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Strategies for Restructuring the Agricultural Research Council of Nigeria

Process, Opportunities, and Lessons

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

ABBREVIATIONS AND ACRONYMS

ADP	Agricultural Development Programme
ARCN	Agricultural Research Council of Nigeria
ARMTI	Agricultural and Rural Management Training Institute
ARTTC	Agricultural Research Technology Transfer Center
ATA	Agricultural Transformation Agenda
CAADP	Comprehensive Africa Agriculture Development Programme
CAAS	Chinese Academy of Agricultural Sciences
CATAS	Chinese Academy of Tropical Agricultural Sciences
CEO	Chief Executive Officer
CGIAR	Consultative Group on International Agricultural Research
EMBRAPA	*Empresa Brasileira de Pesquisa Agropecuária* (Brazil Agricultural Cooperation)
FARA	Forum for Agricultural Research in Africa
FCA	Federal College of Agriculture
FMARD	Federal Ministry of Agriculture and Rural Development
FRIN	Forestry Research Institute
GB	Governing Board
GDP	Gross Domestic Product
IAR4D	Integrated Agricultural Research for Development
IARC	International Agricultural Research Centre
ICAR	Indian Council of Agricultural Research
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communications Technology
IFPRI	International Food Policy Research Institute
IITA	International Institute for Tropical Agriculture
IPR	Intellectual Property Rights
KVK	Krishi Vigyan Kendra
M&E	Monitoring and Evaluation
MDAs	Ministries, Departments, and Agencies
MOU	Memorandum of Understanding
NACGRAB	National Centre for Genetic Resources and Biotechnology
NAERLS	National Agricultural Extension Research and Liaison Services
NAREF	National Agricultural Research and Extension Fund
NARI	National Agricultural Research Institute
NARP	National Agricultural Research Project
NARS	National Agricultural Research System
NCAM	National Centre for Agricultural Mechanization
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental Organization
NISER	Nigerian Institute of Social and Economic Research
NRCRI	National Root Crops Research Institute
NUC	National Universities Commission
R&D	Research and Development
REFILS	Research Extension Farmer Input Linkage Systems
SAU	State Agricultural University
SRC	Staff Research Council
WAAPP	West Africa Agricultural Productivity Program

ABSTRACT

This paper aims to develop specific strategies for reforming the Agricultural Research Council of Nigeria (ARCN) for achieving greater efficiency, effectiveness, impact, and sustainability through its constituent institutions. Based on a two-year consultative and interactive process of internal discussion, external learning, and analysis of various restructuring options, this paper proposes specific interventions for promoting results-based approaches to priority setting, resource mobilization and allocation, effective implementation of research programs, enhanced and timely delivery of results, monitoring and evaluation, impact assessment, and improved networking among domestic and international partners. The paper recommends a phased approach to ARCN reforms, beginning with organizational transformation and capacity strengthening at all levels. In addition, issues, challenges, and opportunities for sustainable funding, integration of research, extension, education, and the regulatory mandates of ARCN are discussed. Finally, an implementation plan for restructuring ARCN is presented.

1. INTRODUCTION

Agriculture is the main source of livelihood for the majority of Nigeria's rural population. Hence, agricultural growth has direct implications for the country's national economic growth, poverty reduction, and food security. Over the years, the performance of the agriculture sector has not been adequate to fulfill its critical role in the country's economy. The sector's performance is constrained by several factors, including the policy environment, diverse agro-ecological zones, and several institutional failures. Agricultural research can play an important role in overcoming these constraints. But agricultural research in Nigeria stagnated for many years, adversely affecting the achievements of strategic programs aimed at improving agricultural productivity and transforming agriculture into a productive and efficient sector of the economy. Recent efforts to revive agricultural growth through initiatives such as the Agricultural Transformation Agenda (ATA) show promise. Yet the fundamental challenge of reforming research and extension institutions to meet the technological, institutional, and policy objectives of the agriculture sector remains. This report is outlines a strategy for reform of the Agricultural Research Council of Nigeria (ARCN) to enable research and extension systems to meet the needs of Nigeria's agriculture sector.

Considerable efforts were made in the past to revive Nigeria's research and extension institutions. For example, the *Report on Strategic Options for Revamping Agricultural Research and Extension Systems,* prepared in 2004, concluded that institutional transformation was the first step to transforming the agriculture sector. The Federal Ministry of Agriculture and Rural Development (FMARD) therefore put forward a plan for institutional change to reform ARCN and the broader National Agricultural Research System (NARS). The aim of the plan was to ensure compatibility between socioeconomic and development objectives for the nation's agriculture and environment sectors.

Objectives of the Strategy Report

This strategy report takes the reform effort further in view of recent developments in the agriculture sector. A broad objective of this report is to develop key interventions that would ensure a harmonized and effective system of management of ARCN's human, financial, and physical/scientific infrastructure. The reform efforts would improve coordination of research, technology development, and adoption along innovation and value chain pathways. It is expected that the proposed interventions would promote a results-based framework for effective priority setting, resource mobilization, focused implementation of research programs, enhanced and timely delivery of results, monitoring and evaluation (M&E), impact assessment, and improved networking among partners domestically and internationally.

The report's specific objective is to undertake a study of the agricultural research system in Nigeria to develop a strategy for transforming ARCN (and its component research institutes) to better drive research-based agricultural development. The report envisages a phased approach to reform ARCN in light of its complexity and size. The first phase of the reform focuses on organizational transformation and capacity strengthening of ARCN. Project activities, in this strategy development phase, include technical and legal consultations, mapping institutional architecture of the Nigeria's research policy process, and extensive stakeholder engagement and learning.

Approach for Development of the Strategy Report

To understand the gaps in the organizational structure of ARCN, the team undertook the following tasks.

First, the strategy development team built a contextual understanding of the current structure, mandate, and governance style of ARCN. The specific objectives in undertaking this task were to: understand the overall structure, conduct, performance, and organization of agricultural research in Nigeria; identify potential organizational structures that would enable ARCN to play its role in more efficiently; develop a framework for better human resources management; mandate functions under the new structure; and articulate mechanisms for clear governance for improved research, training, and extension functions within ARCN and for relevant programs and departments of the institutions in NARS.

Second, the team devised a set of strategies and an implementation plan for the reform process. The effort specifically focused on: devising an implementation agreement for ARCN's reform to address institutional and policy issues; identifying sustainable funding mechanisms for ARCN; developing a framework for commercialization of technology generated by ARCN's National Agricultural Research Institutes (NARIs); strengthening relationships between the research system and extension services; and encouraging private sector participation in the seed system.

Third, the team conducted a comprehensive analysis of the policies and strategies needed for effective development and utilization of ARCN's human resources. This effort aimed to develop a human resources development strategy that promotes innovation and efficiency; develop an intellectual property rights (IPR) policy that improves staff productivity; and identify strategies that promote staff mobility and performance.

Finally, to facilitate a legal framework for the reform process, the team comprehensively reviewed all existing laws relating to agriculture research, training, extension, and the seed system. The objective was to: understand the role of all institutions within the context of the legal framework; highlight key overlaps in organizations' roles; identify strengths, weaknesses, and gaps in the existing legal provisions that might affect the efficiency of Nigeria's agriculture research system; and explore the possibility of speeding up the ARCN reform process.

To develop a long-term strategy, the team examined lessons from and factors responsible for the successful transformation of similar large NARSs in developing countries such as Brazil, China, India, and Kenya. To gain a deeper understanding of Nigeria's need for reform, the team consulted institutions with direct bearing on technology generation, utilization, extension, support, and transfer. These stakeholder consultations included representation from: 1) NARIs, 2) middle-level manpower institutions, 3) development partners, 4) investors in the agriculture sector, 5) universities, 6) federal agencies, 7) state agricultural development programs, 8) international agricultural research centers (IARCs), 9) other related national research centers, 10) ongoing special agricultural programs, and 11) farmer-based organizations and commodity associations. The study covered various agro-ecological regions across Nigeria's six geopolitical zones.

Data used in the report were based on both primary and secondary sources. Primary data were collected through interviews with all prominent stakeholders, including beneficiaries and nonbeneficiaries. The questions used were carefully structured to guide the interviews. The team conducted personal or phone interviews with staff of ARCN, the FMARD, NARIs, Federal Colleges of Agriculture (FCAs), Consultative Group on International Agricultural Research (CGIAR) centers, faculties of agriculture, and other relevant stakeholders. These interviews obtained baseline information on the effectiveness, efficiency, relevance, and impact of the current system, and determined the need for proposed changes. During these consultations, proposals for a new management framework and middle-level manpower under the suggested structure were presented to get major stakeholders' input.

Secondary sources of data and information comprised a literature review, including West Africa Agricultural Productivity Program (WAAPP) project documents and other relevant material. For example, the team undertook an extensive literature review of documents from various institutions and stakeholders to gather information on governance, structure, staff, funding, history, projects, and policies of NARS. Research, training, and extension functions of NARS were evaluated to propose suggestions on relevant organs and programs of ARCN, NARIs, FCAs, and other related organizations. This strategy report also draws on lessons learned from international best practices and experiences in governance, budgeting, capacity building, and communications.

The strategy report is organized as follows: Section 2 provides the background and context for the ARCN reform. Section 3 reviews the lessons and best practices from NARS in other developing countries. Sections 4 and 5 make specific recommendations on issues related to the structure, governance, accountability, institutional and performance gaps, and funding mechanisms. The legal framework for the ARCN reform is discussed in section 6. Section 7 presents the implementation process and section 8 concludes.

Main Areas of the Reform of the Agricultural Research Council of Nigeria

Based on the above analytical process and consultations, this strategy report's specific recommendations are as follows:

GOVERNANCE AND ORGANIZATIONAL STRUCTURE

It is recognized that the reform will be an important issue for staff during the transition period, particularly at ARCN headquarters. The roles and responsibilities of key leadership positions in ARCN need to be streamlined to avoid duplication or conflict in the roles of individuals in ARCN and its institutes. Contrary to apprehensions of some of the staff of ARCN, the new organizational structure will strengthen the ARCN Secretariat and enable greater mobility of researchers within the system, promoting better linkages and efficiency. The ARCN reform involves a shift in the power structure, roles, and responsibilities – some positions may become less powerful while others may get more specific responsibilities. The autonomy of individual organizations may be compromised due to seeming concentration of powers. The rebalancing of governance, power, and responsibilities is necessary for the reform process, however.

Political interference in NARIs' and FCAs' operation was identified as a major impediment. ARCN should base selection of candidates on their merits. Reducing opportunities for the representation of politicians in governance and management of ARCN organizations will be the first step in the reform of human resources management. The reform proposes only one Governing Board (GB) for the entire country, so political interference will very likely reduce. The reform process proposes greater representation of nonpolitical actors (such as the private sector and farmers) in the GB of ARCN and its institutes. The choice of representation should be determined by the agro-ecology and commodity mandates of the organization in question. The reform proposes a drastic reduction in the numerous boards currently in operation. Only a limited number of boards (five to six) that meet the needs of specific subsectors should be considered. Thus,

we propose a clear, lean structure for ARCN, with minimum bureaucracy. Specific guidelines for the integrated functioning of ARCN organizations will be developed and implemented through the collective efforts of their leaders.

ARCN should adopt a system of centralized governance and decentralized operations. Hence, all operational issues relating to programs, human resources, and finances will still originate from the research institutes and colleges in a bottom-up manner. This approach is not expected to result in any erosion of autonomy of NARIs and FCAs due to abolition of their individual GBs. In reality, NARIs and FCAs do not have autonomy, as their GB's (Grade 'B') are subsidiary to ARCN's GB (Grade 'A'); the law dictates that all issues in NARIs or FCAs must come to the ARCN GB for deliberations and final ratification. Hence, there is still a level of autonomy to be maintained by the constituent institutions. The CEOs of NARIs and FCAs misinterpret the principle of subsidiarity extended to them, and their role as political appointees, as a notion of autonomy.

Additionally, the notion that abolishing of GBs of NARIs with only one GB for ARCN will distance NARIs from ARCN is incorrect. On the contrary, having only one GB will unite the system rather than creating a distance, as constituent institutions will operate as one. While consolidation of the institutions under ARCN can improve overall governance, and make the system more accountable, centralization of powers can also result in bureaucratic bottlenecks, slowing down the decision-making process. This is still a challenge in other large NARS, such as in India. Specific guidelines will need to be developed for sharing authority and power between ARCN headquarters and individual institutions.

Transparency in the appointment of the Executive Secretary and the Deputy Executive Secretaries is essential in building ARCN's credibility. While the Executive Secretary is a political appointee with adequate credentials to lead a national research system, we propose that Deputy Executive Secretaries be recruited through a selection committee appointed by the Executive Secretary. The report suggests establishment of a separate recruitment unit in ARCN headquarters. For instance, India has a separate agricultural research recruitment board under the Indian Council of Agricultural Research (ICAR) that ensures fair selection and promotion of scientists in the research system.

The ARCN reform should establish linkages among its institutions prominently for effective coordination. The vertical and horizontal coordination among its constituent organizations and between them and ARCN need to be defined clearly to avoid overlap or confusion. Additionally, since training, outreach, and extension are key to this reform, the report suggests forming a separate unit dedicated to capacity-building efforts. The unit should function under the direct supervision of either the Executive Secretary or the Deputy Executive Secretaries. Forming this new unit with existing ARCN staff will help keep costs low. Depending on the need for development of specific subsectors or commodity value chains, the reform suggests that ARCN should have relevant subcommittees. Such subcommittees should include a wide range of stakeholders, such as farmers, scientists, private sector players, and international organizations, to ensure their informational needs are met. Wherever possible, the centralized function of ARCN should be undertaken by ad hoc committees and taskforces. The reform proposes appointing 20 Directors at ARCN, but keeping the overall number of headquarters staff members low.

Globally, decentralization is the focus for technical decision making on the functioning of the individual research institutions. For example, the CGIAR has a Board and each CGIAR center has its own GB. However, ARCN research institutes will not have their own GBs under the reform. They will be expected to have internal management committees that could have external members appointed by ARCN, similar to ICAR.

The internal management committees of research institutes should consist of technically sound and well-qualified candidates who formulate good policies.

For simplification and greater clarity in governance, we propose changing the titles, reporting, and accountability systems of employees of ARCN and its institutes. The proposed strategy may be perceived as diminishing the position of the Executive Director (ED) or Director General (DG) to that of a Director. The position of Deputy DGs, Deputy EDs, or equivalent should be created within each research institute to support its administration and management. Program leaders should continue to be referred to as Directors of Research for each commodity or program. Better-sounding titles and corresponding responsibilities may indicate a sense of significance of the position. However, for improving the effectiveness of ARCN as a system, these title changes are necessary. Such changes are global good practice and were used in the reform of other NARS in the developing world.

HUMAN RESOURCES POLICIES AND CAPACITY BUILDING

A major objective of the ARCN reform is to look critically at the human resources need, streamline the existing capacity, and fill the gaps. Appropriate capacity building to meet research and development (R&D) requirements will require a capacity needs assessment. There is also a need to develop guidelines for recruitment, placement, promotion, and other related human resources management issues. The reform suggests centralized recruitment, placement, promotion, and other related human resources management issues in ARCN. Such centralization is expected to bring greater harmony

within the system. However, the process would be bottom-up as it would be based on needs assessments and submissions from affected institutions.

Due to differences in remuneration and benefits, “brain drain” from research institutes to universities is considerable. This can be avoided if more incentives exist for scientists to stay in the ARCN system. In India, while salaries are comparable between state agricultural universities and ICAR, researchers belong to a civil service cadre called the Agricultural Research Service, which they join through a competitive examination. This improves the status and quality of the scientists recruited. Research scientists in ARCN should focus on research activities of NARIs, instead of on administrative management activities. The report suggests conducting a needs assessment to ensure that all existing human resources strategies are revisited. Considerable scope exists for improving entry-level candidate requirements for researchers in Nigeria.

FUNDING AND UTILIZATION

Under the proposed reform, ARCN should take ownership and responsibility for provision of the financial and human resources of its institutes, universities, and colleges. This will place the responsibility for maintenance of sustainable funding arrangements, sourcing of internal and external resources, resource allocation, and budgetary control in the ARCN leadership. A resource mobilization and allocation committee composed of selected leaders of ARCN institutions under the leadership of the Executive Secretary needs to be formed. Such committee will operate on well-established guidelines, similar to the control and sharing formula of the National Agricultural Research and Extension Fund (NAREF), establishment of which is also suggested in the reform. The sharing formula for NAREF is administrative and does not need to be spelled out in the law. However, a Board of Trustees could administer the fund. The funding arrangement proposed should consider contributions from farmers’ organizations and the private sector. Allocation of funds to ARCN and its institutes should be direct. ARCN’s mandate should seek ways to leverage means to ensure adequate levels of funding and to rehabilitate and forge working linkages with the industry and external development partners.

ROLE OF FEDERAL COLLEGES

ARCN should consider establishing a Directorate of Agricultural Education to meet the specific needs of Federal Colleges of Agriculture (FCA). (See list of FCAs in Annex 4.) Regularizing the issue of linkages between FCAs and universities will be a key step to integrate colleges with research institutions. For the reform to be effective, FCAs should remain under ARCN.

FCAs were asked to rethink their position vis-à-vis their long-run benefits. The reform specifies areas or platforms where FCAs should adequately feature or actively take part in the nation’s agricultural system. Finally, the reform suggests full autonomy for FCAs whereby they are freed from the parent institutes both administratively and financially.

REGULATORY MANDATE OF ARCN

For the proposed change, we examine systems that have worked before, identify existing problems, and consider solutions that work and how they can be scaled, as in the case of the National Universities Commission (NUC). It is suggested that all staff (Secretariat, institutes, and colleges) be managed under one umbrella and be staff of ARCN.

However, it must be remembered that fundamental differences exist between ARCN and NUC. NUC is a regulatory organization for universities, and is guided by the civil service protocol. ARCN is a single managing organization guided by conditions of service determined by the ARCN GB. While the chairmen of internal management committees of NARIs are members of the ARCN GB, the chairmen of Governing Councils of universities are not members of the NUC GB. Consequently, NUC is not involved with the general management of universities.

OTHER ISSUES

Several other issues will require more attention as part of the reform process, including: weak mechanisms for IPR, ownership, patenting, and related issues; the need to reposition the professional image of agricultural scientists and agricultural research to attract the best minds; the weak working relationship between ARCN, NARIs, FCAs, and related agencies; the poor communication and linkage system; the poor legal framework; insufficient private sector participation and partnerships; technological challenges; weak procedures for copyright notification; inadequate focus on soil research and management; biotechnology; the need for commercialization of technology; and the low level of involvement of trade unions in the reform process. These factors add to the existing challenges facing Nigeria’s NARS and need to be addressed concurrently.

2. AGRICULTURAL RESEARCH SYSTEMS IN NIGERIA: THE BACKGROUND AND CONTEXT FOR REFORM

Agriculture is a key component of the Nigerian economy, accounting for an average 23 percent of the Nigerian gross domestic product (GDP) between 2010 and 2014. The sector employs about 60 percent of the country's working population. Of the total land area of 9.2 million hectares, cultivable land is 83.6 hectares (NBS 2015). The country is blessed with abundant rainfall of between 300–400 mm per year, and an extensive coastal region rich in fish and other marine products. Agriculture contributes to wider economic growth through three key channels:

- Technical change, which rapidly transforms traditional agriculture through adoption of science-based technology, leading to productivity gains for poverty and hunger reduction, food security, and nutrition;
- Linkages and multiplier effects that enable growth originating in the agriculture sector to spill over into other sectors, such as output processing and input supply industries; and
- Increased effective demand for outputs of agriculture and non-agriculture sectors as incomes of rural farming households rise.

These three processes lead to agricultural-demand-led industrialization, implying that agricultural growth can contribute to employment generation, poverty reduction, and a bridging of the rural-urban income gap. Agriculture is expected to contribute to national development by: enhancing economic output; providing employment and income for poverty reduction; providing food security; providing raw materials for industry; reducing imports of food and industrial raw material; and contributing to foreign exchange earnings by increasing export of processed agricultural commodities.

In Nigeria, instability in agriculture sector growth led to fluctuations in availability of food and raw materials. Table 1 shows that the average agricultural growth rate was around 4 percent between 2011 and 2014 (NBS 2015). Apart from that, while the growth rates of crop production and fishing remained positive throughout the period, the growth rates of the livestock and forestry subsectors were negative in 2012. The table also reveals that the growth rates of sectors like food, beverages, tobacco, and wood products, which depend on the agriculture sector for inputs, were low and unstable, reflecting the indirect effects of fluctuating quantities of agricultural raw materials. Sectors such as textiles and paper products that registered relatively higher growth rates were supported by imported inputs, with adverse effects on foreign exchange reserves. A more focused agricultural research system would play an important role in smoothing these fluctuations.

