Human Resource Development and the Prospects for Biotechnology Development in Africa – A Case of Nigerian National Agricultural Research System (NARS)

T.A. Adisa[1] & A.O. Abgontale [2]

Federal College of Animal Health and Production Technology, National Veterinary Research Institute[1]; AEM Department, Federal College of Animal Health and Production Technology, Ibadan[2]

Abstract

Purpose: *The study focused on the pivotal role of human resource development as an important element in the process of enhancing sustainable capacity for agricultural biotechnology in the Nigerian National Agricultural Research System (NARS).*

Design/Methodology/Approach: *Multistage sampling technique was used in the study. Six (6) universities and nine Research Institutes were selected. One hundred and forty eight (148) respondents were then drawn from faculties of agriculture and veterinary medicine and also the research institutes on the basis of their utilization of biotechnology for agricultural research.*

Findings: *Results from the study revealed that there was inadequacy in human resources development opportunities. The most inadequate were: royalties on finding, (82.4%), financial and other incentives (81.0%), and availability of complementary experts (62.8%).Spearman rho correlation results showed that all the indices of human resources development significantly affected participation as follows: training/self development opportunities ($r = .278$, $p < 0.05$), career advancement opportunities ($r = .348$, $p < 0.05$), availability of complementary experts ($r = .230$, $p < 0.05$), availability of support staff ($r = .354$, $p < 0.05$), financial incentives ($r = .333$, $p < 0.05$), royalties on findings ($r = .504$, $p < 0.05$) and supervision by other scientists ($r = .367$, $p < 0.05$). Regression correlations however showed that only availability of royalties on findings ($P < 0.05$) and opportunity for career advancement ($P < 0.05$) significantly contributed to scientist's participation in biotechnology.*

Implication: *The implication of this scenario is that human resources development must be mainstreamed in the effort to develop capacity for biotechnology in the National Agricultural Research system.*

Originality/Value: *The inadequacy of human resource development opportunities for scientists can affect scientist's participation in agricultural biotechnology research; there adequate development opportunities should be provided for scientists to enable their participation in agricultural biotechnology research.*

Keywords: *Human resource development, biotechnology, mainstream*

Introduction

The development of a strong human resource base has been the hallmark of capacity building in National Agricultural System's (NAR's) all over the world. This has particular important implications for National Agricultural Research Systems (NARS) in Africa and the rest of the developing world. The availability of a critical mass of scientists, technologists, technicians, research administrators and other categories of personnel predicts the outcome to be expected from the combination of other vital elements of a veritable research system.

Discussing the Nigerian scenario, Sanyal and Babu (2010) pointed out that human capacity at the federal, state levels and in public and private research institutions, universities and non-government organizations were generally low in sustaining capacity for supplying evidence for agricultural and rural development policies. Among other factors, they pointed to poor funding as a reason for this situation. It is against this background that Gyang (2011) observed that in recent times, the development of human capital has been the focus of concern towards the development of the nation. This is for the fact that the growth of tangible capital stock of a nation depends to a considerable degree on human capital development. Without adequate investment in developing the human capital which is the process of increasing knowledge, skills and the capacities of people in the country, the possibility of the growth of that nation might be minimal. This is particularly true of the agricultural research sub-sector, which by its multi-faceted nature places a rather high demand on competencies from various disciplines.

Beintema and Stads, (2004) documented the fact that as at 2000, Nigeria employed the highest number of researchers in Sub-Saharan Africa (11 percent). If this apparent advantage still produces a rather dismal performance, as seen in the food and agricultural output of the country, the implication for other parts of the continent can then be left only to imagination. In order to provide a graphic view of the human resource state of Research and Development (R&D) organizations in sub-Saharan Africa, Beintema and Rahija (2011) profiled the Public agricultural (R&D) staffing levels and yearly growth rates over close to two decades (1991–2008), as shown on table 1. The picture shows a clear deficiency in human resource capacity across the sub-continent. While it is the responsibility of national governments within which NARS exist to fashion home-grown solutions to their human resource deficits, Beintema and Stads (2011) articulated some rather general approaches that could improve national situations, stating that growing concern exists regarding the lack of human resource capacity in agricultural R&D to enable satisfactory responses to emerging global challenges. National governments and donor organizations must expand their investments in agricultural higher education to allow universities to increase the number and size of their MSc and PhD programs and to improve the curricula of existing programs. The regional community has an important role to play in this regard, particularly when it comes to small countries with limited or nonexistent MSc or PhD training opportunities. They added that in recent years, various regional capacity-building initiatives have begun, but these will have to be further expanded in order to address some of the capacity challenges evidenced in this report, including aging pools of scientists and increasing shares of junior research staff in a large number of countries.

