008	0.016	0.169	0.18
F	6.67*	6.133*	50.503*	39.641

Dependent Variable: Published articles

***** $p<0.01$

Moreover, the imputation of the highest academic qualification (HAQ) of researchers into the model, changed the narrative of the effect of linkages on research productivity. In Model III, we observed that linkages became non-significant but with a positive effect on productivity. The result implied that as researchers obtained a doctoral degree, the likelihood of being productive independently begin to surface and reduces the influence of linkages or collaboration. The three variables, linkages ($r=0.24$, p is greater than 0.05), gender ($r=1.13$, $p<0.01$) and HAQ ($r=3.05$, $p<0.01$) suddenly explain about 17% of the factors which influence productivity in the study area. The final model tested in this study is whether training moderates the influence of linkage on research productivity in the study area. Studies have established that training and capacity building impact the performance of the organisation (Adelowo et al., 2022; Ayo-Lawal et al., 2022). The results here show that linkage has a positive but not significant relationship with research productivity while other factors such as gender, HAQ, and training have a strong positive and significant relationship with research productivity. The result in model III suggested that with a high research degree and adequate training, research productivity tends to become better among the researchers.

Conclusion

The outstanding benefits of networking and collaboration among academia have been long emphasized especially its potential to drive sustainable development and promotion of globalized knowledge. This study set out to establish how collaboration and teamwork among researchers in the Federal Ministry of Science, Technology and Innovation (FMSTI) contribute to research productivity. Creating teams that collaborate at institutional and inter-institutional levels is useful for fostering radical and disruptive innovations as well as promoting productivity. This study has shown that when researchers work together, it increases benefits by enhancing their productivity. However, the level of influence was higher when gender, adequacy of facilities and equipment as well as training opportunities were introduced. This suggests that an appropriate platform should be created that will allow collaboration among researchers within and outside of their institutions to boost productivity and performance. Women should be encouraged to collaborate more often and should be regularly exposed to capacity-building training programs to improve their collaborative efforts. These collaborative efforts are also more likely to promote, encourage and allow access to cross-discipline research collaborations. As researchers can share their knowledge, the quantity and quality of research findings and outputs become more far-reaching and performance naturally increases.

Limitation of the Study

The paper identified collaboration/linkages among researchers as an important variable that contribute significantly to research productivity in Nigeria's FMSTI. Data on research productivity in the country is rare. This necessitated the use of a survey where data were collected from all senior researchers in Nigeria's FMSTI through a set of validated questionnaires. Information provided through the self-reported questionnaire has its limitation, however, the primary research instrument was well-validated through expert review and a pilot study conducted on similar institutions. The measure of research productivity is limited to published articles, though we understand that other metrics of research productivity exist including conference papers, the number of mentored students/staff, patents, spin-offs and commercialised research outputs among others. Given that number of publications is the simplest measure of research productivity and it is a universally accepted standard of evaluating researchers for promotion, award and scholarship. Future studies may focus on research impact using bibliometric or scientometric analysis.

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