Table 1—Growth Rates of Agriculture and Related Subsectors, 2011–2014, percent

Sector/subsector	Year			
	2011	2012	2013	2014
Agriculture	3.45	6.64	2.94	4.27
Crop Production	2.26	8.44	2.54	4.12
Livestock	14.56	-10.87	5.98	5.42
Forestry	12.01	-3.90	5.63	4.55
Fishing	12.06	4.10	8.98	6.70
Food, Beverage and Tobacco	12.14	1.96	11.81	5.63
Textile, Apparel and Footwear	-0.86	133.26	34.48	31.19
Wood and Wood products	9.88	16.06	8.88	12.70
Pulp, Paper and Paper products	13.91	9.39	45.04	14.15
Plastic and Rubber products	21.22	159.29	30.15	30.22

Source: National Bureau of Statistics, 2015.

Table 2 shows that the agriculture sector's contribution to GDP was around 23 percent between 2010 and 2014 (NBS 2015). The numbers clearly show that agriculture sector output is dominated by crop production. The contributions of livestock, forestry, and fishing remained in single digits and generally fell, suggesting that a lot needs to be done to increase their productivity and output. The low contribution of agriculture to GDP is also reflected in the relatively low contributions of sectors that derive their inputs from agriculture (food, beverages and tobacco, textiles, wood products, paper products, and rubber products). Undoubtedly, a better-organized agricultural research system can increase the agriculture sector's productivity and outputs and its contribution to GDP.

Table 2—Contributions of Agriculture and Related Sectors to GDP, 2010–2014, percent

Sector/subsector	Year				
	2010	2011	2012	2013	2014
Agriculture	23.96	23.59	23.91	23.33	22.90
Crop Production	21.49	20.92	21.56	20.96	20.54
Livestock	1.76	1.92	1.62	1.63	1.62
Forestry	0.25	0.27	0.24	0.24	0.24
Fishing	0.46	0.49	0.49	0.50	0.50
Food, Beverage and Tobacco	4.24	4.53	4.39	4.65	4.62
Textile, Apparel and Footwear	0.65	0.61	1.36	1.73	2.14
Wood and Wood Products	0.23	0.24	0.26	0.27	0.29
Pulp, Paper and Paper Products	0.04	0.05	0.05	0.07	0.07
Plastic and Rubber Products	0.06	0.07	0.18	0.22	0.27

Source: National Bureau of Statistics, 2015.

Data on imports and exports of agricultural commodities between 2010 and 2013 show that agriculture remained an insignificant contributor to merchandise export and imports. The *World Development Report* (World Bank 2015) suggests that the share of Nigerian agriculture in exports and imports has since increased. However, the increase in imports was much more than that of exports, reflecting the lack of diversification in Nigeria's agricultural economy. The agriculture sector needs to contribute to the country's self-reliance by reducing imports and further increasing exports of agricultural and food commodities. For example, Nigeria is the largest producer in the world of cassava, yam, and cowpea and has a comparative advantage in exporting processed cassava. This is a result of strides in cassava research that led to improved varieties. However, since labor constitutes a large percentage of the production cost (75 percent), competitiveness can be improved by labor-saving technologies, especially in the context of rapidly aging peasant farmers. An effective agricultural research system has the potential to contribute to this goal.

Finally, the contribution of agriculture to employment shows a declining trend (NISER 2015). While agriculture remains the main source of employment for most Nigerians, it is among the lowest sectors in remuneration earned, reflecting a lack of commercialization of agriculture in Nigeria. In 2014, while 41.3 percent of the population's primary occupation was agriculture, only 0.9 percent received substantial remuneration from it (NBS 2014). Productivity and incomes can be enhanced by improving farm management practices such as land and irrigation management practices that vary substantially across agro-ecological zones. Furthermore, increasing area under irrigation will expand output since crop yield under irrigation systems is much higher than under rainfed systems (except for cassava, yams, and leafy vegetables). Farmers can also diversify and become commercial farmers. This requires a responsive agricultural research system that meets the emerging technology and innovation needs for commercialization of Nigeria's agriculture sector.

Nigeria's agriculture sector has not fulfilled its avowed role in the national economy due to several factors, including a prolonged unstable policy environment, diverse agro-ecologies, and institutional failures. With the country's high rate of population growth, sustainable use of its resource base is increasingly under threat. Cognizant of the food insecurity challenges the country has faced, the federal government of Nigeria put in place different policies and programs over the years (Babu and Mavrotas 2014). The country recently embarked on an Agricultural Transformation Agenda (ATA) – a strategic program aimed at improving agricultural productivity and transforming agriculture into a productive and efficient sector of the economy. As transformation proceeds, productivity gains must occur in all parts of the agricultural system. Some efforts toward such a transformation include: increased efficiency in transportation, which lowers distribution costs; better packaging and handling techniques to make more products available to consumers; and new ways of processing commodities into higher-value products for both domestic and international consumers. These have the potential to increase employment and income to support wider economic growth.

In this context, a NARS can play a critical role in increasing the sector's productivity through technological development and knowledge sharing. At the same time, the system faces severe constraints, such as declining budgets and donor support, lack of human and physical resources, fragile institutional structures, and a weak policy environment. To survive, NARS must deliver technologies that are effective and relevant to secure domestic political and financial support, especially given dwindling government revenue and associated austerity measures. To this end, activities of agricultural research and extension institutions need to be:

1. "Demand-driven" in the focus and conduct of research programs. This implies allocation of resources effectively so that they respond to the needs and opportunities of the marketplace and the natural environment.

2. Directly linked to technology development by: identifying research results that can become viable technologies; incorporating product development into ongoing research programs; and understanding the requirements of effective technology transfer.

Development and dissemination of new technology is an important factor determining the future of agriculture. As demonstrated by the experience of the Green Revolution in Asia, which led to a doubling of food grain yields in the 1960s and 1970s, technological change in agriculture can be a powerful force in reducing poverty through both direct and indirect effects. Direct effects are gains for adopters of technology, while indirect effects are gains derived from adoption of technology for others, leading to lower food prices, employment creation, and growth linkage effects (De Janvry and Sadoulet 2001). Thus, agricultural technology can affect smallholder income, employment, food prices, environmental sustainability, and linkages with the rest of the rural economy. Agricultural technology was a primary factor contributing to increased farm productivity in developing countries over the past half-century (DFID 2015).

The importance of technology and research has long been recognized at the continent level and supported by the international development community. For instance, under its Malabo declaration, the New Partnership for Africa's Development (NEPAD) aims to achieve 6 percent growth in agriculture by increasing agricultural productivity through technology generation and dissemination. The fourth pillar of NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) is concerned with technology generation, dissemination, and adoption. At the sub-regional level, efforts in the recent past under the World Bank-assisted project for members of the Economic Community of West African States (ECOWAS), the West Africa Agricultural Productivity Project (WAAPP), were designed to support the generation and adoption of improved agricultural technologies across West Africa (Phillip et al. 2013).

In 2004, the World Bank conducted a study on "Strategic options for revamping agricultural research and extension services in Nigeria," and attributed the inability of Nigeria's agricultural research and extension services to meet producers' needs to the weak linkages between research, extension, and producers; and between government services (World Bank 2004). The study recommended a paradigm shift toward a system that is responsive to stakeholders by improving access to research and extension services. This is critical for moving Nigerian agriculture onto a higher growth path. Lessons from more developed economies show that system coordination and strategic research planning under an Integrated Agricultural Research for Development (IAR4D) plan require a robust management structure.

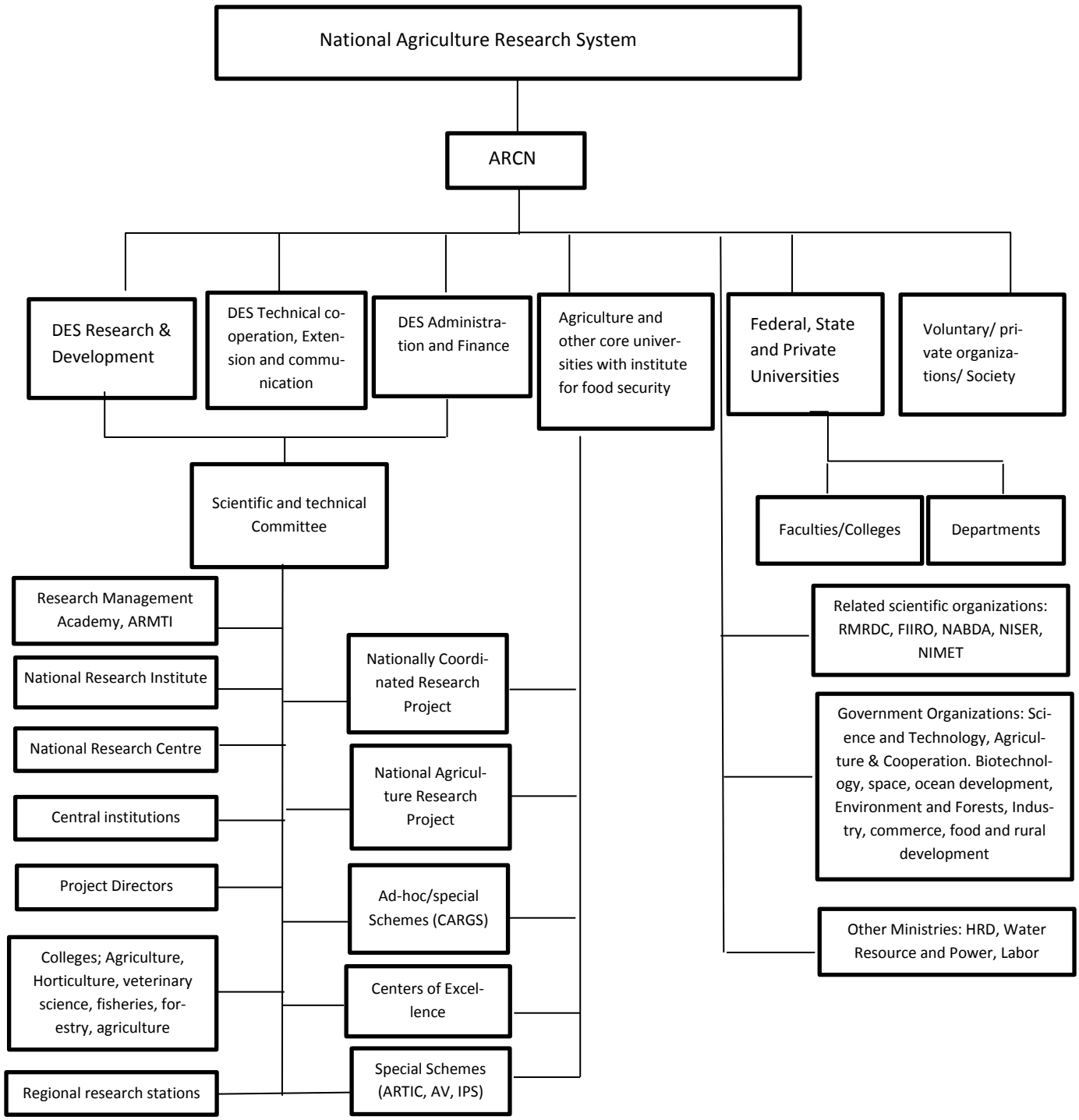
A retrospective look into the Nigerian economy and its development reveals that agriculture was both the mainstay of the Nigerian economy and the chief foreign exchange earner (Chigbu 2005; Federal Republic of Nigeria 2000). The agriculture sector's contribution to economic growth declined over the years, however (Central Bank of Nigeria 2014). Agricultural growth is directly related to growth in agricultural productivity, which in turn is driven by investments in agricultural research and technology dissemination. Transforming the agriculture sector to contribute to the economic transformation agenda requires transformation of its institutions as a first step. This calls for developing a long-term strategy and implementing specific actions to transform ARCN. In this spirit, the strategy report suggests a pathway to reform Nigeria's NARS.

Current Structure and Organization of the National Agricultural Research System

The composition of the Nigeria's National Agricultural Research System with its major partners in the research system is shown in Figure 1. This demonstrates the need to strengthen and build capacity of the ARCN to promote and manage agricultural research and become capable of contributing as major player in agricultural transformation of the country. This includes capacity to manage research on diverse problems facing production and developing new technologies suited to different agro-climatic conditions through a network of projects and strategic programs. ARCN should also be well positioned to link the research system to regional and international initiatives. The National Agricultural Research Institutes NARIs and non-ARCN institutes and universities in Nigeria are described below. Traditionally, ARCN has had a relationship with all the of these institutions mentioned below:

Research Institutes. The ARCN-based research institutes comprise five crop based-based research institutes; one horticulture institute; three plantation and tree crops research institutes; two livestock research institutes; two fisheries research institutes; one post-harvest research institute; and one extension research institute. The non-ARCN-based research institutes are the Federal Institute for Industrial Research, Nigeria Institute for Trypanosomiasis Research, Forestry Research Institute, Agricultural and Rural Management Training Institute, National Centre for Agricultural Mechanization, Nigeria Institute for Social and Economic Research, National Biotechnology Development Agency, and National Centre for Genetic Resources and Biotechnology. A detailed list of all the institutes is presented in Annex 3.

Figure 1—Current Structure of Nigeria's the National Agricultural Research System in Nigeria



Source: Authors.

The ARCN-based research institutes vary in size, age, scope, and mandate. Some focus on narrow problem areas, such as freshwater fisheries, while others have wide mandates and several out-stations in remote parts of the country. These out-stations do not receive enough attention due to poor funding. This results in inadequate staffing and resources to handle the commodities for which the out-stations were set up.

There is, therefore, a need to establish Research Centers (RCs), which would cater to neglected commodities. These centers would open avenues for partnership between the federal and state governments in funding of Research Centers (RCs), with certain states having a comparative advantage for the same. Jigawa State has already taken took a bold step in this direction, but there is a lack of commitment due to budget constraints. These commodity-based Research Centers would require multidisciplinary teams working on issues that have direct relevance to resolve regional demands and problems. The Research Centers would be designed to concentrate on crops and commodities not well served by Institutes in their regular course of work. These centers may in the future grow into full-fledged institutes if their standard of work increases or their area of work assumes greater national importance.

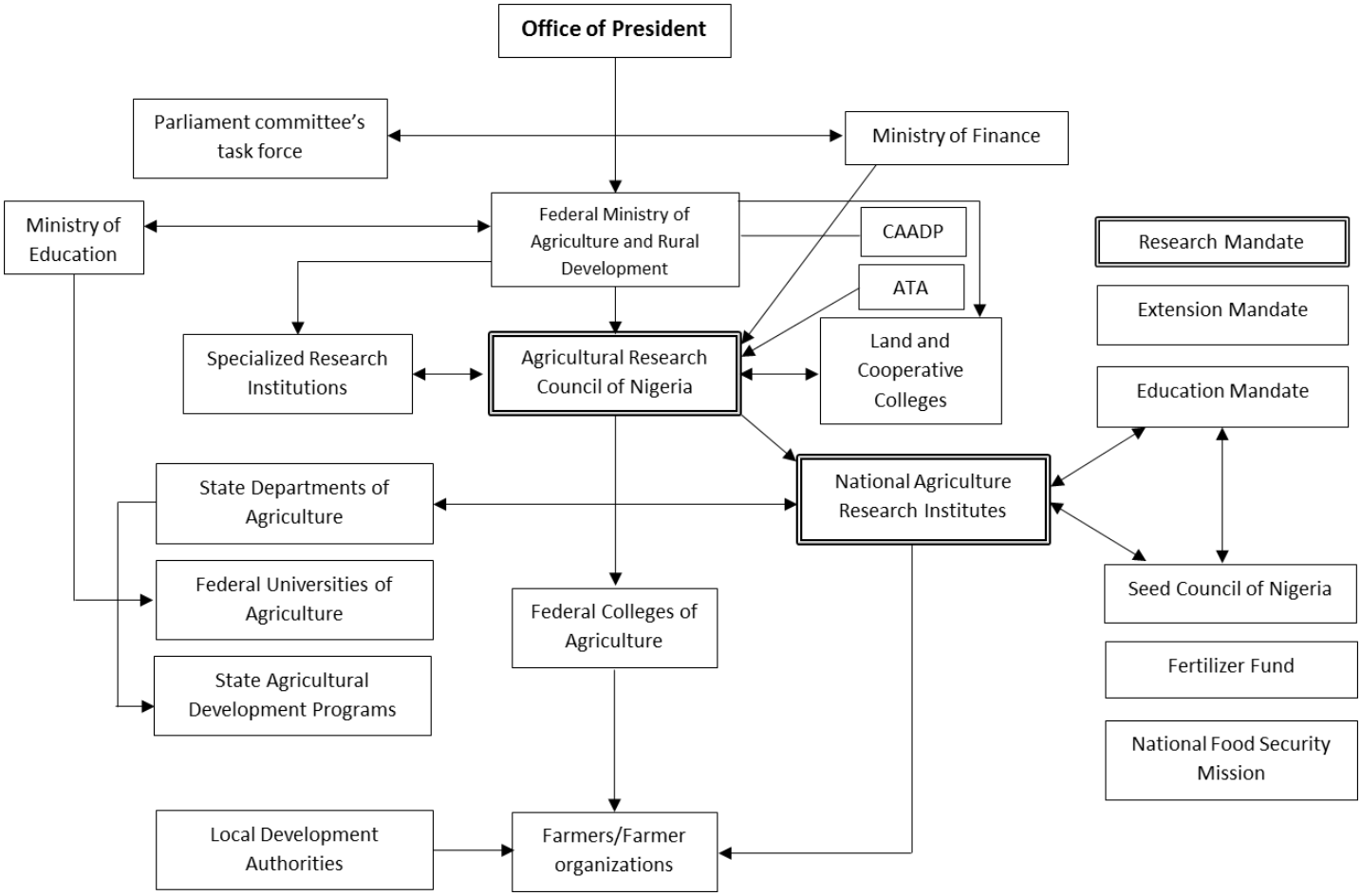
Universities. In the Nigerian NARS there are 46 federal, 40 state-owned, and 61 privately-owned universities. These are located in different agro-ecological zones of the country and offer attractive opportunities for strengthening collaborative partnerships for agricultural research. All the universities listed in Annex 1 have been partners with ARCN in the past.

International Agricultural Research Centers. Several international agricultural research centers operate in Nigeria. The major ones include International Institute for Tropical Agriculture (IITA), International Crops Research Institute for Semi-Arid Tropics (ICRISAT), International Livestock Research Institute (ILRI), Africa Rice Research Center, and Sasakawa Global 2000.

Agricultural Research System Structure

The importance of a well-functioning agricultural research system in Nigeria has long been known. ARCN was established in 2006 with a mandate to coordinate, supervise, and regulate agricultural research, training, and extension in Nigeria. The policy process for institutional reform in Nigeria in ARCN's context is shown in Figure 2. As depicted, ARCN comes under the FMARD. It became the apex body of 15 NARIs and 11 FCAs under the FMARD. The formation of ARCN aimed at revitalizing and refocusing the research system, since NARS's structure and organization was not wholly effective in: responding to the government's demand for cost-effective management; generating appropriate technologies; reversing the stalling agricultural growth; or meeting the needs of smallholder farmers.

Figure 2—Policy Process Mapping of Institutional Reforms: Agricultural Research Council of Nigeria



Source: Authors.

Currently, Nigeria has the largest NARS in Africa south of the Sahara, comprising 18 Agricultural Research Institutes (15 under the aegis of ARCN), 17 FCAs (11 under ARCN), 19 State Colleges of Agriculture, three Universities of Agriculture, 47 Faculties of Agriculture in both state and federal universities, ten Faculties of Veterinary Medicine, and five IARCs (International Institute for Tropical Agriculture (IITA), Africa Rice, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), IFPRI, and International Livestock Research Institute). In addition, several private sector organizations, nongovernmental organizations (NGOs), community-based organizations, and faith-based organizations carry out research in the agriculture sector.

Over the last 10 years, ARCN has undergone several reorganizations, leading to instability in its structure and functions. Instability in the agriculture sector also resulted in transfer of some of its key institutions to other ministries.