Statement of problem

At the fore front of developing a sustainable capacity agricultural biotechnology in Africa is a consciousness need for human resource development. An assessment by FARA (2010) indicated that various universities in sub-Saharan Africa (SSA) are developing courses in modern biotechnology at both undergraduate and postgraduate levels. Most of these courses address non-GM approaches to modern biotechnology. Short-term courses in specific areas of biotechnology or tools should be available in tertiary institutions. FARA, with the assistance of the international community, provides support for these specialised short-term courses and backstops analytical work in advanced laboratories within or outside Africa by SSA scientists. A permanent arrangement for such institutional support for human resource development is lacking in SSA at present and should be provided along the lines suggested.

The question of developing a permanent arrangement for institutional support for human resource development cannot be adequately achieved outside the availability of lucid information on available options for enhancing this all important input in the NARS. An empirical evaluation provides a veritable input to policy makers, technical partners, R&D institutions and other local and multinational organizations who have a mandate for developing the human resources element of biotechnology research with requisite and appropriate baseline information.

Methodology

The population of the study is scientists in National Agricultural Research Institutes (NARI's), Faculties of Agriculture, and Faculties of Veterinary Medicine in Nigerian universities who are participating in the use of agricultural biotechnology applications for research. These are individuals in the employ of either these institutions, and are responsibility for research activities that utilize agricultural biotechnology applications.

Multistage sampling was used to draw samples from both Universities and National Agricultural Research Institutes. Two Federal universities, two state universities, A Federal University of Agriculture and a Federal University of Technology were selected from a list university. Forty three scientists were purposively selected from the faculties of agriculture and veterinary medicine in these universities, based on participation in agricultural biotechnology research. Nine research institutes were purposively selected based on their mandate. A total of 105 scientists were purposively selected from the research institutes, based on their participation in agricultural biotechnology research. The total number of respondents from the selected both universities and research institutes amounted to 148 scientists.

Both primary and secondary data were utilized in the study. Secondary information covered general information on agricultural biotechnology research and development. Important concepts with respect to building capacity for research were discussed with respect to how they affect human resource development opportunities for scientists. Nature of employment was categorized into university and research institute while qualification was ordered hierarchically (B.Sc., M.Sc., M.Phil, and PhD) for the respondents to indicate their highest level of attainment. Major activities were ranked based on official time allocation. A list of activities was provided and scientists asked to indicate their official time allocation from the highest to the least. The listed areas included: research, teaching/training, extension administration, and production activities. Cadre was measured by asking respondents to indicate whether they were management, senior or intermediate level staff in the organization.

Human resources: Items determining human resource development opportunities available to scientists were listed (opportunities for training, availability of support staff to scientists, complementary experts, financial incentives, job security, royalties on findings, and feedback mechanism. These were ranked from 'very adequate' =3, 'adequate' =2, 'inadequate' =1).

The dependent variable is scientist's participation in agricultural biotechnology research. In this study it represents the use of agricultural biotechnology research laboratory/field applications, publication/documentation of biotechnology information, training/extension activities in the area of agricultural biotechnology and participation in agricultural biotechnology development activities. Respondents indicated the frequency of participation in these activities, i.e. Always=2. Sometimes=1, and never=0. An aggregate score of all the participation indices indicates level of participation.

Results and Discussion

Table 1: Public agricultural R&D staffing levels and yearly growth rates, 1991–2008