These include the National Center for Agricultural Mechanization, National Center for Genetic Resources and Biotechnology, Forestry Research Institute (FRIN), and the Agricultural and Rural Management Training Institute (ARMTI). Figure 2 maps out all NARIs and FCAs, along with their mandates.

Recent reports reveal that over 120 research institutes and university-based institutes are in the system (ASTI 2010). The report suggests a dwindling number of full-time equivalent researchers with limited access to resources. At the last review in 2012, the total number of employees of NARS stood at 9,889, of which 1,282 were researchers. Of these, 308 held a PhD (24 percent) and the ratio of research to non-research staff was 1:7, which is quite high (ASTI 2012).

The federal government is the main source of funding for agricultural research, with an average of USD 0.074 billion per year covering recurrent and capital expenditure from 2000 to 2012. This trend continues to exist. Overall, government funding toward agricultural research is 0.02 percent of agricultural GDP, well below the all-Africa average of 0.85 percent (ATSI 2012). Further, the recurrent funds induced greater stability than the capital grants. This is because researchers did not have access to adequate operating capital for grants; thus, the research institutions lost many qualified staff.

Challenges Faced by ARCN

The Government of Nigeria prepared and put in place different policies and programs aimed at addressing the challenges faced by the agriculture sector. The country is currently operating its Agricultural Transformation Agenda (ATA) – a strategic program aimed at improving the sector's productivity and transforming it into an efficient sector of the economy. The federal government mapped out a plan to achieve the objectives of ATA and is implementing specific actions to transform ARCN.

ARCN is not effective for four main reasons: ineffective governance, lack of funding, low human capacity, and poor communication, all of which mutually reinforce the institution's suboptimal performance. ARCN has ineffective governance due to the multiplicity of unprofessional GBs, lack of coordination among involved entities, poor central planning, and lack of focus on strategic priorities. Insufficient funding has led to an inability to hire and retain top-level researchers and to limited resources for research. Current research facilities are obsolete, acting as a constraint to researchers. Bureaucracy and unclear legal structures have led to weakened collaboration and communication across the research centers. Finally, extensive political interference limits the autonomy of the institutions at all levels. Specific challenges facing Nigeria's agricultural research system are summarized below.

Research management strategies. Institutions do not have effective research management strategies. Their challenges are in: identifying technical, economic, and institutional constraints for effective management; developing and adapting resources and resource mobilization; conducting on-farm trials for different ecological zones to extend technologies and innovation; and working with extension agents to ensure transfer of knowledge to farmers and to receive feedback on emerging farm-level problems. The absence of a centralized research program on human resources planning and management at the national level makes it difficult to align human resources needs with national agricultural development challenges.

Governance structures. A major challenge for Nigeria's NARS is the weak governance structures within ARCN and NARIs. Currently all NARIs have separate GBs, whose research objectives, funding, appointment process for CEOs of institutes/colleges, and other management issues are not aligned. In some cases, duplication of NARIs' mandates still exist. Appropriate governance structures are needed for better coordination and for holding leadership accountable for performance and results.

Partnerships. Building international and national partnerships to keep institutions aware of and adopt best practices can speed up the innovation process. Research lessons from global partnerships can help design national policies and program that are evidence-based. However, institutions in Nigeria face leadership and capacity challenges in: evaluating risks in partnerships; building research coalitions and developing flexible research strategies; and partnering with the university system through consensus.

Research coordination. Coordination of research is essential to avoid overlap and duplication of effort. Better coordination can help in building synergy in research and innovation across the country. However, several challenges arise in bringing the existing institutions together to set research priorities, plan research programs, implement research projects, and monitor, evaluate, and assess the impact of research investments. In addition, developing research programs based on specific agro-ecological zones that cuts across several states involves coordination at the state level.

Responding to persistent and emerging challenges. Making NARS responsive involves conducting research and building a knowledge base in agricultural science for short-, medium-, and long-term interventions in a more rapid man-

ner; this will be essential for responding to current and future food security challenges. This involves: developing environmentally sound technologies for various agro-ecological zones for year-round production; adapting food systems to new settings, such as climate change and the vagaries of the economy; and modifying food systems to meet dietary and nutrition goals. In the current context of Nigeria, research is needed to address productivity-enhancing technologies, water use efficiency, changing consumption patterns, and food price fluctuations.

Building linkages with extension and education systems. This refers to NARS' capacity to address and articulate the needs of federal, state, and local governments, universities, and other institutes of higher learning. Increased partnership with the private sector/industry and markets and establishment of linkages and stability in the extension delivery system are essential in the Nigerian context. A better-organized ARCN could facilitate such linkages at the national level.

Sustainable funding mechanisms. Delays in budgetary process, inflationary trends, and delays in release of approved funds are major factors that constrain the smooth functioning of NARS. In addition, poor remuneration for research scientists has led to internal brain drain from institutes to universities. Nigerian NARIs are characterized by high instability of funding from the government. ARCN can play a leadership role in mobilizing resources for NARS and developing various mechanisms for effective use of research resources.

Monitoring, evaluation, and impact evaluation. Regular monitoring, evaluation, and impact evaluation of research programs are necessary in understanding the appropriateness and relevance of developed technologies in specific agro-ecological contexts. This requires institutes to build capacity for evaluating various impact components, such as social, economic, environmental, and livelihood returns. In addition, impact evaluation involves the challenge of: conducting technical and economic feasibility studies of research outcomes; estimating the extent of adoption and commercialization; and keeping pace with international best practices.

Legislation and legal instruments. Multiple legislative instruments (both principal and subsidiary) purport to regulate agricultural research. A review of the literature indicates that the research 47 is deemed to be the cornerstone, nucleus, and catalyst for transformation of the agriculture sector.

The current state of disorganization has stemmed legislation conferring powers to a large number of stakeholders who conveniently operate in silos, without any incentive to bear allegiance or commitment to national agricultural priorities. The Coordinating Council of ARCN, which is expected to be the apex for agricultural research, became ineffective over the years due to the multiple layers of authority.

The current membership of the GBs of ARCN and NARIs prefer appointments through political patronage as opposed to merit-based selection of members. In its current state, the ARCN GB lacks the academic and professional skills required to implement the ARCN mandate and to provide leadership for driving agricultural research. At least two categories of NARIs exist from the point of view of their legal instruments:

- Those established under University Statutes, before the establishment of ARCN; by constitution, these are entrenched in the academic environment, operating under the statutes of their parent academic institutions.
- Those established under the National Research Institutes Act 1964; these are federal establishments under the supervisory responsibility of the Minister. The members of their GBs bare appointed by state and local governments and are in much higher numbers than required.

Other challenges. Other challenges facing Nigeria's NARS include: institutional instability; poorly articulated funding mechanisms; inadequate research staff in both number and quality; inadequate government policies; poorly developed legal frameworks; and unmarketable technologies leading to poor commercialization potential.

3. REVIEW OF INTERNATIONAL BEST PRACTICES IN NATIONAL AGRICULTURAL RESEARCH SYSTEMS

Agricultural Research Council Models

NARSs differ significantly in their effectiveness, reflecting the inherent strengths or weaknesses of their organizational systems for specific functions. It is generally recognized that countries of Asia and Latin America have achieved successes in their agriculture because they were able to reorganize their research systems to enable research to play a pivotal role in transforming the agriculture sector. The changes that took place in Asia and Latin America are examples of interactive dynamics between political and socioeconomic processes. Although the socioeconomic and political conditions differ, the processes that led to the establishment of Agricultural Research Councils in countries of Latin America and Asia have striking similarities. The reorganized Indian Council for Agricultural Research (ICAR), for example, resulted from a situation in which technology and research were seen by the relevant political system as key factors in solving the problems faced by the country. In Brazil and some other Latin American countries, it was shortages in food

grain availability or declining trends in export commodities that accelerated the reorganization of agricultural research systems.

Different models exist for reorganization of agricultural research systems. The Agricultural Research Council (ARC) model operated in India, Brazil, China, South Africa, Kenya, and Bangladesh represents a variant of an autonomous research organization, playing the roles of policy making, managing or administering, coordinating, and funding through respective research councils. The ARC model may or may not include responsibility for agricultural education. ARCs are organized either as managing councils, coordinating councils, or funding councils.

MANAGING COUNCILS

The Managing Council model is considered quite effective. Managing Councils plan, organize, manage, and direct most of the government-funded research station network. They carry out some research through their own research institutes and some in collaboration with other organizations. They administer the activities of experimental stations, institutes, programs, and scientists. Their numbers vary according to the size of the research system. In large countries, where agricultural research is organized at both federal and provincial levels under different administrative set-ups, Managing Councils link federal and regional experimental stations through a series of national programs.

ICAR, Brazilian Agricultural Research Corporation (EMBRAPA), Chinese Academy of Agricultural Sciences (CAAS), Chinese Academy of Tropical Agricultural Sciences (CATAS), Pakistan Agricultural Research Council (PARC), and Indonesian Agency for Agricultural Research and Development (AARD) are examples of Managing Councils. ICAR has about 100 research institutes while EMBRAPA comprises 47 research institutes. South Africa's ARC has 11 research institutes. These countries' experience with the Managing Council model show that:

- While the function of policy planning, reviewing, and funding should be centralized, the process of program execution, administration, and authority for use of resources should be decentralized to make individual units efficient but responsible.
- The review process and a system of incentives and deterrents encourages efficiency and should be built into the system.
- A system of external program and management reviews is useful in toning up research and management.
- Comparatively greater autonomy with accountability is needed in administrative and financial matters.
- The recruitment and promotion process is usually harmonized through establishment of autonomous units or boards for the entire system.
- As an ARC is responsible for partially funding, strengthening, and coordinating research, training, and extension, it should ensure that institutes and universities have a healthy balance of basic, strategic, applied, and adaptive research.

FUNDING COUNCILS

Funding Councils do not have any research under their administrative control, but influence the direction of research through control over disbursement of government funds. Thus, in prioritizing research, they give a sense of direction to and shape research programs. To a large extent, financial control can influence the course of research without inspiring or catalyzing it. In addition, Funding Councils tend to be highly bureaucratic because of their financial powers. The Philippine Council for Agricultural and Resource Research and Development (PCARRD) is such an example.

COORDINATING COUNCILS

Coordinating Councils' primary responsibility is coordination of research for the country, but the research institutes that they coordinate maintain administrative and budgetary independence. This is the model presently practiced in Nigeria by ARCN's Coordinating Council. Coordinating Councils' functions are to:

- Develop national research plans based on strategic and economic considerations, thus influencing the research program of different experimental stations in the country; and
- Periodically review the work of experimental stations.

Coordinating Councils are the least effective of the three ARC models, because they lack both resources and administrative powers. Persuasion and motivation alone cannot effectively influence the course of research without proper planning, adequate resource mobilization, and efficient management.

International NARS Study Tours

A select group of professionals in ARCN and NARS took study tours of ICAR, CAAS, CATAS, and EMBRAPA. Tours were organized by FMARD and sponsored by WAAPP. The purpose of the tours was to collect relevant information and acquire knowledge to inform the ARCN reform process. These research systems are playing a major role in the speedy transformation of their countries from food-deficit to food-surplus nations.

At each institution visited, the delegation received lectures on the:

- Organization of agricultural research;
- Role played by the institution in the country's agricultural revolution;
- Relationship between the agricultural research system and extension services;
- Relationship between the agricultural research system and the seed system;
- Relationship between the agricultural research system and the private sector;
- Process of commercialization of research results;
- Mechanism of funding of NARIs; and
- Relationship between the agricultural research system and the central, state, and local governments.

Observations made as a result of the study tours and their relevance for Nigeria are summarized by country.

INDIA'S NARS

Delegates visited ICAR, the Indian Agricultural Research Institute, the National Gene Bank and Cryopreservation Centre, Krishi Vigyan Kendra (KVK), the Punjab Agricultural University, the Central Institute of Post-Harvest Engineering and Technology, ICRISAT, and the Bio-Seed Company. A strong link was observed between ICAR and India's NARS, as evidenced by the following:

- ICAR is headed by a Director General who is also the Secretary to the Department of Agricultural Research and Education (DARE) in the Ministry of Agriculture and chairs the Governing Council. Thus, ICAR is represented at the highest policy-making body of the Ministry. The Council has been in existence for almost 60 years.
- The India NARS comprises of 30 research institutes, 60 project directorates, 78 All-India Coordinated Research Projects, 61 state agricultural universities (SAUs), six deemed universities, and agricultural faculties in many traditional universities that are under ICAR's coordination and supervision in terms of funding of research activities. Thus, ICAR is closely linked with NARS through funding, even though the different institutions may be under different administrative management.
- Of the 30 research institutes, seven are national institutes. All national institute staff are staff of ICAR and are funded through ICAR. The staff strength is about 10,000, made up of 4,000 scientists with an annual budget of about US$2 billion. Each institute has a management board chaired by the Director. Staff are recruited and promoted through an autonomous Recruitment Board headed by an equivalent of the Director-General of ICAR. Even though the states have the primary responsibility for the agriculture, health, and education sectors, ICAR has a strong relationship with the states in setting priorities and implementing agricultural research.
- Different fora exist where issues concerning national agricultural research activities are discussed under the guidance of ICAR and all stakeholders are usually represented. Agricultural research policy is generated through a bottom-up approach and is completely participatory. Decisions reached at such fora are prioritized and guide ICAR in approving projects to be funded annually. All agricultural research centers have similar operational, structural, and funding mechanisms across provinces, and all funding comes through ICAR.
- India's KVKs (Agricultural Science Centers) are a big success story as effective platforms for fostering close research-extension-farmer linkages. ICAR established 642 KVKs at the district level (one per district); these technology transfer centers are under the administrative control of research institutes affiliated with ICAR, SAUs, and NGOs. The centers are responsible for the transfer of new technologies, for training extension agents and farmers, for providing soil testing for farmers, and for other related services. Extension agents visit KVKs to obtain technologies to disseminate to farmers. KVKs are the smallest unit of the various research institutes.

CHINA'S NARS

The delegates visited the CAAS headquarters, CAAS facilities and its gene bank, and the CATAS headquarters and its gene bank. The administrative and academic systems of both CAAS and CATAS are virtually identical, the differences

being only in their peculiar ecologies (that is, the northern, cooler climate versus the southern, warm or tropical climate, respectively). The following observations were made during the China visit:

- CAAS is headed by a President, who is also the Deputy Minister of Agriculture, supported by five Vice-Presidents. CATAS's administrative set-up is similar. CAAS has 40 research institutes with a staff strength of about 10,000, of which 7,000 are researchers, with an annual budget of US$700 million from the government.
- CAAS and CATAS both operate nonprofit research institutes and revenue-generating ones through various subsidiaries and research activities.
- Research funding is heavily dependent on the government, even though institutes compete for funds for research projects through a competitive research grant scheme (70 percent of funds dedicated to this). Funding of CAAS/CATAS is in three categories: (i) 60.5 percent government; (ii) 35.2 percent contract research; and (iii) 4.3 percent self-generated income. Research institutes are allowed to invest their income. However, some institutions are nonprofit organizations that are fully funded by the government.
- Extension developed over time, allowing for uptake of research findings at the grassroots level. Agricultural research and extension in China operate on hi-tech basis and linkages with farmers are mostly linear. China plans to adopt the Farming Station approach, similar to India's KVKs.
- Both CAAS and CATAS have very functional and effective gene banks as the nucleus of their work for crop improvement. Each has elaborate biotechnology laboratories for identifying what it has at molecular level, not phenotypic or anatomical.

BRAZIL'S NARS

Delegates visited EMBRAPA headquarters, the Ministry of Agrarian Development, the Chamber of Foreign Trade, a project site in the Cerrados, the head office of EMATER (an agricultural extension company), and the Ministry of Foreign Trade. The following observations were made:

- EMBRAPA has a Policy Supervisory Board of three members; an Executive Administrative Board of seven members that includes the President of EMBRAPA; and a National Advisory Board of forty members chaired by the President of EMBRAPA. The latter works very closely with the Executive Board and is responsible for strategic action planning. Three Executive Directors under the President of EMBRAPA oversee the three major departments: Administration, Research, and Technology Transfer.
- EMBRAPA is the focal point of agricultural research in Brazil. It is a public organization that undertakes research design, implementation, and innovations to overcome agricultural problems in Brazil.
- EMBRAPA has 47 research centers under its purview. Their entire staff are part of EMBRAPA, which is the funding source for each center. The organization has a total of 9,790 employees, of which 2,444 are researchers, 2,503 are analysts, 1,780 are technicians, and 3,063 are assistants.
- About US$1 billion is disbursed to EMBRAPA annually by the federal government to finance the capital, research, overhead, and recurrent expenditures of its research centers. Funds for research activities are given to the centers through a competitive research grant scheme. Other sources of funding for specific research protocol can be obtained directly from the federal government by each center.
- The head of each center is appointed by the President of EMBRAPA. Staff are recruited through an open public examination conducted by EMBRAPA. Various fora exist through which issues concerning national agricultural research activities are discussed under the guidance of EMBRAPA and key stakeholders are represented.
- EMBRAPA's research program is policy-induced and demand-driven. The policy thrust behind the organization's technology-generation efforts is provided by the Federal Ministry of Agriculture, Livestock and Food Supply, which grants EMBRAPA a liberal budget policy in terms of regular allocations for running costs and competitive grants for actual research work.
- In the value chain of agricultural technologies, EMBRAPA is a critical link to end users. The organization has a Technology Transfer Secretariat that operates under a Technology Transfer Board and focuses on the private sector and large-scale farmers as end users of technological innovations.
- EMBRAPA's technologies are delivered to farm families through the research-extension linkage system established by the Federal Ministry of Agrarian Development. The Ministry provides farm families access to services of private companies or independent public corporations. The Ministry operates on the concept of "family farm" to make knowledge available to farmers, to provide technical assistance in terms of farm subsidies, and to provide

farm inputs to farmers. Furthermore, the Ministry implements the “More Food International” program and a “School Feeding Program” targeting vulnerable people.

- EMBRAPA’s R&D activities draw considerable benefits from technological innovations of the global development community through international cooperation for knowledge exchange and professional services. This is usually tied with the sale of machinery to developing countries through the Chamber of Foreign Trade. The R&D activities management system is based on a 12-year master plan under a governance structure directly linked to the Ministry through the Deputy Minister of Agriculture as chairman of the Governing Council.

Lessons Drawn from International Experience

The study tours revealed important insights about the three countries’ experience with NARS. These insights were applicable to the Nigerian context, and were used as a basis for this strategy report. Lessons learned from the study tours that have application for Nigeria are described below.

RESEARCH AND EXTENSION LINKAGES

In all three countries, state governments oversee agricultural extension and a strong linkage exists between extension and agricultural research. The Indian KVKs are an effective platform for fostering close research-extension-farmer linkages. KVKs trains their workers to transfer technologies to outgrowers and other farmers. These centers have a distinct line of reporting by which all KVK Coordinators report to the Zonal Project Directors at their respective zones (eight in number), while the Zonal Project Directors report to the Deputy Director General (Extension) of ICAR. Establishment of KVK-like bodies in the Nigerian system would go a long way in alleviating the country’s poor research-extension linkage. ARCN would more effectively coordinate agricultural research efforts in Nigeria if these centers were operated by universities, NGOs, and other institutions that are linked and can collaborate under ARCN supervision.

RELATIONSHIP WITH THE SEED SYSTEM

The seed systems in all three countries are fully liberalized. That does not hinder research institutes’ business units’ ability to produce seeds. In fact, seed companies work very closely with the research institutes. In India, an Agro Business Incubator Model between ICRISAT and seed companies offers private, easy access to skilled researchers and research facilities (laboratories, trial/demonstration fields) required for the development and scale up of products, their quality control, and standardization at manageable fees. Seed certification in India and China is not centrally controlled but done by private companies and research institutes, respectively. In Brazil seed certification is done by licensed private certification officers/agencies. The strength of EMBRAPA, CAAS, CATAS, and ICAR seed systems is their ability to actively involve private and multinational seed companies, such as Bio-Seeds, Monsanto, Du Pont, Syngenta, and others. Seed companies in these countries compete vigorously among themselves for market share and maintain demonstration plots, well-equipped laboratories, market outlets, and a highly skilled manpower.

The procedures for determining seed requirement in these countries are well-structured and coordinated, with demand flowing from states to the national level. The Agro Business Innovation Platform, known as Value Chain Consortia in India, can be easily replicated in Nigeria for stakeholders’ interaction. However, this would require an upgrade of infrastructure and research facilities in NARIs, along with adequate and sustainable funding. Robust capacity building geared toward enhancing skills of researchers and production of more scientists, particularly seed breeders, is of utmost necessity in Nigeria.

The practice of establishing a Seed Business Unit strictly treating foundation seed as a business is worth emulation, as it ensures an adequate supply of foundation seed to beneficiaries at acceptable standards. The use of licensed private certification officers/agencies, as in Brazil, enhances the acceptability of seeds and increases private sector participation in the seed system. Nigeria needs to consider development of such a system to ensure adequate seed supply at reliable quality standards.

FUNDING OF AGRICULTURAL RESEARCH

Agricultural research is very well funded by the government of all three countries. Additionally, funds for research are generated from other sources. Most funds for agricultural research are allocated through block grants, but funding through competitive grants is now gaining acceptance, especially for operating and equipment costs. Resource allocation decisions are based on informed opinion and collective wisdom regarding research priorities that address development objectives. Institutions are directly involved in allocation decisions, and other stakeholders are widely consulted. In India, the central government funds a block grant to agricultural institutes through ICAR, which also manages grants and loans from multilateral donors and collaborative research programs funded by bilateral donors and international organizations. Additionally, ICAR manages an Agricultural Produce Fund levied at 0.5 percent on specified export commodities. Overall,

the central government provides 52 percent of public funding for agricultural research and education, almost all of which passes through ICAR.

A significant proportion of ICAR funds (30 percent) is made available for extramural funding and a large proportion of this (87 percent) is directed to SAUs. About 30 percent of the extramural funding from ICAR is disbursed through AICRIPs in the form of block grants, 12 percent through competitive funding, 34 percent through donor-funded projects, 17 percent through grants to KVKs, and 7 percent as development grants to SAUs.

In China, funding of research is heavily dependent on the government. As per the funding arrangement, institutes compete for funds through a competitive research grant scheme. Funding of research in Brazil is mainly done by the federal government (about 1 US$ billion), given to research centers through a competitive research grant scheme, although other sources of funding are also available for specific research protocol.

COMMERCIALIZATION OF RESEARCH RESULTS

Agricultural research in all three countries is demand-driven. Research institutes and universities have strong linkages with farmers and manufacturers. Also, platforms exist within different regions of these countries and nationally where researchers, farmers, and manufacturers meet to hold discussions on the ongoing technological developments to build synergy and avoid duplication of effort. To promote the process of commercialization of research results, ICAR set up the Intellectual Property and Technology Management Unit (IP&TM) headed by an Assistant Director General. ICAR is thus slowly, steadily, but comprehensively moving toward intellectual property management and technology transfer in an organized manner.

A decentralized three-tier intellectual property management mechanism was institutionalized in ICAR in 2006, comprising three major components. The first includes individual institutes of ICAR, empowered and enabled to enter licensing contracts or commercial agreements for the commercial transfer of ICAR technologies to interested parties. The second includes a middle-tier consisting of five Zonal Technology Management and Business Planning and Development Units stationed at IARI in New Delhi; IVRI in Izatnagar; CIRCOT in Mumbai; NIRJAFT in Kolkata; and CIFT in Kochi. The units were developed to facilitate business and strengthen public-private partnerships. The units also publicize ICAR technology profiles available at various ICAR institutes located in the respective zones. The third includes a central IP and technology management unit at ICAR headquarters to facilitate techno-legal and policy matters/concerns on a case-by-case basis and to catalyze public-private relationships at the central level.

ICAR's focus areas for commercializing research results are streamlining the transfer of knowledge and technology products through commercial, cooperative, and open public channels; joint intellectual property management support in collaborative projects; facilitation and advisories in techno-regulatory and policy matters related to intellectual property and technology management; and public-private partnerships in technology/know-how transfer and R&D.

ICAR encourages interested parties to enter into commercial ventures with its technology and knowledge products and services. In addition to the above, ICAR headquarters and its institutes established Business Planning and Development Units. EMBRAPA's Technology Transfer Secretariat operates under a Technology Transfer Board that focuses on end users of its technological innovations.

RELATIONSHIP BETWEEN RESEARCH AND CENTRAL GOVERNMENT

In India, China, and Brazil as in Nigeria, a very close and complex relationship exists between agricultural research and the central governments. The government finances every aspect of research and education through ICAR in India, CAAS and CATAS in China, and EMBRAPA in Brazil. These research councils:

- Fund and manage a vast network of national research institutes for research and postgraduate education; central research institutes for commodity-specific research; national bureaus for conservation and exchange of germplasm and soil-survey work; and national research centers for applied, commodity-specific strategic research.
- Manage many nationally coordinated research projects. In India for instance, ICAR manages the All-India Coordinated Research Projects, which draw scientists from both ICAR institutions and SAUs. However, for the most important All-India Coordinated Research Projects – those for rice, wheat, maize, cattle, oilseeds, water, cropping systems, and biological control of pests – ICAR established special project directorates with their own research infrastructure under ICAR administrative control, consisting of teams of multidisciplinary scientists.

All-India Coordinated Research Projects are like Nigeria's Nationally Coordinated Research Projects (NCRPs). NCRPs attempt to link the country's research system to universities across the nation, with NARIs coordinating the projects in accordance with their mandates. Additionally, ICAR established KVKs at district level for the transfer of new technologies. Similarly, EMBRAPA's Technology Transfer Unit disseminates knowledge. These models can be easily replicated for Nigeria's agriculture sector.

RELATIONSHIP BETWEEN RESEARCH AND STATE GOVERNMENTS

The relationship between NARS and state governments can be seen clearly in the context of the Indian experience. Apart from the district-level KVKs, India has training centers to train extension workers in areas such as livestock, horticulture, fisheries, and home science. One central agricultural university under ICAR caters to the needs of small states in northeastern India. And SAUs have zonal research stations to address research problems for different agro-climatic zones.

Although agriculture is a state responsibility, India's central government funds a block grant of substantial amounts through ICAR. Additionally, grants and loans from multilateral donors and other collaborative research programs funded by bilateral donors and international organizations are provided through ICAR. The training centers in the Indian system can be compared to the Federal and State Colleges of Agriculture in Nigeria, which are meant to train middle-level extension workers in all aspects of agriculture in accordance with farmers' needs.

4. RECOMMENDATIONS FOR ARCN REFORM FROM COUNTRY REVIEW EXERCISES AND INTERNATIONAL EXPERIENCES

Organizational reforms

A review of Nigeria's NARS helped identify the weaknesses that need to be addressed to revamp the system. Overcoming the following challenges would be essential in increasing productivity of the agriculture sector and ensuring efficient use of resources:

- Restore the role of ARCN as the apex body responsible for coordinating the budgeting, planning, monitoring, and funding for all research projects and technology transfer across the country as per the ARCN Act.
- Provide adequate funding of ARCN for its effective and efficient functioning, also enabling it to exercise some control over agricultural research activities in the country.
- Ensure that NARIs follow ARCN guidelines for staff recruitment and funding processes. This will enable a higher level of control over research institutes, similar to other countries.
- Review governance procedures for efficiency, quality of membership, and multiplicity of GBs to ensure better coordination among NARIs.
- Reexamine NARIs' mandate to avoid duplication and strengthen them financially; there is a strong need to split some research institutes in the National Vision 2020. This would ensure better focus on farmers' needs and help boost enterprises with comparative advantage in specific regions.
- Refocus and strengthen the weak research-extension linkage in Nigeria. The existing Research Extension Farmer Input Linkage Systems (REFILS) arrangement is expensive and unsustainable.
- Revive the NCRPs for proper and effective coordination of research projects and activities across the country.
- Carry out extensive transformation of the seed system in Nigeria, which is currently quite weak, especially regarding the relationship between agricultural research and seed companies.
- All institutions/organizations related to agricultural research should be properly placed within NARS for adequate supervision and coordination; for instance, National Centre for Genetic Resources and Biotechnology (NACGRAB) and National Centre for Agricultural Mechanization (NCAM) should be under ARCN.
- For maximum impact, it is suggested that at least one Agricultural Research Technology Transfer Center (ARTTC) be established in each Local Government Area (LGA) of the country.

The strategy team devised recommendations based on research, stakeholder interaction, and international experience. The following recommendations form the fulcrum of the reform process:

- Review ARCN's structure and transform it from a Coordinating Council to a Managing Council, making it more effective in its supervisory role. This also implies reorganizing the ARCN governance structure to exert greater authority in NARS, hence repositioning it as the focal point of research for agricultural transformation in Nigeria.
- Identify and establish the roles and responsibilities of ARCN as a Managing Council, and propose management and implementation guidelines for all NARIs and FCAs.
- Reform the research funding system, directing greater financial control toward ARCN and its component NARIs.
- Develop and implement a strategy for funding NARIs.

- Develop clear recommendations for revitalization of FCAs and their role in technology delivery.
- Develop strategies for sustainable partnership arrangements with key stakeholders in the agriculture and allied sectors.
- Develop a strategy to establish in all Local Government Areas (LGAs) of the country Agricultural Research Technology Transfer Centers (ARTTCs) to strengthen the research-extension linkage. These centers will be responsible for transfer of new technologies, trials, demonstrations, training of extension agents, soil testing for farmers, vocational training, and other extension activities. Centers should be established in phases.
- Review the extension system to identify the role of research in the delivery of technology and knowledge dissemination.
- Promote commercialization of research results within the research system and through establishment of Business Plan and Development Units in ARCN and NARIs. NARIs with clearly viable technology and innovations should be encouraged to establish spin-off companies.
- Revitalize the IPR reward and protection system in the agriculture sector under the management of ARCN.
- Promote states and the private sector as active stakeholders in agricultural research.
- Establish and operationalize NCRPs to draw multidisciplinary scientists from all over NARS (both national and state) and work on different research topics of strategic national importance. WAAPP should support ARCN in this regard.
- Reform the crop variety and livestock breed release systems to consolidate related services within ARCN, under services of the Variety Release Committee and the National Agricultural Seed Council, respectively.
- Develop a framework or platform to facilitate cooperation between the central and state government for joint programing and implementation of the agricultural research agenda.
- Revise legal provisions relevant to management of Nigeria's NARS.
- Based on the above experiences, it is strongly recommended that ARCN and its research institutes create a Business Planning and Development Unit for effective commercialization of research results. This unit will facilitate close linkages and collaboration with the private sector. The institutes should engage with the Manufacturers Association of Nigeria (MAN) and the Association of Commerce, Industry, Mines and Agriculture (ACIMA) for dissemination and adoption of technologies developed.

Governance and budgeting

Governance and budgeting-related reforms will set the foundation of the entire reform process. Currently, ARCN and its institutes have their own independent GBs, although the mandate of coordinating, supervising, and regulating agricultural research, training, and extension across the country rests with ARCN. As per the current Act, ARCN also has supervisory role over NARIs. Due to this provision, the NARI Chairpersons are currently the members of the ARCN GB. Thus, the expectation is that the Chairs of the NARI GBs will ensure that NARI policies are aligned with those of ARCN. Experience has shown, however, that having the Chairs of NARI GBs as part of the ARCN GB does not ensure the intended congruence. Instead, this arrangement has made the ARCN GB rather unwieldy and expensive to maintain, while the policies adopted by NARI GBs are not aligned with those of ARCN.

Meanwhile, members of the NARI GBs are typically nontechnical, detracting from the quality of policy decisions and guidance offered. To reform the governance process, it is recommended that the usefulness of NARI GBs be revisited and that the ARCN GB be made leaner. At the NARI level, GBs could be called Internal Management Committees. Additionally, it is important that these committees consist of technically competent persons with relevant intellectual and practical experience in all components of the agriculture sector, including processing and agro-allied industries. These committees' members should be appointed by ARCN.

Last, the challenge of varied procedures for appointment of chief executives of university-based NARIs should be harmonized by allowing the involvement of ARCN in the selection process. Regarding the budgeting process, ARCN should oversee the budget process to be effective. Currently, the budget supervisory role is played by the Agricultural Science Department of the FMARD. The ideal process should be for NARIs to forward their budgets to ARCN for vetting and moderation as necessary. Thereafter, ARCN should consolidate NARI budgets and its own to arrive at the budget for NARS, which is considered and authorized by the Minister of Agriculture to be submitted to the Federal Ministry of Finance. However, in practice, the budget process in NARIs bypasses ARCN. Evidence shows that NARIs submit their budgets to the FMARD, after which they are forwarded to the Federal Ministry of Finance. Thus, the institutes operate on their own agenda, without connecting or contributing to a larger vision for agricultural research. Apart from detracting

from the supervisory role of ARCN, the process renders the research budget vulnerable, fragmented, and ineffective. There is no full accountability for the funds received as the FMARD does not have the capacity to track or evaluate NARIs' research.

Capacity building

For ARCN and its institutes, the two dimensions of capacity considered most pertinent in the context of agricultural research, training, and extension are human resources capacity and organizational capacity. The capacity constraints identified as critical in preventing NARIs from fulfilling their mandates were the dearth of research scientists due to brain drain to universities; and the inability to attract young scientists because of obsolete research facilities and infrastructure, particularly in comparison to those of universities or the private sector. In addition, NARIs have a pyramidal staff structure, with a very large base of nonscientists and a very narrow apex of scientists; and their institutional rigidities do not allow partnership arrangements with local and international research organizations.

Communication

Communication is a critical component for the effectiveness of NARS in transferring research technologies to users. The major challenges for dissemination, uptake, adoption, and commercialization of useful technologies for driving agricultural development in Nigeria are: the lack of an all-inclusive approach in the research planning mechanism; poor linkages and feedback with end users; end users' weak capacity to articulate technological demands; and weak links among institutions such as NARS, MDAs (Ministries, Departments, and Agencies), and extension systems.

A revitalized communication strategy to improve the delivery and adoption of research technologies and knowledge products by farmers and industry will go a long way in Nigeria. Many research projects could become more effective in the areas of information, knowledge sharing, and extension. The objective of the communication strategy is to effectively deliver agricultural research to farmers. The idea is to ensure research meets the needs of farmers and significantly increases technology adoption. For this, institutional barriers, individual habits, and attitudes that determine the relationships between science, knowledge, innovation or research technology and the communities they serve need to be systematically addressed; and institutional arrangements, capabilities, and behaviors to effectively manage these technological changes need to be developed. This requires strengthening capacities of NARS and extension services in social marketing, strategic communication, and knowledge transfer to effectively implement the institutional arrangements proposed in the reform. The reform envisions multi-stakeholder capacity-building programs with the following intended actions:

- Use contextual factors for undertaking strategic communication for delivery of research
- Establish client-based partnerships with smallholder farmers and other stakeholders to enable agricultural technologies and innovations to deliver on outcomes at scale
- Promote innovative farmer communication systems by strengthening and scaling up proven dissemination pathways, such as participatory media and information and communications technology (ICT).

In conclusion, while the reform covers a wide variety of issues, the focus of ARCN's restructuring should be on improving governance structures, ensuring the sustainability of funding mechanisms, enabling constant capacity building, and ensuring effective communication of research results. The specifics of the reform process are described in the next section.

5. RESTRUCTURING THE AGRICULTURAL RESEARCH COUNCIL OF NIGERIA

Recommendations for restructuring ARCN are based on evaluation of the performance of the agriculture sector and the role played by NARS. Literature reviews and other countries' experience show that countries that have reformed their research system made tremendous progress in increasing agricultural productivity and investments. Countries such as Brazil, India, Malaysia, Côte d'Ivoire, and Kenya provide a framework for international best practices to drive the objectives of the agriculture sector. The framework encourages strategic alliances with key partners in the research system toward reviving the system's capacity for R&D through innovative partnerships.

To achieve the objectives mentioned above, ARCN must be transformed into an organization with capacity to: plan research programs for achieving agricultural objectives; drive implementation strategies in a holistic manner; build processes that provide incentive systems that encourage interdisciplinary teamwork and partnerships with other stake-

holders; and emphasize mutual learning and effective knowledge management that promotes change. In this way, agricultural research will fulfill its responsibility to support development and become an effective contributor to national and global development objectives.

ARCN as presently structured and staffed is not well-positioned to meet the increasing demands of Nigeria's agriculture sector. The NARS structure should be integrated to meet a common vision and mission as articulated by ARCN. The mission and vision proposed by the reform are as follows:

> **Vision:** To reduce poverty and increase food security by contributing to the establishment of sustainable agricultural growth and development in Nigeria.
>
> **Mission:** To achieve significant improvements in agricultural productivity, marketing, and competitiveness by generating appropriate technologies and policy options, promoting innovation, establishing knowledge management capacity, and strengthening the agricultural research system.

ARCN's general objectives for enhancing sustainable productivity, commercialization, and competitiveness of the agriculture sector are as follows: (i) Generate and promote appropriate agriculture product value chain technologies and innovation; (ii) Promote and develop markets and marketing strategies for enhancing agricultural product value chains; (iii) Facilitate and advocate appropriate policy options for enhancing agricultural product value chains; (iv) Strengthen research and capacity for implementing agricultural product value chains; and (v) Establish and operationalize mechanisms for managing, sharing, and upscaling agricultural knowledge, information, and technologies.

ARCN should adopt a central approach for its research planning and management in a way that is linked to each institute's approach for the same. The research institutes' areas of focus should have a stronger organizational commitment toward intended impact. Institutes should align to the strategic orientation and positioning of ARCN as a leader in generation and promotion of innovative agricultural technologies, and stakeholders' empowerment aimed at increasing productivity, commercialization, and competitiveness of the agriculture sector. Each research institute's areas of focus shall be expected to contribute to the attainment of the outcomes suggested by ARCN.

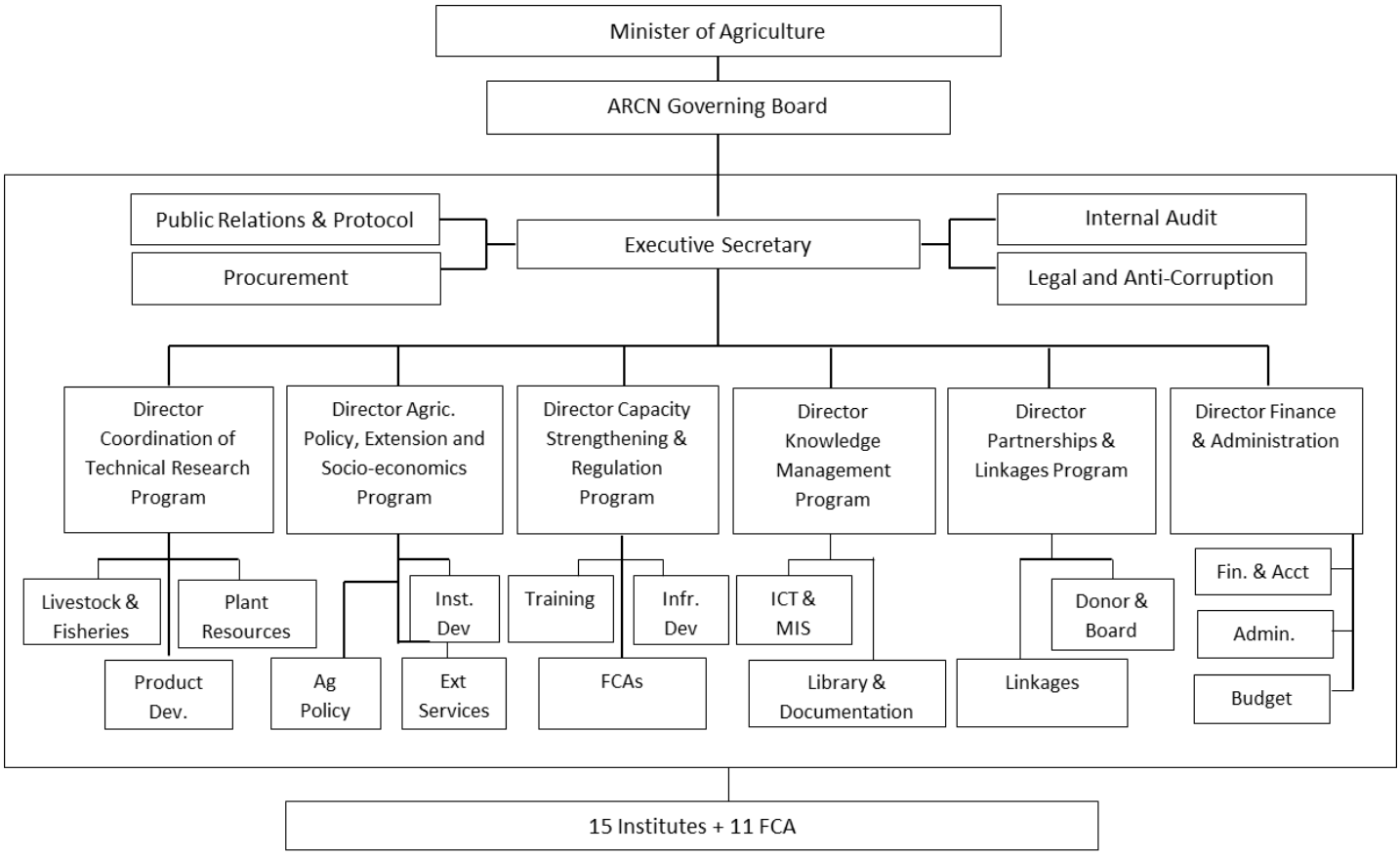
To do this in the most effective and efficient manner, each research institute's areas of focus shall be expected to deliver on results similar to those at the ARCN level but with scale and scope limited to their area of interest and expertise. To ensure effective upgrade and promotion of priority product value chains under each of the research institutes, ARCN will need to strengthen its institutional capacities and competences. Hence, multiple mandates of existing research institutes need to be disaggregated to ensure adequate focus remains on specialized research centers and on specific commodity value chains, and that the overall focus of all institutes together remain the same.