Total number of researchers (FTE)				**Yearly growth rate (%)**			
Country/size in 2008	**1991–95**	**1996–2000**	**2001–05**	**2008**	**1991–96**	**1996–2001**	**2001–08**
More than 1,000 FTEs							
Nigeria	1,083	1,202	1,439	2,062	1.1	4.0	5.9
Ethiopia	425	610	1,028	1,318	8.7	10.3	6.0
Sudan	539	678	913	1,020	4.4	5.1	3.6
Kenya	970	915	925	1,011	–1.0	–1.3	1.5
500 to 1,000 FTEs							
South Africa	998	1,034	835	784	2.1	–3.2	–1.7
Tanzania	526	523	639	674	–1.1	2.8	1.4
Ghana	387	457	465	537	6.3	0.6	2.5
100 to 500 FTEs							
Mali	244	239	292	313	–0.4	–0.7	–0.7
Uganda	238	257	240	299	1.4	0.0	3.4
Mozambique	na	na	121	263	na	na	11.7
Burkina Faso	175	193	237	240	0.6	4.9	1.4
Guinea	219	235	218	229	1.6	–0.4	0.3
Madagascar	189	204	209	212	2.9	1.0	0.3
Zambia	195	196	146	209	3.2	–8.1	3.8
Mauritius	120	148	151	158	5.0	0.0	1.7
Senegal	196	166	147	141	–1.8	–4.9	0.5
Zimbabwe	na	na	154	148	na	na	–1.5
Malawi	162	165	133	127	1.7	–3.2	–1.7
Côte d'Ivoire	216	170	118	123	–4.1	–8.5	–0.1
Eritrea	na	69	90	122	na	10.7	6.6
Benin	108	114	111	115	1.0	1.9	–0.2
Rwanda	na	na	na	104	na	na	na
Fewer than 100 FTEs							
Burundi	130	61	69	98	–22.4	2.6	5.1
Botswana	44	59	76	97	8.7	6.9	5.6
Congo	110	124	104	94	3.1	–0.2	–2.5
Niger	101	113	100	93	3.5	–1.8	–1.9
Mauritania	na	na	66	74	na	na	3.1
Namibia	na	na	61	70	na	na	0.2
Sierra Leone	na	na	48	67	na	na	3.8
Togo	90	88	81	63	–2.4	1.6	–4.0
Gabon	26	35	41	61	7.2	4.0	8.2
Gambia, The	33	41	41	38	–0.6	3.4	–1.8
SSA total (45)	**9,001**	**9,369**	**10,404**	**12,120**	**1.2**	**1.2**	**2.8**

Sources: Compiled by authors based on country-level ASTI survey data and several secondary resources (for more information, see individual ASTI Country Notes available at www.asti.cgiar.org). Beintema and Rahija (2011).
Notes: Countries are ordered from largest to smallest in terms of their total number of FTE researchers in 2008.

Table 2: Professional Characteristics of Scientists

Variable		Frequency	Percentage
Employment	University	53	35.8
	Research Institute	95	64.2
Qualification	B.Sc	37	25.0
	M.Sc	72	48.6
	M.Phil	4	2.7
	Ph.D	35	23.6
Experience (Years)	1-10	62	41.9
	11-20	70	47.3
	21-30	13	8.8
	31-40	2	1.4
	>40	1	0.7
Cadre	Management position	14	9.5
	Senior position	100	67.5
	Intermediate position	34	23.0
Major Activities	Teaching	42	28.4
	Research	90	60.8
	Extension	7	4.7
	Administration	5	3.8
	Production	4	2.7

Table:3 Human resource capacity building opportunities for scientists

Human Resource Capacity	Very Adequate	Adequate	Inadequate
Training/Self Development Opportunities	29(19.3)	31(21.3)	88(59.4)
Career Advancement	16(10.7)	52(35.1)	81(54.7)
Available of Complementary Experts	16(10.7)	39(26.3)	93(62.8)
Availability of Technical Support Staff	24(16.0)	40(27.0)	84(56.7)
Financial and other incentives	13(8.7)	15(10.1)	120(81.0)
Royalties on Findings	12(8.0)	14(9.5)	122(82.4)
Supervision/Guidance from other Specialists	31(20.7)	50(33.8)	67(45.2)

Figures in parentheses represent percentages

Table:4 Correlation analysis of human resources development opportunities and participation (Spearman rho)

Variables	Training/self development	Career advancement	Complementary Experts	Support staff	Financial/other incentives	Royalties	Supervision
Participation	.278**	.348**	.230**	.354**	.333**	.504**	.367
	.001*	.000*	.005*	.000*	.000*	.000*	.000*

**Correlation coefficient
*significant

Table 5: Regression correlation of variables and participation in agricultural biotechnology

	Unstandardized Coefficients		**Standardized Coefficients**		
Model	**B**	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	20.579	2.421		8.501	.000
Training and self-development opportunities	.635	1.062	.063	.598	.551
Career advancement	2.130	1.006	.200	2.118	.036
Availability of complimentary experts	-1.424	1.094	-.128	-1.301	.195
Availability of support staff	.053	1.087	.005	.048	.961
Financial and other incentives	.037	1.194	.003	.031	.975
Royalties on findings	4.280	.901	.435	4.749	.000
Supervision guidance from senior scientists	1.505	.827	.151	1.819	.071

Qualification of Scientists

The modal qualification of researchers is M.Sc (48.6%), while 2.7% and 23.6% had M.Phil and PhD as their highest qualification respectively (as shown in table 2). This trend is in consonance with findings in a similar study conducted by Irefin *etal,* (2005) to assess agricultural biotechnology research and development and innovations in Nigeria, which reported the qualifications of researchers in agricultural biotechnology and other related fields as 51.43% and 40% for M.Sc and PhD respectively. The study asserted that qualification is crucial because biotechnology research and development has high scientific content and requires availability of qualified manpower that can handle very sophisticated equipment and processes. The implication of this is the need for high human resource capacity building, most especially investment in human resource development in agricultural biotechnology. Ozor, (2008) surmised that it is an intensive research area which needs high human resource capacity to achieve substantial benefits.