Current and Proposed Structure and Organization of ARCN

This section proposes alternative organizational structures for restructuring ARCN. A major constraint in the current structure is the lack of alignment of ARCN's efforts with other national agricultural development programs. Programs and other research institutes operate in silos, without a prioritized common goal. A move away from ARCN's current organizational structure is essential to enable it to drive research activities at the institute level. Currently, ARCN (with 15 institutes and 11 FCAs) is headed by the Minister of Agriculture and a politically appointed GB. The Executive Secretary serves as the link between the GB and six Program Directors, with specific mandate. Figure 3 shows that the division of organizational roles in ARCN's current structure is based on functions, rather than on Nigeria's core research priorities.

It is anticipated that the reform process will continue based on the impact assessment of the present reforms after a few years of implementation. The new structure will have a Deputy Executive Secretary for each of the following units: Crops Research; Livestock, Fisheries and Marine Research; Technical Cooperation and Communication; Training and Extension Research; and Administration and Finance. Figure 4 shows the first option for a reorganized ARCN. As per the consultation process, this is the option most preferred by ARCN staff. In this structure, DESs will be assisted by Directors, Deputy Directors, and Assistant Directors. The number of these Directorate Staff will be determined by ARCN, considering efficiency and cost-effectiveness.

Figure 3—Current Organogram of the Agricultural Research Council of Nigeria



Source: Developed by authors

This organizational structure proposes that ARCN be headed by a GB with a Scientific and Technical Committee; a Finance Committee; an Appointments and Promotion Committee; and an Audit Committee. This will allow for greater specialization in ARCN and its institutes. While the role of other committees has been discussed before, the Appointments and Promotion Committee needs more explanation. According to the reform, this committee will: prepare robust Appointment and Promotion guidelines to ensure staff retention in NARIs, thus preventing the current pull toward universities; ensure salary parity but based on performance expectations; ensure staff mobility between NARS and universities; and build inclusiveness. The criteria should also be extended to the appropriate Directorates in ARCN to ensure staff quality in national research programs. This will also enable mobility of competent staff from NARIs to be engaged in ARCN on the same conditions of service. To this end, at the commencement of implementation of this reform, ARCN should set up a committee to study the modus operandi, nomenclature, designation, remuneration, and other related matters in university-based research institutes, such as Nigerian Institute of Social and Economic Research (NISER), Nigerian Institute Of International Affairs, National Institute For Policy and Strategic Studies, and similar organizations, and advise on the appropriate human resources management and administration framework to achieve these objectives at ARCN and in the NARIs.

The second option proposed for ARCN's organizational structure (Figure 5) has four Principal Officers: an Executive Secretary and a Deputy Executive Secretaries for Research and Development, for Technical Cooperation, Extension and Communication, and for Administration and Finance. This alternative provides a leaner structure for the organization of ARCN.

Figure 4—Proposed Organogram of the Agricultural Research Council of Nigeria (Option 1)

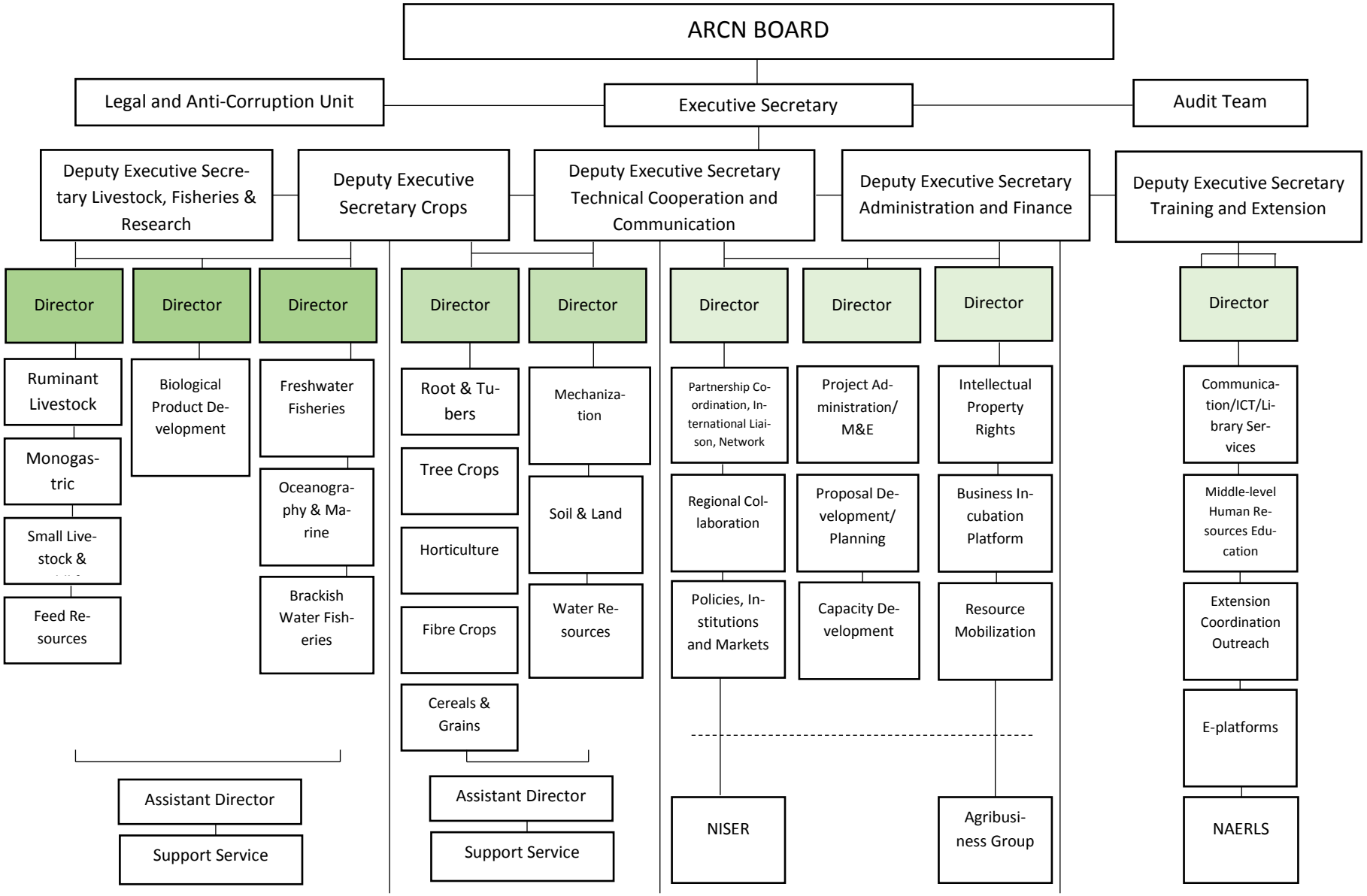
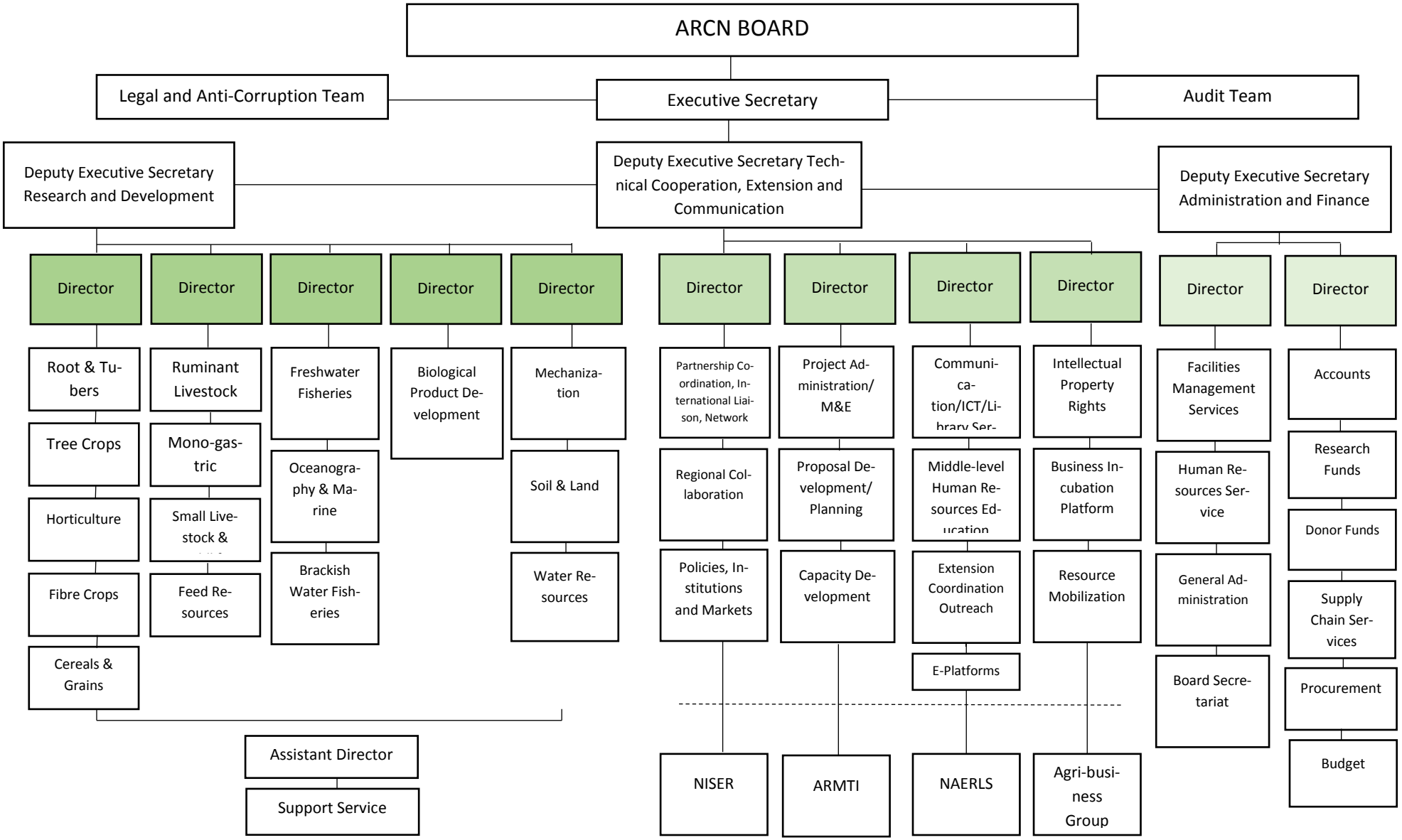


Figure 5—Proposed Organogram of the Agricultural Research Council of Nigeria (Option 2)



Source: Authors

Analyzing Gaps in NARS and Suggested Reforms to Address Them

This section analyzes gaps in Nigeria's NARS, looking at different aspects of the system with reference to experiences in other countries. The points below highlight the gaps and suggest reforms. According to our observation and analysis, major gaps exist in the following areas:

NARS GAP 1: INSTITUTIONAL STRUCTURE

Due to instability in NARS over several years, some research institutes are wrongly placed under the supervision of MDAs, resulting in their suboptimal performance. These distortions can be corrected by mere administrative actions. Described below are certain important administrative changes that could strengthen the NARS structure.

National Center for Agricultural Mechanization (NCAM)

The primary thrust of NCAM is to accelerate the pace of agricultural development and utilization in Nigeria through R&D. Its mandate also includes, among others, engaging in adaptive and innovative research toward the development of indigenous machines for farming and processing techniques. Hence, NCAM should be domiciled in ARCN to enable it to fulfill its mandate in tandem with other research institutes under the FMARD.

National Center for Genetic Resources and Biotechnology (NACGRAB)

NACGRAB's main thrust is promoting the sustainable use of genetic resources and their effective conservation. Some of its efforts include: exploration, collection, identification, evaluation, characterization, storage, and conservation of animal and plant germplasm materials; acquisition, maintenance, utilization, exchange, and dissemination of information on genetic materials of plants, animals, and microbes; national coordination of a genetic resources program and its sustainable utilization; fostering of relationships with other national satellite genetic research centers located in research institutes, universities, and polytechnics as well as other international organizations and centers working on related programs; and coordination of activities of the National Committee on naming, registration, and release of crop varieties, livestock breed, and fisheries; arrest of rapid erosion and loss in the country's crop and animal genetic resources caused by cultivation, urbanization, rural development, grazing, desertification, pest outbreak, and national catastrophes; and documentation of the germplasm stocks held by NACGRAB, research institutes, and relevant organizations.

NACGRAB has always been domiciled in NARS given its strategic importance for the provision and storage of germplasm needed for research in the development of varietal seeds. The role of varietal seeds is critical for crop and animal improvement. If transferred to ARCN, NACGRAB will undertake research and coordinate activities on germplasm collection, introduction and exchange of seeds and plant materials, and characterization, documentation, maintenance, and conservation of genetic resources for utilization in crop management. Following transfer to ARCN, NACGRAB will also be engaged in collection, maintenance, and utilization of plant, animal, and fish genetic resources.

Establishment of a National Soil Research Institute

Establishment of such an institute is critical given the basic foundation it provides for crop research. This institute will prepare soil maps of Nigeria, record local government/ward-level soil resource inventories, establish soil correlation and classification at national level, conduct research on soil genesis and classification, impart training on soil surveying and mapping, soil taxonomy, land use planning, and establish a soil data bank for use in agricultural research and extension.

Initiate the National Agricultural Research Project (NARP)

Universities with capacity for conducting agricultural research do not have a strong base for research at the regional level. Most of the funds available to them were utilized for developing their main campuses, thus neglecting regional research needs. To overcome this, ARCN can put in place the National Agricultural Research Project (NARP) to strengthen the regional research capabilities of these universities to conduct need-based, location-specific, and production-oriented research in identified gg zones. Under this project, the country can be divided into a contiguous set of zones based on climate, soils, crops, and ecology. A major regional research station with a multidisciplinary team of scientists already exists in each zone. These existing research stations can be strengthened to partner with a university identified in that zone.

Capacity strengthening will be accomplished by providing funds for scientific and supporting staff, laboratory, equipment, transport, operating costs, and other physical facilities. The university, on its part, will provide funds for land, cultivation, and station maintenance. The project also requires strengthening the office of the Director of Research in these universities for coordinating research activities undertaken by these stations. An inventory of resources and different systems of cultivation will be prepared for each zone to serve as a project document to guide implementation and to

identify regional research needs. Emphasis on a multidisciplinary approach to problem solving and establishment of a close linkage between research and extension at the grassroots level are essential component s of this project. The re-form suggests that the university will collaborate with NARI for zonal workshops, station scientists, develop staff, and make farmers' representatives review the progress and plan for the future based on actual needs. The project will be guided and serviced by the NARP Directorate, to be in ARCN headquarters, which will regularly monitor its progress.

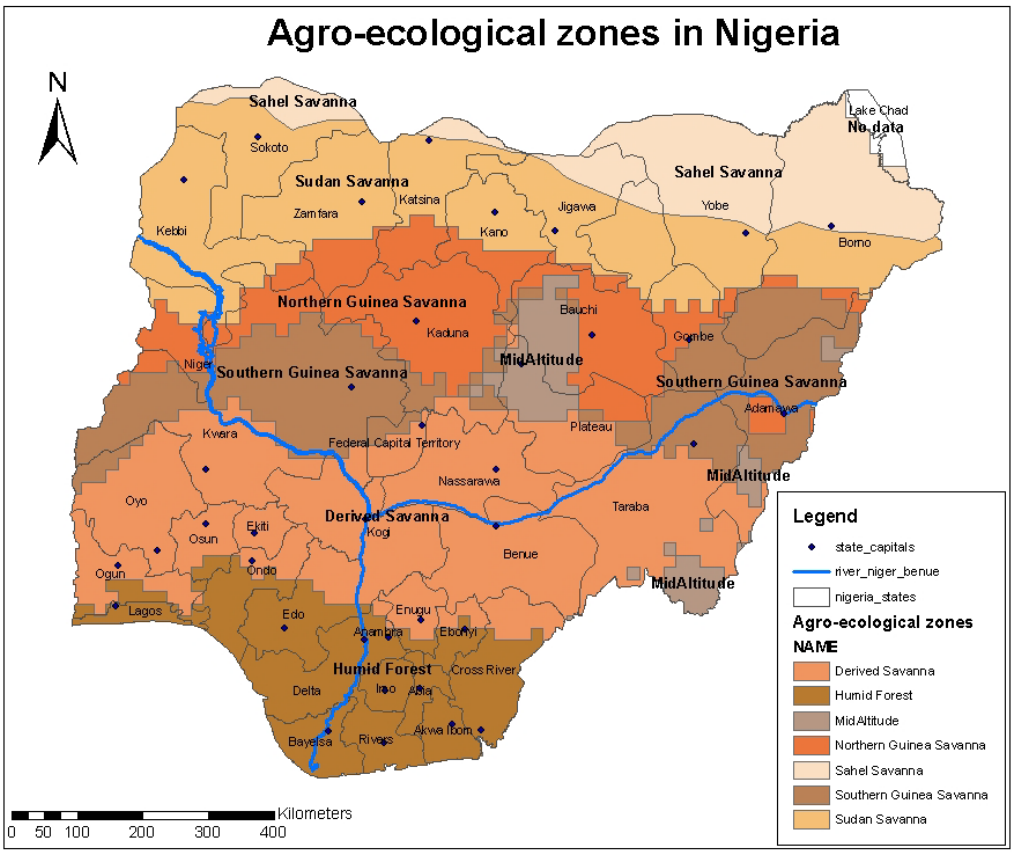
The NARP will place major emphasis on crops in which each region has comparative advantage, such as cereals, pulses, and oilseeds. This project is intended to ensure the process of decentralization of agricultural research to build the necessary critical mass of scientists for NARS. Strengthening regional research on a scientific agroclimatic basis is the most significant positive development that will be achieved through implementation of NARP. Its main objective will be to help strengthen the regional research capabilities of ARCN and NARIs.

How zonal research influences the provision of information, adaptive research, and technology transfer for various farming systems has been under discussion. The most critical controversy around the REFILS is with the composition of the farming systems groups, especially the omission of important groups in the sector, such as agribusinesses and commodity farmers' associations. Thus, the reform proposes a NARP with separate funding, targeting different ecological zones, inclusive of all stakeholders and centrally managed from ARCN but implemented at NARIs.

Establishment of National/Zonal Research Centers

Multidisciplinary/non-commodity specific research centers can address issues peculiar to the zones. They can also serve as the focal point/host for the zonal activities of the new NARP farming systems research, and for coordination of Adopted Village schemes and ARTTCs. Figure 6 shows Nigeria's agro-ecological research zones to indicate the potential number of institutes that will need to be set up.

Figure 6—Map of Agro-ecological Zones in Nigeria



NARS GAP 2: INTERNAL ENVIRONMENT

The internal environment of ARCN as a research organization in terms of resources, organization, activities, and achievements is expected to drive the economy of Nigeria through technology-driven increases in productivity and incorporation of international best practices. The internal environment will outline the institutional circumstances that affect implementation of the future strategy. In terms of resources required for reform, three factors need to be addressed:

- Location: Research centers will be based on the major agro-ecological zones and guided by areas of commodity concentration and comparative advantage. This will also determine collaborative links with other institutions, universities, IARCs, and other stakeholders.
- Facilities: Facilities such as libraries for centralized documentation, communication links with all NARIs, specialized documentation, and e-extension facilities will be available at ARCN headquarters. This will enhance public confidence in service delivery. Facilities at NARIs will be deployed at research sites in an integrated manner for cost savings and reduced duplication of major equipment.
- Expenditure: Funds designated as core and capital expenditures will be allocated for research to ensure focus and attention to core mandates of NARIs, extension, training, information dissemination and linkages, outreach, field programs, specialized centers, and commercialization through spin-off companies. This should be developed from the research sites, research centers, NARI headquarters, and divisions at ARCN headquarters, and compiled by the Deputy Executive Secretary for each Department for consideration by the Finance Committee of the GB. Adequate attention should be paid to the ratio of staff to non-staff activities.

NARS GAP 3: INSTITUTE-LEVEL MANAGEMENT

We propose that each individual institute be headed by the Director and organized into well-defined divisions based on different areas of research. Research implementation is proposed to be along commodity programs, however. Program implementation will be based on a multidisciplinary value chain approach headed by a program leader. There will be a competitively selected program leader, with a rank of Principal Research Fellow at a minimum, for each commodity to drive the NCRPs. Each institute would comprise the following committees:

- Research Advisory Committee (RAC) or the Professional and Academic Board represented by program leaders, external experts, and scientific division heads. This committee will be headed by an external eminent expert of professorial cadre. This committee will meet once a year to provide broad policy guidelines, review developments in the sector, and review research progress and other value chain inputs.
- Scientific and Technical Committee (STC) with members from institute scientists chaired by the Director of the institute to plan, monitor, and evaluate research projects.
- Management Committee represented by all management staff and chaired by the Director to provide broad management guidelines, policy formulation, and implementation and staff/financial matters.
- Quinquennial Review Panels set up by ARCN to conduct peer review of institute activities in accordance with national policies and priorities.
- Program leaders to function through multidisciplinary groups supported by experimental stations/sites set up for commodities. Program leaders will be supported by a Research Program Committee composed of all Project Scientists in the commodity value chain.

Examining internal linkages

This subsection examines the linkages of NARS with various stakeholders within the agricultural system. The important linkages that need to be strengthened are those between NARS and policy makers, and linkages between NARS, technology transfer systems, and users. ARCN links with policy makers will be at the level of the GB with representation of relevant authorities as members. ARCN should play a major role in driving the program of the FMARD and the states. To effectively transform agriculture, the current strategy of agricultural extension should be reformed. The reform process was initiated following establishment of the Federal Department of Agricultural Extension, which oversees, monitors, and provides the leadership needed for this. ARCN is an important contributor to intended outcomes and is expected to play a key role through the Department of Technical Cooperation, Extension and Communication. The challenges hindering effective extension and advisory service delivery in the country are many. The absence of a policy framework, for one, has resulted in inconsistencies in government pronouncement, providing wrong signals to potential investors in the agriculture sector and the lack of commitment to its implementation by the government. Leadership and coordination gap in the extension system is another reason for inefficiencies. In the past, extension activities were nationally coordinated by the Federal Agricultural Coordinating Unit (FACU) and the Agricultural Development Programmes (ADPs) in the states. After this ceased to exist with the withdrawal of World Bank funding, the extension system became characterized by loss of focus, unnecessary rivalries, and conflicts in program and project implementation. Lack of involvement of key stakeholders and development partners in policy articulation adds to weak internal linkages. Finally, inadequate budgetary and other financial provisions make it difficult for ARCN to undertake efforts to improve these linkages.

As part of the reforms, we suggest several solutions to strengthen external linkages for ARCN. A legislated agricultural extension and advisory services framework needs to be developed to formalize the related efforts. An effective,

efficient, demand-driven, pluralistic agricultural extension system complemented by appropriate supply-driven services to take advantage of market opportunities and the natural resource endowment needs to be developed. Further, institutional arrangements for effective extension service delivery are needed. Additionally, targeting women, youth, and other vulnerable groups in the agriculture sector will be essential in making the efforts more inclusive. (See Annex 5 for an organogram of the organization at federal, state, and local levels of agricultural extension in Nigeria.)

Apart from building sustainable funding mechanisms, mainstreaming all bilateral and multilateral loan-funded agricultural extension programs into the National Agricultural Extension System and coordinating other non-loan interventions by Federal Development of Agricultural Extension (FDAE) will be essential. Regulation and supervision of the activities of private agricultural extension service providers and NGOs in the country will ensure quality control of services. All public extension services in the country will be coordinated, with clearly defined roles for the different tiers of government and private sector in extension services delivery and funding. Finally, farmers' and community-based organizations are needed to improve service delivery and understanding of the collective needs of farmers.

The state ADPs are the best option for public extension delivery at the grassroots level. The extension approaches and tools used should include farmers' fields and business schools; value chain innovation platforms; e-extension/ICT; Adopted Village and school concept; Technology Transfer Centers; ways to empower women and youth in agriculture; extension support materials, interactive/study tours; national helpline hubs; and needs-based skill training programs.

It is proposed that an Agricultural Extension Implementation Steering Committee be established at ARCN to provide strategic direction for extension activities. Coordination of linkages with farmers and extension systems should, however, be rooted in the Integrated Agricultural Research for Development (IAR4D) approach endorsed by Forum for Agricultural Research in Africa (FARA) and its sub-regional organizations as a paradigm change in the way agricultural R&D activities are carried out in Africa. (See Box 1.)

Box 1—Integrated Agricultural Research for Development (IAR4D) approach

IAR4D is an innovation-based approach involving many stakeholders and partnerships (multi-institutional and multi-stakeholder framework). IAR4D integrates the perspectives, knowledge, and actions of different stakeholders around a common theme or "entry point," as well as the learning that stakeholders gain from working together. It brings together analysis, action, and change across the different dimensions of development (such as environmental, socio-economic). And finally, it integrates analysis, action, and change at different levels of spatial, economic, and social organization. Actualizing IAR4D revolves around the successful establishment of innovation platforms that link different groups of actors in different segments along the value chain to feed information, knowledge, and technologies to the value chains. The platforms include the extension system with participation from NGOs and farmer or community groups like cooperatives, community organizations, and farmers' associations. The linkage allows for more communication between supply and demand of inputs and products, and lower transaction costs. Building these platforms will be an important step in strengthening ARCN's internal linkages.

Examining external linkages

This subsection examines the linkages between NARS and its external sources of knowledge and collaboration, particularly with universities. Between 1993 and 1995, the International Service for National Agricultural Research (ISNAR) conducted a project on "Strengthening the role of universities in National Agricultural Research Systems (NARS) in Sub-Saharan Africa." It was observed that universities' role is much less recognized in NARS, despite the high concentration of trained scientists conducting research on topics of national importance. While researchers in universities are underutilized for agricultural research, there is a paucity of qualified researchers in NARS. It was found that academic staff members often share a wide and flexible attitude toward research, and remain positive toward development-oriented, problem-solving, applied and adaptive research. Major limitations to university involvement in research include incoherent national research strategies and policies and poor priority setting, programming, and M&E, which fail to provide guidance to universities; absence or weakness of research management structures; inadequate and declining research funding; short-term considerations for promotions; poor linkages with NARIs' extension, farmers, and development agencies; a paucity of well-trained research staff and technicians, and insufficient research support staff; deficient physical research infrastructure and lack of maintenance of buildings and equipment, and shortages of consumable research materials; and limited contact with external research agencies. Compared to universities, research policies and priority programing are better articulated in NARIs. However, research funding, particularly for operational and maintenance budgets, has declined in both research and academic institutions.

While some limited linkage mechanisms of an informal nature were identified in all cases, national and university policies to initiate and guide collaborative agricultural research are generally inadequate. Poor recognition of mutual benefits that can be gained by linking institutions of higher agricultural education into the work of NARIs is another major factor that inhibits greater synergy among various institutions working on agriculture in Nigeria. Last, disparities in policies and practices influence the professional and career environment for employees. Therefore, staff retention is low in NARIs and they favor a pull toward universities.

To promote research collaboration between universities and NARIs, with the aim of strengthening the capacities of NARIs, ARCN should:

- Formulate a national agricultural research policy and define a priority research agenda consistent with development objectives articulated in the national development plan.
- Provide leadership in the process while ensuring full and effective participation of NARIs, universities, farmers' organizations, processors' organizations, and other stakeholders in the agricultural value chain.
- Ensure maximum harmonization and coordination in planning, programing, monitoring, and funding of agricultural research at the national level.
- Serve as the national institutional structure for planning and coordination of agricultural research.
- Encourage universities and NARIs to mobilize resources and engage in collaborative programs addressing priority research tasks.
- Encourage universities and other non-ARCN research organizations to:
    - declare their commitment to participation in national priority research programs;
    - define their research strategies for participating in priority agricultural research, and integrate as much as of their teaching and research activities into national agricultural development plans;
    - enhance their structural capacities for research management, coordination, project formulation, and implementation;
    - constantly revise their teaching curricula to ensure relevance, and strengthen their post-graduate training programs and orient them toward national priority needs linked with NARIs' research programs;
    - involve research staff in the supervision of post-graduate students;
    - revise promotion criteria so that problem-solving research and teamwork are given due merit (the current criteria are biased toward single-author research publishable in international journals, and not necessarily related to national research priorities); and
    - establish and strengthen programs of continuing education, research and extension, and ensure a balance in resource and staff time allocations to teaching, research, and extension activities.

ARCN should build NARIs' capacity for greater collaboration with universities. It should:

- Adopt policies to enhance resource development, research planning, management, and coordination to provide an environment for university partnership and complementarity in research.
- Encourage the participation of university staff in research planning, priority setting, and implementation of research programs.
- Facilitate the exchange of staff, joint supervision of graduate students, sharing of research facilities, sabbatical leaves, and reciprocal representation of universities and NARI staff on each other's governing and academic boards.
- Foster preparation and financing of countrywide coordinated projects that provide for research coordination between NARI and university staff, and other forms of research collaboration.
- Coordinate partnership arrangements with international research organizations and centers and development partners to:
    - support NARS to develop capacity to become integral and effective partners;
    - promote an interactive and coherent system of research, higher agricultural education, and extension for agricultural development, and assist the country in making sustainable improvements to NARS;

- encourage increased investment in university research and post-graduate training programs by facilitating funding, promoting special fellowships, and supporting collaborative research programs that involve both university and NARI staff;
- support the establishment and promotion of regional associations and research networks and ensure the inclusion of universities and NARIs in their membership and operation;
- regularly document and widely disseminate successful collaboration between universities and NARIs; and
- assist in mobilizing international funding support for competitive research grant schemes, Nationally Coordinated Agricultural Research Program, and other initiatives of ARCN aimed at supporting research institutions, individual scientists, or groups.

Sustainable agricultural growth needed for an improved economy and food security requires political will to develop appropriate strategic visions and policies; good planning and firm commitment to additional and sustained funding; physical resources; a conducive environment; and a strong and effective NARS. It is widely accepted that improved capacity and productivity of NARS is vital for sustainable agricultural growth. Capacity and productivity improvements of NARS can be attained in part by greater research collaboration between universities and NARIs, which will harness the resources of research scientists available in universities, currently underutilized for research. With their wealth of highly qualified academic staff members and untapped, universities are currently recognized more for their teaching role than for research. Furthermore, linkages between universities and NARIs in the cases reviewed are poorly developed, often not functional, and unsustainable.

For NARIs to achieve their development objectives, substantial effort must be made by national governments, universities, and NARIs themselves, as well as by regional and international organizations and IARCs, to foster university research and remove the obstacles that prevent universities from being firmly linked to NARS. NARS should develop guiding values for efficient utilization of resources. Programs should be collaborative, multidisciplinary, and inclined toward farming systems and commodities, and should enhance on-farm research and participation of clients. Allocation of funds must be based on priorities. Improvement in the capacity and productivity of NARS should proceed together with development of regional and international cooperation. A test model for university/NARS collaborative research linkage in each of the zones, involving one faculty of agriculture and a neighboring NARI, should be set up, with the expectation of the following outputs:

- Sustainable structures for research organization and management, with firm links with NARIs, so that they can interact effectively within NARS.
- “All Country-Coordinated” projects/programs promoted by the major NARIs linked to joint team participation from universities and NARS.
- University linkage projects designed to increase university involvement in research addressing priority needs. These projects should also provide for post-graduate training as an integral component.
- Establishment and strengthening of multidisciplinary agricultural experimental stations/institutes devoted to specific problem-solving research in the fields of food, agriculture, and rural development. Such institutes, while maintaining a high level of autonomy, would remain firmly linked to teaching and post-graduate studies, in addition to targeted research.
- “Research fund” pooled from growers' associations and the public and private sectors to be allocated to researchers from both universities and NARIs on a competitive basis and targeting priority research needs.

Examining extension linkages

Linkage with the extension system is NARS’s weakest area of operations. This is because weaknesses in the structural organization of agricultural production systems. Several options were attempted in the past. It is of great concern that Nigeria’s National Agricultural Research and Extension System (NARES), the largest in Africa south of the Sahara, has not been able to engender the sustainable agricultural development that would have ensured both national and household food security, improved rural livelihoods, and made Nigeria’s agriculture competitive in the global agricultural market today. The new National Policy on Agricultural Extension in which ARCN will play a central role is currently being put in place.

NARS GAP 4: MANAGEMENT OF AGRICULTURAL RESEARCH

Management of agricultural research is the primary mandate of institutions like ARCN. Management of research has various aspects, such as program formulation and budgeting, monitoring, resource allocation, human and physical resources management. These are discussed in the context of the Nigerian NARS:

Research program formulation and budgeting

Research program formulation and budgeting activities in most NARIs encompass research priority setting, planning, and budgeting. A review of the responses to the questionnaires' sections on research planning, priority setting, and budgeting reveals that most institutes' research planning process begins with calling for research proposals from staff. Proposals typically go through various stages of review before finally being presented to management for funding. In several institutes, the research planning process begins with an attempt to identify problems confronting farmers, processors, and other operators along the value chain. This is typically accomplished through consultative meetings and engagements with these stakeholders. Preparation of periodic master plans for research, training, and extension centrally coordinated by ARCN will assist in meeting national development objectives.

The research planning process varies across NARIs. While some strive to ensure that their research planning process and priorities are demand-driven, it is not clear that this is the case in many others. For those that strive for a demand-driven research agenda, the expectation is that farmers, processors, agro-allied manufacturers, and other actors along the value chain will be intimately connected to the institutes and researchers. The indication, therefore, is that NARS needs a major initiative and active framework that will ensure that the research agenda is truly demand-driven.

ARCN should provide leadership in research planning at the macro level and support, guide, monitor, and evaluate the institutes' research programs. This will also be formalized through the budgeting process. Currently, there is indication that the process to collate and consolidate the budget of individual research projects and submit them will be "through the ministerial and executive levels for legislative screening and appropriation." The funding arrangement also shows that the research fund is currently part of a capital budget. While this is logical and appropriate, the practice of treating capital budget as a residual makes it an excuse for resource shortfall. For example, the capital budget of most MDAs for 2015 has not been released. This poses major threats to NARIs' research operations. Analysis of the financial data provided by some NARIs shows clearly that the share of research capital in the total institute budget is always the smallest. Meanwhile, the Vision 20:2020 envisaged intensification of agricultural research to meet the desired goal of agriculture as a sustainable and profitable sector. Accordingly, the reforms proposed in this report are intended to enable ARCN to respond effectively to this unanimous call for more active involvement.

Financial management of research

The problem of inadequate finance for research is stark. For instance, all NARIs pointed at the lack of funds as the first constraint preventing them from performing optimally in research, training, and extension. ARCN should play a major role in advocating and mobilizing financial resources for NARS as a whole, and its NARIs in particular. ARCN should be instrumental in resolving the issue of low and falling research budget and should also undertake initiatives that insulate the research fund from the vagaries of appropriations and releases. In this regard, the reform includes legal and institutional proposals to establish a National Agricultural Research and Extension Fund (NAREF), toward which 1 percent of duties on agricultural exports and imports will be directed. The Fund will be managed by ARCN and used exclusively to support the uninterrupted flow of resources into agricultural research, training, and extension.

Financial constraints prevent NARIs from effectively partnering with international research institutions and development partners. Meanwhile, while quite several NARIs can attract international programs and collaboration because their longstanding reputation, many NARIs can benefit from a larger, more formidable organization like ARCN to secure such collaboration for the network of NARIs and other national research organizations in the universities.

Financial management processes in most institutes are reasonably streamlined. Specifically, salaries are now paid through the Integrated Payroll and Personnel Information System (IPPIS), payments are made through Government Integrated Financial Management Information System (GIFMIS), and procurements come in according to due process. This and similar issues should call for a reformed ARCN that can effectively play a coordinating role in financial management. It is recommended that allocation of the finances and budgeting arrangements of ARCN/NARS be consolidated but implemented at the various levels of authority under the following independent cost centers, namely, GB matters; headquarter coordination; staff and non-staff costs; capital requirements; NARI research; commodity research centers; farming systems research; collaborative networks; special projects for emergency responses; and NARP

Monitoring and evaluation of research activities

Virtually all institutes have a good system of M&E of their research projects. This typically involves field visits and surveys of beneficiaries or adoption studies to measure projects' impact. However, most institutes agree that the reformed ARCN should be involved in the process. The key to the success of agricultural research efforts in the ARCN system is the in-built mechanism of research M&E. At the institute level, M&E will be carried out through Staff Research Councils (SRCs) and through a comprehensive review by specially constituted Quinquennial Review Teams every five years. Coordinated research projects will be evaluated at workshops and through mid-term appraisal committees that will review the work from time to time. The progress of ad hoc research schemes is monitored through regular reports examined by

the Scientific Panels. Overall monitoring of different research schemes is undertaken by the subject matter divisions at ARCN headquarters, and overall implementation of the plan schemes by the Plan Implementation and Monitoring Unit.

Information management for research

Information management encompasses information generation/acquisition, processing and storage, and dissemination. All NARIs are acutely aware of the importance of information management in the process of research planning, priority setting, training and extension, and adoption. However, information management requires a lot of financial and other resources, which are inadequate in the institutes. Moreover, this is an area where economies of scope and scale can be easily realized through a strong and effective ARCN, as it coordinates information management by NARIs and disseminates information to all stakeholders. Again, the ARCN reform should facilitate this process.

Development and management of physical resources for research

Analysis of the available budgets of NARIs shows clearly that provisions for physical capital programs of the institutes are not only small but dwindling. Meanwhile, the allocations for overhead costs remain inadequate to operate, implying that much-desired maintenance activities are not carried out. The result is serious infrastructural deficiency in all institutes. Indeed, all NARIs identify finance and infrastructural deficiency as key constraints to optimal performance. The reform of ARCN proposed should assist in addressing the problem of physical and infrastructural inadequacy and obsolescence.

Management of human resources for research

Human resources development and management is an acute problem according to NARIs and their collaborators and partners. The ratio of non-research staff to research staff is extremely high, hence, many experienced researchers retire at age 65 whereas their university counterparts retire at age 70. Additionally, the proportion of all scientists with a Ph.D. is low and falling. The proportion of female scientists with a Ph.D. is even smaller.

This means that many good scientists migrate to universities in search of better conditions of service and career prospects, especially professorial appointments. Further, the conditions of service and work environment at NARIs are inferior to those of universities, making it difficult to attract and retain young scientists. This situation calls for a concerted effort by ARCN and NARIs to reverse the systematic decimation of human capital. To this end, the institutional, legal, and organizational reforms proposed should address these issues. In particular, the prevailing inferior conditions of service of the research staff in NARIs compared to that of their university counterparts should be addressed. In addition, ARCN reform should provide experienced and respected scientists opportunities to serve in key leadership positions in ARCN and return to their home institutes on completion of assignments or tour of duty. Finally, the reform of ARCN should enable it to advocate for excellent working conditions with modern facilities as well as the opportunity for staff to remain engaged with the global community of practice and networks in their respective fields through exchange programs, staff development programs, study tours, and visiting scholar schemes. All staff of non-university-based institutes will be staff of the reformed ARCN. However, all matters on human resources hitherto handled by NARI GBs will be handled by ARCN. Other matters related to this issue are addressed in the legal framework.

Governance functions for research

To reform the governance process, it is recommended that the GB of ARCN should be lean in structure and comprised of technically competent persons with relevant intellectual and practical experience in all components of the agriculture sector, including the processing and agro-allied industries. Moreover, the challenge of varied procedures for appointment of chief executives of university-based NARIs should be harmonized by allowing ARCN involvement in the selection process.