Work Experience of Scientists

A large proportion of researchers (58.1%) had work experience spanning over 10 years, as shown on table 2, with the mean work experience being 10.9 years, and the modal value being 12 years. This is an invaluable asset for the future of agricultural biotechnology research development. In addition to the improvement in research skills with time, experience enables scientists to develop wider and stronger networks that impinge on the value and quality of research outputs from universities and NARS. Uvah, (1999) however observed a trend in which there is loss of these competent hands occasioned by worsening conditions of scientific research. This has led to the flight of the best among them to other sectors of the economy as well as other countries in search for greener pastures. Aluko- Olokun, (1999) suggested a total overhauling of the system in such a way that first rate scientists will adequately be compensated and subsequently be motivated to study and work in research and development capacities in the tertiary institutions and research institutes.

Cadre of Scientists

A majority of the researchers are at the senior cadre (67.5%), with 23.0% occupying intermediate positions. Only 9.5% are at the management level. The relatively small proportion of researchers involved in administration is a plus to agricultural biotechnology research which is a time consuming venture. Administrative functions create an identity crisis of the civil- servant/ scientist in the researcher. This inclines the researcher to identify with the civil service system on issues such as bureaucratic control and entitlements to the perks of office according to civil service conditions. Under this condition, researchers are not motivated to be result oriented and problem solving, and still be engaged in respectable research. This consequential result of participating in management however is the opportunity to give priority to agricultural biotechnology research programmes.

Major Activities of Scientists

The formal activities of scientists were categorized into five broad areas; these include: research, teaching, extension, administration and production. Results show that research activities of scientists attracted the highest work time allocation of 60.8% as shown on table 2 Alabi *et al,* (2007) identified important activities of scientists involved in biotechnology to include research and applications covering laboratory and greenhouse research for field testing and commercialization of research products. Teaching activities of researchers accounted for 28.4% of official work time, while extension activities attracted only 4.7% work time allocation. Extension is an important key in ensuring the adoption and sustained use of products from both modern and traditional biotechnology research, and must be integrated into the development of the technology. At present, faculty members are overburdened with administrative responsibilities ranging from participation in universities' governance to bureaucratic documentation and evaluation of students, courses and programs that take away their quality time from research and teaching (Sanyal and Babu, 2010).

Human Resource Development opportunities

The human resource capacity for agricultural biotechnology research consists of training, career advancement opportunities, availability of complementary experts, financial incentives, and the availability of technical support staff. These were rated by scientist in terms of their and the result presented below.

Career advancement opportunities

Table 3 shows that only 10.7% of scientists consider career advancement opportunities on the job as very adequate, while 35.1% rate it as just adequate. A higher proportion (54.7%) consider career advancement opportunities as inadequate. Considering the tedium involved in a life-science like agricultural biotechnology research, this motivational element will impact directly on the stability of scientists and their efficiency in terms of quantity and quality of research output. Alabi *et* *al*, (2007) underscored the present unfriendly work environment as setting the stage for a dearth in skilled personnel to man laboratories for agricultural biotechnology research.

Availability of Complementary Experts

About eleven percent (10.7%) of scientists indicated that the availability of complementary experts is adequate, while 26.3% indicated that complementary professionals for the conduct of agricultural biotechnology research are just adequate. Over sixty percent (62.8%) indicated that complementary experts are inadequate. The multidisciplinary nature of agricultural biotechnology research requires that complementary disciplines be available for effectiveness.

Availability of Technical Support Staff

Table 3 shows that 56.7% of scientists indicated inadequacy of support staff, while only 16.0% considered support staff very adequate for the conduct of agricultural biotechnology research. Such staff includes laboratory technicians and assistants, field assistants, equipment maintenance experts, drivers and other relevant personnel. Their availability in adequate numbers provides an environment that facilitates research and allows the scientists to concentrate. Uvah, (1999) suggested the training of existing personnel to increase the range of available skills or to improve their proficiency in the component task elements of agricultural research.