The ARCN GB will formulate policies for the entire NARS. Accordingly, there will be no GB for each NARI. For each institute, however, the ARCN GB, with the approval of the Minister of Agriculture, will constitute an Internal Management Committee of members who will oversee its research, training, and extension programs and advise ARCN as necessary. These and other issues are fully addressed in the legal framework.

Administrative procedures in NARS

The administrative procedures proposed in the ARCN reform are based on the need to secure effective coordination while avoiding suffocating bureaucratic controls. Accordingly, the management of NARIs will continue to maintain their current administrative autonomy subject to the existing rules and regulations of public service. In addition, all administrative matters that were hitherto addressed directly to the Federal Minister of Agriculture or the Permanent Secretaries will now be routed through ARCN. In other words, the channel of communication from institutes to the FMARD will be via ARCN.

In keeping with good practice in similar Councils, institutes will be free to interact and engage with local and international collaborators, but the Deputy Executive Secretary in charge of partnerships and related issues must be put on notice. Without prejudice to the status of the institutes as legal entities, all legal agreements, Memorandum of Understanding (MOUs), and similar engagements/interlocutions between ARCN institutes and their partners/collaborators should be endorsed by the Deputy Executive Secretary in charge of partnerships, who should in turn notify the Executive Secretary. Administrative relationships between ARCN and non-ARCN institutes will be limited to those required for effective implementation of collaborative and/or competitive research programs as specified from time to time and for each program. These and other issues are fully addressed in the legal framework of the reforms.

Transitional arrangement and retooling of existing ARCN staff

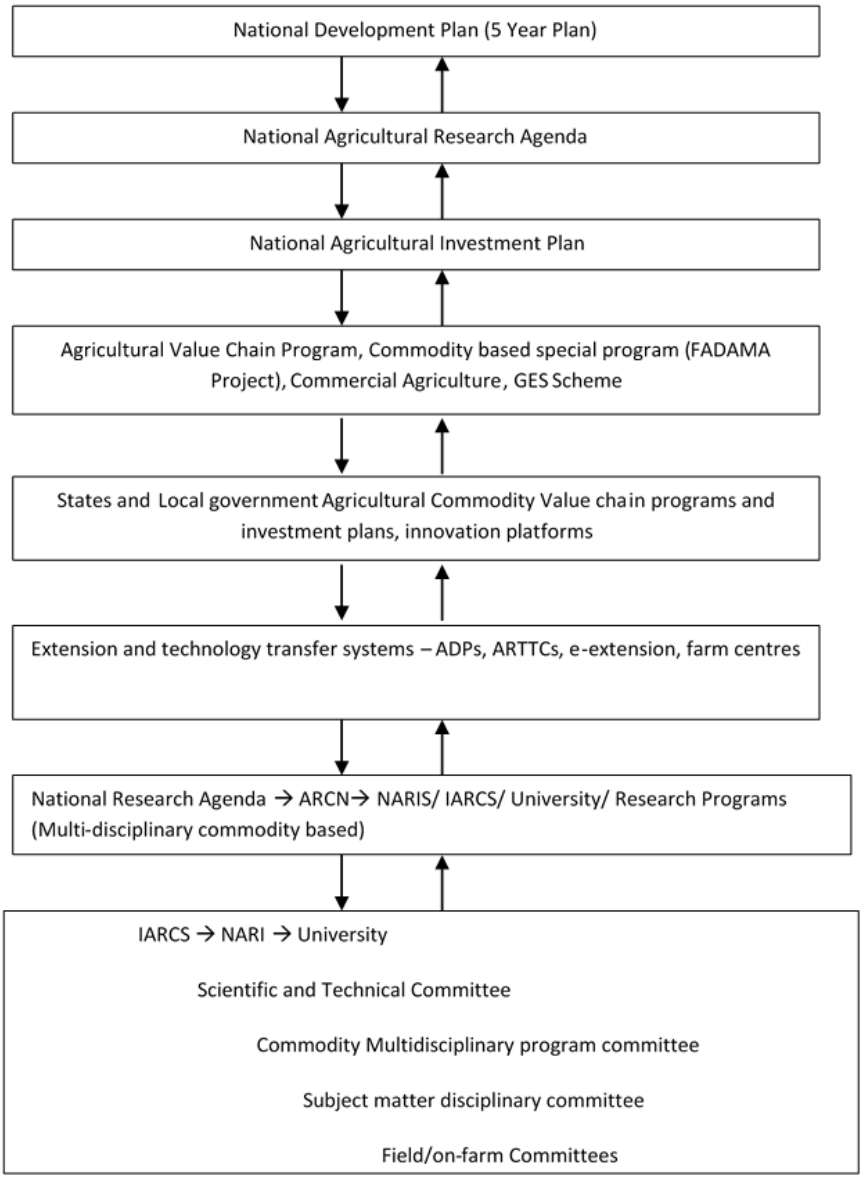
It is important that the reform proposed in this report ensures a win-win situation for all stakeholders, especially existing ARCN staff. In this connection and in recognition of the envisaged legal issues connected with wide-ranging collaboration between ARCN and other organizations, it was proposed that the Legal Unit be elevated to Legal Department. Moreover, a transitional arrangement/retooling program that will ensure that the interests of existing ARCN staff are protected is imperative. To this end, ARCN should put in place a comprehensive training/retooling program to prepare staff for new positions in the reformed ARCN. This will include, but not be limited to, short-term training programs in relevant areas; sponsorships for post-graduate programs; and internships at relevant NARIs. The opportunities offered by FCAs should be exploited for these purposes. Similarly, universities and other non-ARCN research institutes should be engaged for these purposes. ARCN should also take advantage of the extant practice of making salaries and allowances personal to deserving staff that may not be able to benefit from these retooling arrangements.

NARS GAP 5: RESEARCH FUNCTIONS

It is important that the research agenda of ARCN/NARS and its partners align with the national agricultural development agenda, as shown in Figure 7. Thus, planning, implementation, and evaluation of outcomes and progress in the sector can be measured and harnessed for better resource management. ARCN, as a bona fide research organization, will also execute agricultural research policy development and management of the research system. To effectively design and implement the research strategy for the agricultural system as a whole, ARCN will need to identify the best practices to develop and implement the research priority-setting approaches and methods in line with global standards and adapt them to Nigeria's agriculture sector.

Further, ARCN should Identify the research needs in the areas of organizational and management principles and practice as they relate to management of the national research systems that include the constituent bodies of ARCN and ARCN headquarters. In collaboration with NARIs, universities and other relevant research and capacity-building organizations (such as NISER, Federal Institute for Industrial Research (FIIRO), Forestry Research Institute, Raw Material Research Development Council, and National Agriculture Seed Council), ARCN has to undertake capacity-building activities necessary to promote application of modern research planning, execution methods, adaptive research techniques, monitoring and impact assessment techniques, budgeting and research administration, all of which are necessary to ensure impactful problem-solving agricultural research. ARCN will continue to implement special purpose research vehicles like the NARP and Competitive Agricultural Research Grants in conjunction with NARIs, universities and other relevant research organizations (such as NISER, FIIRO, and FRIN), and other capacity-building organizations. Additionally, ARCN should advise government and other stakeholders on the optimal level of investment necessary to develop and maintain effective performance of NARS in general and NARIs, in particular. ARCN should identify appropriate approaches to enhance the research–extension linkages and the associated joint research with state-level organizations. Finally, ARCN should propose, support, and undertake research, institutional and human resources capacity-building initiatives necessary for genetic resource management, policy analysis, and ICTs as applied to NARS as a whole.

Figure 7—National Agricultural Research and Development (R&D) Framework



Source: Authors

Research, policy, and resource allocation

For the agriculture sector to improve on its contribution to the overall goal of national economic growth, wealth creation, food security, and poverty alleviation, the sector must be transformed from subsistence to a commercial and profitable business enterprise. For this to happen, a National Sustainable Agriculture Development Plan (NSADP) must be in place and should include interventions that increase agricultural productivity through a variety of support measures along the entire agricultural value chain; promote commercial agriculture through private sector participation; improve agricultural research and extension delivery systems; promote efficient and effective sector resource management systems; manage and exploit the country's fishery and marine resources and access local and international markets; manage and exploit the country's forestry resources to mitigate against climate change; and mainstream cross-cutting issues in agriculture.

To position ARCN strategically as a key driver in its transformation of the agriculture sector, it should adopt the Agricultural Product Value Chain approach to research within the framework of IAR4D. The adoption of the Agricultural Project Value Chain approach to research for development is necessary because of the focus on agriculture and agri-business as priority sectors for spurring economic growth in Africa. This calls for development of Agricultural Project Value Chains that integrate producers and markets to make the agriculture sector more responsive to consumer demands.

Recognizing the developments taking place at the national, regional, and international levels, Strategic and Operational Plans must be tailored to strategically position ARCN to contribute significantly to agriculture sector development. From a regional and global perspective, the Strategic Plan should be in line with CAADP, West and Central African Council for Agricultural Research and Development (WECARD), and the Millennium Development Goals (MDGs). The institutional basis for the use of programs lies in the CAADP framework, which stresses the need for a shift toward a

more holistic and integrated approach rather than the development of technology packages. ARCN developed its Strategic Plan following certain key principles relating to the central role of clients and partners in the innovation and technology research process. These were integrated into the Plan to ensure that development issues were also addressed. These key principles are derived from CAADP, with which the ARCN Strategic Plan is closely aligned. (See Box 2.)

Box 2—Comprehensive Africa Agriculture Development Programme (CAADP)

CAADP is an initiative by the African Union, endorsed by the African Heads of State and Government (NEPAD 2002). Its primary goal is agriculture-led development that eliminates hunger and reduces poverty and food insecurity, opening the way for export expansion. To improve the productivity of agriculture to attain an average annual growth rate of 6 percent, with particular attention to small-scale farmers, especially focusing on women, CAADP's targets are to: have dynamic agricultural markets within countries and between regions; have integrated farmers into the market economy and have improved access to markets to become a net exporter of agriculture products; achieve a more equitable distribution of wealth; be a strategic player in agricultural science and technology development; and practice environmentally sound production methods and have a culture of sustainable management of the natural resource base (NEPAD 2003).The four main pillars supporting CAADP are:

- Pillar I – Extending the area under sustainable land management and reliable water control systems
- Pillar II – Improving rural infrastructure and trade-related capacities for market accesses
- Pillar III – Increasing food supply, reducing hunger, and improving responses to food emergency crises
- Pillar IV – Improving agriculture research, technology dissemination. and adoption

Implementation is through programs and projects at institutes and FCAs, which in turn is delivered through the network of appropriate stakeholders. Project leaders focus on implementation with oversight from appropriate governance structures. All institutes and FCAs contribute to a greater or lesser extent to the delivery of ARCN results. Each institute and FCA is necessary, but only together will they be sufficient to deliver the results and achieve ARCN's objectives. The shift to a program-based approach requires changes in organizational and institutional systems and structures that need to be integrated into the programs. Networking and partnerships are mechanisms for ensuring national collaboration and delivery of results. Existing networks and platforms are being reviewed and reformed to address specific national priorities.

Program formulation

The Forum for Agricultural Research in Africa (FARA), through its members, was given the mandate to specifically address achievement of CAADP Pillar IV. FARA also developed the Framework for African Agriculture Productivity (FAAP), a set of guidelines for implementing CAADP. ARCN's Operational Plan is built on FAAP principles and has strong linkages with CAADP and FAAP, ensuring coherence with sub-regional and regional issues.

The new Strategic Plan addresses prioritized issues and makes a clear commitment to delivering a series of results that encompass a new paradigm for agricultural R&D, addressing not only conventional research, but also the use of innovation platforms in the holistic approach of IAR4D. The implementation of the reform will be based on a centrally coordinated program approach that is driven from a central planning system but ensures collaboration and coherence in relevant agricultural R&D activities. It ensures that all institutes and FCAs contribute to achieving the national research objectives within the reorganized ARCN framework. The approach presents a clear focus on harmonization of investment activities and facilitates resource mobilization for regional, sub-regional, and national agricultural initiatives.

Research program implementation

The management approach proposed for ARCN in this new strategy envisages alignment of ARCN with the mandates of NARIs. This approach is program-based and holistic, adopting new ideas on how agriculture can be utilized as an engine for broader economic growth. It represents a paradigm shift away from the previous scientist-driven, top-down project and discipline-based mechanism with isolated and largely uncoordinated institutes and colleges.

Interactions between programs ensure that all aspects of the ARCN Strategic Plan are addressed in the delivery of results. The principal advantages of the new approach include opportunities for inter-program linkages and planning; more effective monitoring, evaluation, and learning; simplified streams for knowledge and information; clear lines of accountability; strengthened corporate cohesion; clear focus for resource mobilization and development partners; and assurance that all work conducted is consistent with the country's agricultural development plan.

Modes of operation

This subsection describes the various modes of operation needed for research program implementation. To conduct research in an efficient and effective manner, the following aspects need to be focused on:

Research planning and priority setting. NARIs have evolved excellent methods of conducting in-house reviews and approvals. Post-reform research planning will be based on several criteria. Regional contacts from NARIs, zonal research centers, field teams, farmers, and other stakeholders will be taken. Contacts with scientists from network participants will be established. Further, advice from international and other partners will be taken to set research priorities. There would be a comprehensive review of previously identified research priorities. The above information will be harnessed into the national agenda communicated by the government through ARCN from a national plan to guide development of researchable issues. Development of research programs will be done by NARIs/Research Centers. And finally, aggregated research programs and budgets will be taken from the cost centers and transmitted to the Finance Committee through the Scientific Committee to the GB for approval.

Research implementation. Research implementation will be guided and funds shared by different research groups to ensure balance. ARCN will coordinate this function with all NARIs based on basic scientific research at NARIs/universities/IARCs. It will take consideration of the conditions for collaborative work, including: clearly identified, commonly shared problems and a realistic research agenda; participants motivated to contribute by a strong self-interest; and participants' readiness to contribute resources to the network including staff and facilities, and some modest incremental funding. Apart from this, ARCN will take the NCRPs; Competitive Agricultural Research Grant Scheme; contract research; farming systems and adaptive research; multidisciplinary research; macro- and micro-economic research; and technology application research to coordinate research implementation with all NARIs.

Strategy and ARCN goals. The strategy and goals of ARCN will be to strengthen NARIs' ability to conduct technical and policy research in agriculture and related fields and thus develop their own technical solutions to production problems and promote economic development for Nigeria. The aim would be to contribute to scientific knowledge in a way conducive to solutions to agricultural productivity and drive NARIs to levels of competitiveness with international best practices through networking with national and international research organizations, thereby contributing to regional initiatives.

The operational mandate. As per the operational mandate, research programs will be guided by the economic importance of commodities and products; the comparative advantage in the agro-ecological zones such as semi-arid, northern guinea savannah, southern guinea savannah, forest, and mountainous; and target groups like smallholders, medium to large holdings, agribusiness, small and medium enterprises (SMEs), pastoralists, ranchers, and exporters. The idea would be to prioritize issues as high, medium, or low; understand the nature of the problem and its reach; identify special advantages through any past experiences, aggregate of current knowledge; availability of partners; the critical mass of scientists and facilities; the probable impact, especially for food security, poverty alleviation, income for the rural poor, and gender mainstreaming; and the stability and sustainability of the research operation.

Research management under ARCN will have a central planning unit but with a decentralized implementation strategy at NARS/Research Centers. This will ensure that the research agenda is properly aligned with the national agricultural agenda in terms of planning, implementation, focus, budgeting, M&E and impact assessment, and accountability.

Results and delivery. Four results constitute the heart of the paradigm shift away from conventional research and approaches that ARCN institutes and FCAs followed in the past:

Result 1. Demand-driven agricultural technologies generated and innovation promoted. This focuses on technology development and the promotion of innovation. This is close to the traditional role assumed by ARCN stakeholders, but the focus shifts to ensure responsiveness to demand and an adaptive approach to ensure that research also supports change. The focus is on smallholders and pastoralists, although the approach is broad-based and does not exclude other stakeholders, including large-scale and commercial producers.

Result 2. Appropriate policy options for agricultural growth formulated and made available. By encompassing policy, trade, marketing, institutions, and socioeconomics, ARCN will broaden its perspective and ensure increased likelihood of impact as well as more appropriate responses to demand. For ARCN this means involving nonconventional partners in the research process through platforms and partnerships. It requires new skills and approaches and will be crucial for ensuring success.

Result 3. Agricultural research, training, and extension system strengthened. A major role for ARCN as a national organization with a broad mandate through the ARCN Act is to encourage and develop capacity within its constituents. The national system in this context includes the various and diverse agro-ecological systems and zones within Nigeria; public and private sector organizations and institutes; input and output markets; and policy and decision-making bodies.

Capacity strengthening includes not just the conventional components of formal training and physical resources, but specifically the development of skills and competencies to operate and function in the business paradigm of IAR4D. It

is concerned directly with the empowerment of stakeholders to participate fully in the process of development, enabling them to articulate demand and access solutions.

Result 4. Agricultural knowledge management system established. This is an undertaking to increase efforts at developing and activating the types of linkages with uptake networks that are essential if the other results are to succeed. It recognizes that ARCN institutes and FCAs do not have a delivery role as such, but need to be in close contact with those that do. It is about creating the platforms to ensure information on technologies, and the information that makes the technologies happen is combined to create the knowledge necessary for innovation. By internalizing the responsibility for improving networks and communication, ARCN will reduce the probability of such linkages failing, and disrupting the uptake of results 1, 2, and 3. More importantly, it does this without adding to researchers' terms of reference the dissemination roles for which they do not have comparative advantage. Activities leading to the delivery of this result also utilize information, knowledge, and technologies generated by activities of results 1, 2, and 3.

Internal organization. *Research Implementation Guidelines for the Central Research Institute System* will be coordinated from the central NARIs and Research Centers where the multidisciplinary commodity programs are driven. Each Program or Center will have a coordinator who, under the Deputy Executive Secretary for the Academy for Entrepreneurial Studies will be responsible for the cluster. The coordinator will be responsible for the budgeting, cost center management, financial control, M&E, and reporting to the GB through the Executive Secretary. All the responsibilities will adopt the channels of reporting following the hierarchy of the organogram.

Other activities ARCN will oversee from headquarters include: collecting, storing, and evaluating and monitoring the distribution of germplasm; supervising the import of germplasm by collaboration with Quarantine Services; analyzing soils and plants through Soils Research Centers; providing support for statistical analysis of national data sets and training of NARS staff; providing support for networks; maintaining online documentation of national and international information assets on agriculture and related fields; sourcing and maintaining budgets and financing for agricultural research; developing a strategy for capacity for management development in NARIs; and maintaining a Policy Analysis Unit to regularly provide information for NARIs to be proactive in planning a research agenda to meet the strategic needs of the agriculture sector.

NARS GAP 6: MONITORING AND EVALUATION

ARCN established an M&E Framework as a logical tool for measuring performance. Unfortunately, this did not take root because of problems already enumerated.

NARS GAP 7: PROGRAM COORDINATION

ARCN will be responsible for agricultural research planning at the national level. Its headquarters will scrutinize and sanction research schemes received from NARIs and other institutions. The research schemes will first be examined technically by the concerned subject matter divisions in headquarters and put up for consideration before the Scientific Panels. Once they are found technically sound, they will be examined for financial implications by the Standing Finance Committee. Finally, they will be placed before the GB for approval. ARCN will provide the broader mandate and research programs while responsibility for formulation of all research projects will be vested in NARIs. The institute scientists will submit their research proposals in a standard performance annually. These will be discussed by the Research Councils at the divisional level in larger institutes followed by SRCs at the institute level. SRCs are attended by the institute scientists under the chairmanship of the Director. New proposals and ongoing projects are evaluated by the SRC and approved by the Director. Some of the major criteria used to evaluate new proposals in SRC meetings are: farmers' needs; urgency of research problem; compatibility with the institute's mandate; socioeconomic benefits; ease and cost of adoption by farmers; and contribution to knowledge.

NARS GAP 8: SEED DISTRIBUTION SYSTEM

The seed distribution network has suffered because the weak extension system. A reformed research system can help meet the demands for breeder and foundation seeds, ensure demand-driven output, provide quality assurance of seeds, and develop and release high-yield varieties to meet farmers' needs. The National Agricultural Seed Council (NASC) linkages with NARS are different at different levels. ARCN-level linkages include: coordination of seed research in NARIs; membership of the National Seed Entrepreneur Accreditation Committee; membership of the NASC GB; and membership of NASC Institutional Biosafety Committee. NARI-level linkages involve: development and maintenance of crop varieties; certification of breeder and foundation seed fields; production of breeder and foundation seeds; and joint inspection of breeder seed fields. Finally, at the university level, linkages need to be established via Seed Extension Villages and Seed Technology Centers.