Financial and other Incentives

It was discovered that 8.7% of the respondents consider finance and other incentives very adequate in their participation in agricultural biotechnology research, while 10.1% consider finance and other incentives just adequate. This contrasts with 81.0% who are not satisfied with the financial motivation of their jobs. This lack of motivation may not satisfy the need for a vibrant manpower requirement for the conduct of agricultural biotechnology research.

Royalties from products of agricultural biotechnology research

Eight percent of scientist involved in agricultural biotechnology research indicated that they considered the royalties they received on products of their research adequate. A study by Irefin, *et al* (2005) to determine agricultural biotechnology R&D and innovation in Nigeria revealed that only 4% of scientists were enjoying any royalties from products of agricultural biotechnology research. Tonukari, (2004) suggested that at the fore front to exploit biotechnology should be the entrepreneurial scientist, with both research and management skills, including marketing and intellectual property management.

Staff Training in agricultural biotechnology related areas

Not too many of scientists participating in agricultural biotechnology research (19.3%) rated training and self development opportunities as very adequate, while 21.3% rated training opportunities as just adequate. A greater proportion (59.4%) however identifies opportunities for self development in the area of agricultural biotechnology research as inadequate. This agrees with the position of Ajayi, (1999), describing the lack of training opportunities as responsible for the inability of researchers in Nigeria to break new frontiers through active participation in research. Persley, (1992) identified key areas in which training is needed in agricultural biotechnology to include: bridging courses for research managers and matured scientists, post- doctoral fellowships, graduates training for M.Sc and PhD students and undergraduate courses.

GAIN, (2006) identified individual and collaborative efforts by a number of national and international agencies to expand training opportunities in the areas of agricultural biotechnology research. Some of these establishments include International Institute for Tropical Agriculture (ITTA) which is a Consultative Group for International Agricultural Research (CGIAR) center, United States Agency for International Development (USAID), West African Biotechnology Network (WABNET), Nigeria Agricultural Biotechnology Project (NABP), National Agricultural Development Agency and Science and Technology Complex (SHESTCO).

Human resource development opportunities and participation

Results from correlation analysis (table 4) reveal that there is a significant relationship between availability of training/self development opportunities ($r = .278$, $p < 0.05$), career advancement opportunities ($r= .348$, $p < 0.05$), availability of support staff ($r = .354$, $p < 0.05$), availability of complementary experts ($r = .230$, $p < 0.05$), financial and other incentives ($r = .333$, $p <0.05$), royalties ($r = .504$, $p < 0.05$), and supervision from senior scientists ($r = .367$, $p < 0.05$) and participation in agricultural biotechnology research. These indices collectively measure the human resource capacity for agricultural biotechnology research. Human capital is an important element in the efficient performance of every research system. The World Bank, (2007) describes human capital as going beyond an important requirement for the conduct of research to being a vital tool for advocacy that can influence research policy.

Human Resources Development Opportunities

Results from the study reveal that there is inadequacy in human resources development opportunities. The most inadequate are royalties on findings, (82.4%) financial and other incentives (81.0%) and availability of complementary experts (62.8%).

Spearman rho correlation results show that all the indices of human resources development significantly affected participation as follows: training/self development opportunities ($r = .278$, $p < 0.05$), career advancement opportunities ($r = .348$, $p < 0.05$), availability of complementary experts ($r = .230$, $p < 0.05$), availability of support staff ($r = .354$, $p < 0.05$), financial incentives ($r = .333$, $p < 0.05$), royalties on findings ($r = .504$, $p < 0.05$) and supervision by other scientists ($r = .367$, $p < 0.05$). Regression results (Table 5) showed that only availability of royalties on findings ($P < 0.05$) and career advancement opportunities ($P < 0.05$) significantly contributed to scientist's participation in agricultural biotechnology. It can be comfortably argued that scientists who have opportunity to benefit from their efforts through royalties would be better motivated to make the sacrifice that that the tedium of biotechnology could bring. The same applies to those who have opportunity to acquire increased competencies through further training. Biotechnology itself is such a dynamic and versatile area and these opportunities can translate to increased motivation for the scientists.

Conclusion

The result shows that training and self development opportunities, career advancement, availability of complementary experts, availability of technical support staff, financial incentives, royalties on findings and supervision and guidance from other specialist were all rated inadequate. All the indicants of human resources development affect participation significantly. The obvious implication of the outcome of this work is that the development of human resources remains cardinal in the overall efforts geared at mainstreaming biotechnology in addressing the food and agricultural needs of Nigeria and indeed all its developing peers.

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