NARS GAP 9: INTELLECTUAL PROPERTY RIGHTS AND COMMERCIALIZATION POLICY

Private sector investment is growing in Nigerian agriculture and requires new advances in agricultural sciences to increase productivity. This has generated private sector demand for protection rights for their technologies. Intellectual Property Rights (IPR) are therefore attracting more attention, especially with growing competition among researchers to excel and control prominence in technology development, especially those influencing food security. Using India (a regional leader in implementing IPR in agriculture) as an example, IPR was targeted at breeder seed development for maize and pearl millet. The policy encouraged private investment in the seed industry, which generated new materials for which protection rights were required. These were replicated for several crops, if found positive.

Even though IPR, innovation, and productivity are related, some authors have shown that this effect may be country- and commodity- (crop) specific. India's experience with IPR and agriculture is closely tied to the country's seed industry, which evolved from state-owned seed enterprises, research centers, and a regulatory agency to a system that includes highly competitive foreign and domestic private firms, rapidly expanding markets, and a more complex, market-oriented regulatory system. Again, this requires a major policy change in the seed industry. Thus, policy reforms are critical for innovation and IPR. Another good example is the change in the Biodiversity Policy in India, which led to the Biodiversity Act in 2002 incorporating germplasm access.

As such, IPR frameworks will depend on major policy shifts in agriculture. India became a Member of the World Trade Organization in 1995 and signed the TRIPS Agreement, in which article 27.3 required signatory countries to provide protection for plants as patent. How IPRs are manifested in a country is embedded in: the tools society uses to promote innovation and creation; the emphasis on rights-based issues; the justice system; the institutions that society creates to attain its development and social objectives; intellectual property and trade barriers for expansion of agricultural exports; patents on living forms; and appropriation of traditional knowledge.

The advantages of ensuring sound IPR regimes are many. Some include protection of innovation and potential rights for future development; opportunity for generating new, external funds for research; innovation within the value chain; commercialization and production efficiency; enhanced relationships with industry and research; and protection against unfair competition. The case study in Box 3 illustrates further.

Box 3—A Case Study of the National Veterinary Research Institute (NVRI), Vom

The National Veterinary Research Institute (NVRI) in Vom is a parastatal of the Federal Ministry of Agriculture and Rural Development. Established in 1924, the Institute has the mandate to: conduct research in all aspects of animal diseases, including their treatment and control; develop and produce animal vaccines, both sera and biological items to meet national demand; provide surveillance and diagnosis of animal diseases; provide extension services to poultry and livestock farmers; train intermediate-level manpower in veterinary and medical laboratory technology; and promote animal health and production technology.

The Institute currently produces 16 different animal vaccines at an average of 100 million doses per year. This mandate of vaccine production is currently able to meet 70 percent of the national demand for vaccines for large animal diseases and 30 percent of the national demand for poultry vaccines, with the balance met through import of foreign vaccines by private organizations. Because the federal government provides funds for personnel cost and production inputs, vaccines are sold to farmers at a subsidized price. With the current financial situation in the country, vaccine production needs to be separated into a business venture that will generate revenue to support R&D.

Status of Vaccine Production Facilities in NVRI

The laboratories currently being used for vaccine production were commissioned in 1961. Even though some rehabilitation and modifications of the laboratories were carried out in the recent past, these still do not meet the requirement of current Good Manufacturing Practices (cGMP), hence the need for new facilities. Market intelligence reports indicate that the market size of imported poultry vaccines alone is up to US$6.25 million. Estimates of livestock population based on National Agricultural Sample Survey (NASS 2011) by National Bureau of Statistics and FMARD indicate that NVRI needs to produce at least 200 million doses of large animal vaccines and 600 million doses of poultry vaccines annually to be able to cover 80 percent of the national herd and flock to ensure herd immunity and protection from disease. This also means that the Institute can increase its internally generated revenue to about US$800 million annually if vaccine production capacity is increased. To achieve this target, the production of vaccine needs to be commercialized to attract private investment to improve existing facilities and build new ones.

The commercialization protocol could be wholly government-owned but workers will be paid by the vaccine company (as is the case with Vaccine Production Institute of Ethiopia in Bishoftu) or in partnership with any foreign vaccine production company, as is the case with Botswana Vaccine Institute. The proposed name for the company is Vom Biological Products Limited to allow for vaccine production and production of allied products such reagents,

drugs, and feed additives. It is therefore pertinent to establish independent commercial and research organizations with the former to create funding streams for research, which will help free the federal government of the burden of financial support for the institute.

Existing IPR Regimes

The existing IPR regimes include the World Trade Organization, to which Nigeria is a signatory; TRIP; Biodiversity Act; and Plant Variety Protection (PVP). The National Agricultural Seed Decree No. 72, 1992 made provision for the Crop Variety Registration and Release Committee and the Seeds Standards Committee, among others. However, it is not clear if these Committees have any legal framework for IPR/ Intellectual Private Property (IPP) or are limited to mere documentation and dissemination. Thus, the national seed system is inadequate in responding to the growing national seed requirements for improved crop output. This is because IPR/IPP for agriculture is yet to receive institutional attention with full legislative backing.

Recommendations

Regarding the existing IPR regime, the recommendations for NVRI are to:

- Extend establishment of an Intellectual Property Technology Transfer Office at NARLs, Polytechnics, and Monotechnics in the manner that is now done in universities by the National Office for Technology Acquisition and Promotion;
- Revise the legal and policy frameworks to provide for agricultural research IPRs;
- Amend the National Crop Varieties and Livestock Breeds Registration and Release Committee Decree 33 of 1987 to include (PVP), Animal Breeders Rights, and Farmers Rights;
- Align extant modus operandi in IPR agencies to suit agricultural research;
- Promote strong interagency collaboration and coordination to establish and facilitate IPRs for agricultural research;
- Build NARIs' capacity to formulate and implement IPRs and technology commercialization policies and practices;
- Create adequate awareness among scientists and promote information flow across the IPR chain, policy makers, operators, and users of IPRs;
- Optimize IPRs to enhance commercialization of agricultural research and technologies.

IPRs should be designed and implemented in a way that contributes to agricultural production and poverty reduction and they should avoid implementing legal regimes that create exclusivity. In a patent involving steps in the process, only the inventive step should be covered by the patent. Last, capacity building on IPR/IPP concepts and framework should be developed in all institutions.

NARS GAP 10: MIDDLE-LEVEL MANPOWER DEVELOPMENT

Middle-level education is critical to the development of agricultural productivity because the relevance of middle-level training for providing technical and entrepreneurial support for production systems. However, some issues limit the effective participation of this category of human resources in Nigeria's agriculture sector. ARCN supervises 11 FCAs. Even though a lot of other FCAs and related disciplines exist in Nigeria as parastatals of the FMARD, they have no relationship with ARCN.

In addition to the above, all states have Colleges of Agriculture under state Ministries of Education and in some cases Ministries of Higher Education. Those under state control have enabling laws or statutes covering their establishments, whereas those of the FCAs have none. A good number of agricultural programs are taught in polytechnics at both ordinary national diploma and higher national diploma levels.

The National Committee of Heads of Colleges of Agriculture and related disciplines suggested the need to reform ARCN, thereby providing better supervision for FCAs and ensuring their participation in national agricultural development programs. The issues and proposed reforms are presented below:

- There is no interaction on technical matters between FCAs and ARCN. The relationship is limited to administrative functions of ARCN. The supervision of FCAs should be properly domiciled in the proposed reform of ARCN to ensure full visibility and participatory functions.
- The criteria for advancement of academic staff in FCAs seem to follow mainly those laid down for research institutes. Promotion in FCAs should take cognizance of the peculiar nature of services rendered by the staff, such as teaching, supervision, and so on.

- The restriction of FCAs under ARCN to just 11, even when several others exist in the FMARD, needs to be considered. To ensure harmony, all such Colleges under the direct supervision of the Ministry need to be brought under ARCN.
- The regulatory function for FCAs lies with the National Board for Technical Education. These are in the areas of curriculum development and implementation, accreditation, and award of certificates. Unfortunately, National Board for Technical Education is under the Federal Ministry of Education and does not focus on policies that key into strategic issues in the agriculture sector. ARCN has no input in the design of FCAs' curriculum.
- The proposed reform should recognize FCAs' research funding needs, as FCAs' research is a very important requirement for promotion of academic staff and could play a major role in the research-extension continuum.
- Staff are expected to focus on extension duties following graduation. Training in key and emerging extension methodologies should form the new paradigm of their training, such as e-extension techniques, Adopted Villages, Innovation Platforms, technology transfer methodologies, and management of Technology Transfer Centers. This category of diplomats could form the core extension agents in the reformed national research and extension platform as currently conceptualized.

In addition, FCAs will be important for strengthening the Adopted Villages and hosting establishment of the Agricultural Research Technology and Innovation Transfer Centers. This is also applicable to the State Colleges of Agriculture, which could drive agricultural extension needs at the state level. Ownership of FCAs was addressed in the FCA Bill. As is the case with universities, Colleges of Education, and Polytechnics, FCAs need a common regulatory body under the FMARD. This is very important given the need to ensure that FCAs deliver their mandate in line with Nigeria's agricultural policies. By so doing, federal, state, and private colleges of agriculture will be better regulated.

Funding Mechanisms

As mentioned earlier, it is imperative that NARS be very well funded in a secure and sustainable way. Therefore, the primary financing mechanism is establishment of the NAREF, into which 1 percent of the duties on imported agricultural commodities will be paid. The fund will be used exclusively to finance the research programs of ARCN, while costs of personnel, overhead, and physical capital will continue to be provided for in the appropriation act. ARCN and its institutes can mobilize financial resources to support a research program approved by ARCN or the institutes' management. In such cases, the relevant Deputy Executive Secretary should be duly notified and other necessary administrative processes will apply. Some specific domains for funding are highlighted below:

DOMAIN 1: CONCEPTS IN RESEARCH AND DEVELOPMENT (R & D) FUNDING

Over the years, it has been shown that agricultural research spending in Nigeria usually increases largely because of higher salary levels, without real investments in the rehabilitation of research infrastructure and equipment. Stakeholders indicated that the budget process can be complex and lacking in transparency. NARIs confirmed marked disparities between the provisions of the final approved budgets and those requested by the institutes. They also confirmed that funds are often delayed for long periods, and shortfalls in funding disbursements are common. Thus, funding of R&D by the federal government must be addressed in view of its critical role in the scientific transformation of agriculture, particularly in terms of value-chain development.

A sustainable strategy must be put in place to address how an adequate pool of funds can be mobilized, as well as strategies for effectively managing and disbursing research funds. A first step is to understand that the agricultural research priorities must change as economic growth occurs. This is on the plank that NARIs currently suffer low and unstable investment in agricultural research, especially as private sector research funding is negligible. In line with CAADP, the government committed to spend 10 percent of budget on agriculture and one percent of GDP on agricultural R&D.

We propose a study to develop a strategy for the development of a financing mechanism that is stable based on: a sound agricultural development program; transparency and probity; clearly defined responsibilities for all partners; market orientation; effective communication; funding; and partnerships. The funding would require a paradigm shift in government research spending priorities. The introduction of Intellectual Property/Plant Breeder's Rights (PBR) legislation can catalyze this institutional shift and better cooperation with private companies/institutions to avoid competition. An agricultural funding consortium should be set up, consisting of ARCN and its NARIs (Crop Industry Development Fund; Livestock Industry Development Fund; Poultry Association of Nigeria; Maize Breeders Association; All Farmers Association of Nigeria; NACCIMA; and Rice Growers Association). These organizations will partner to create a unanimous approach for agricultural R&D funding. Federal legislation is required to permit public funds to flow to these organizations.

A matching investment initiative should be created whereby ARCN provides research resources for up to 50 percent of the cost of a project when matched by private firm and industry group investments in research. Matching grant

schemes are used to mobilize financial support for states, zones, and districts/local governments with peculiar and specific regional problems. Another recommendation is to set up spin-off companies for private investment that will generate funds to ensure project continuity and service development of new initiatives based on innovation platforms.

DOMAIN 2: STRATEGIC FINANCING MECHANISMS

ARCN needs to expand its sources of funding and avoid reliance solely on the government. Sources and mechanisms for allocating research funds among agents/institutions include: competitive grant schemes from government and international donors based on research proposals; research contracts with the private sector and farmers unions; formula/block grant allocations; coordinated research projects; special crop related funds; multinational funds; grants for young scientists; grants for mentoring; grants to put innovation to use; sponsored research projects; an endowment fund for agricultural research; co-financing; commercialization of research results; and internally supported strategic grants and trust funds. These sources will provide sustainable funding to Nigeria's NARS.

DOMAIN 3: BUILDING PARTNERSHIPS

The three major R&D providers are the federal government (ARCN/NARS), states, and the private sector. They should sign an MOU with the intent to link resources within the food and agriculture sector and work together for the collaborative management and delivery of agriculture, agro-food, and agro-industrial programs. The report suggests building partnerships at four different levels:

- International partnership – An international strategy to mobilize additional investment in agricultural research and extension is desirable despite cogent beliefs that the national government should bear the full cost of agriculture research as a public good. A list of international agencies and development partners, their areas of interest, and contacts should be available to all institutes. An international matching budget support facility for national agricultural research and extension, for example, would be substantially more equitable. Last, partnering with industry and government to leverage core budget is essential in building international partnerships.
- Partnership with states and regional initiatives – The reform suggests emphasis on comparative advantage and attention to localized problems to drive state governments to promote the establishment of special research centers.
- Partnership with the private sector –The reform encourages partnering with industry and government to leverage core budget with a view to accessing more funds from the private sector. Additionally, the reform suggests matching/counterpart funding on agreed terms to solve some critical problems affecting the industry.
- Partnership with national agencies –The reform propagates national agencies to promote agricultural research to avoid duplication and promote interagency collaboration with NUC, the National Biotechnology Development Agency, the Raw Material Research Development Council, the River Basin Development Authorities (RBDAs), and other ministries. An investment target of 2 percent of agricultural GDP in agricultural research and extension combined would be a reasonable and defendable target, bringing actual agriculture sector growth closer to its potential growth.

DOMAIN 4: COORDINATION OF AGRICULTURAL RESEARCH FUNDS

The justifications for the centralized approach to financial management are many but do not preclude some inflows at local levels that should be communicated widely. These include: stabilization of funding to research through time-based releases; better planning and implementation strategies; lower level of duplication; better networking with the private sector and development partners; and promotion of better collaborative approaches. ARCN should maintain central coordination of all research funds and designate budget lines for all projects. All NARIs should designate budget lines for research projects and maintain decentralized project implementation. NARIs should forward a comprehensive list of all ongoing projects with details of funding sources to ARCN. And finally, ARCN should strengthen the Donor Secretariat for effective research fund drives, the maintenance of a databank to coordinate donor contributions, and to improve information flow on agricultural research activities.

In summary, ARCN should develop a strategy to ensure a natural progression from publicly funded research to a blend of privately and publicly funded strategies. It is important to: increase access to investment from both sectors to achieve targets; set up an all-inclusive, participatory, and highly technical group of experts to harmonize both core budgetary funds and other finance sources; and maintain a more stabilized inflow of funds for research.

Cost-Benefit Analysis

Typically cost-benefit analysis requires careful measurement of the streams of costs and benefits of a project. The streams are discounted to obtain their present values. The ratio of benefits and cost is thereafter calculated to facilitate

decision on implementation of the relevant project. Cost-benefit analysis is also quite useful in choosing the most cost-effective approach to implementing a project.

Against this background, a detailed quantitative cost-benefit analysis of the proposed reform of ARCN is not feasible at this stage. First, several elements of the costs, especially personnel costs are difficult to project into the future. It is anticipated that there will be significant increase in cost if the recommendation that the conditions of service of staff of NARIs and FCAs should not be inferior to those of the universities. Second, the proposed reform requires significant increases in capital expenditure to upgrade and modernize research equipment and other physical infrastructure. Finally, there should be major and sustained increases in financial resources required for executing the research programs. This section presents budget projections based on the real GDP estimates using the assumptions given below.

An analysis of the budgetary allocation to NARIs and ARCN between 2010 and 2013 shows the ratio of agricultural R&D to GDP as less than 1 percent (Table 3). This number fell consistently from 2010 to 2013. The proposed ARCN reform will clearly require a major increase in budgetary allocation and release to ARCN and its institutes.

Table 3—Ratio of Agricultural R&D to GDP, 2010-2013, percent

Year	2010	2011	2012	2013
Ratio of agricultural R&D to GDP	0.66	0.55	0.43	0.44

Moreover, in line with the research functions and programs described above, considerable resources should be made available to ARCN to implement the NARP, Competitive Agricultural Research Grants, and various institutional and human capacity-building initiatives described above. Accordingly, while the total allocation to NARIs should increase significantly, there should be a major increase in budgetary allocation to ARCN to enable it support NARS. ARCN will also effectively manage, coordinate, and supervise NARIs' activities, thereby enabling it to effectively mobilize national research capacities in the entire NARS and direct them to areas necessary to increase agricultural productivity, output, employment, income, and foreign exchange earnings. In addition, this will ensure that NARS: contributes to economic diversification by supplying agricultural raw materials to industries; promotes food security; reduces import of food and agricultural raw materials; and increases export of processed agricultural commodities. Therefore, the relatively miniscule and declining allocations to ARCN should be reversed. Table 4 gives the allocation for ARCN as part of the total allocation to NARIs in Nigeria.

Table 4—Share of ARCN in Total Budgetary Allocation to Agricultural Research Institutes, 2009-2013, percent

Year	2009	2010	2011	2012	2013
Share in Budget	4.02	6.64	5.53	4.29	4.41

In the first five years, it is proposed that at least 2.5 percent of GDP should be allocated to agricultural R&D for NARS to support the avowed roles of the agriculture sector in the Nigerian economy as articulated in Vision 2020. The allocation for each year is shown in Table 5. The calculations assume that Nigeria has a real GDP growth rate of 6 percent in 2016; 8 percent in 2017; and a sustained growth of 10 percent between 2018 and 2020. Further, we assume that the country has a stable inflation rate and at least 1 percent of nominal GDP is allocated to agricultural research.

Table 5—Proposed Budgetary Allocation to ARCN and NARIs, Nigerian Naira

Year	2016	2017	2018	2019	2020
Real GDP	74,029,000	79,952,000	87,947,000	96,741,000	106,416,000
Nominal GDP	98,164,000	106,017,000	116,619,000	128,281,000	141,109,000
ARCN & NARI's budgetary allocation	982,000	1,060,000	1,166,000	1,283,000	1,411,000

Source: Authors' computations based on nominal and real terms projected GDP for Nigeria.

According to this, the annual costs of the proposed reform will be covered by the federal government for 2016–2020. It must be stressed that this does not include the proceeds of the NAREF, proposed to be 1 percent of duties on agricultural imports and exports. While it is difficult to provide quantitative estimates of the benefits, it can be assumed that if the proposed reform is effectively implemented, agricultural productivity will improve significantly. Our projections suggest that Nigeria will become: food secure by 2020; a net exporter of processed agricultural commodities; a leading sophisticated African economy, having successfully diversified its economic base away from oil into modernized agriculture and agricultural processing; and successful in developing an agriculture sector that will generate decent paid jobs and help reduce poverty and inequality, especially rural-urban inequality.

As mentioned earlier, a mid-term review of the performance of the reform process should be conducted, at which time adequate data should be available to support a comprehensive, rigorous cost-benefit analysis.

6. LEGAL FRAMEWORK

All stakeholders and development partners raised concerns about the need to restructure ARCN for the onerous task of planning, organizing, directing, and more particularly, managing all government-funded research station networks and programs. It was thus necessary to review the ARCN Act vis-à-vis the outcome of field studies, submission of opinion via the questionnaires, and views expressed at meetings. The draft ARCN Bill, among other things, contributed to development of the agricultural research sector, as it:

- set the pace for the understanding of the reform processes
- helped restructure the Council at all critical levels
- reformulated the composition of ARCN's human resources base for effective service delivery, and
- established an ARCN envisioned as an effective managing institution that enjoys sufficient independence with secured ability to administer research institutes in Nigeria.

Review of ARCN Act

Very critical sections of the ARCN Act were addressed to provide the necessary impetus for the reform process. A brief note on each relevant section of the Act and the recommendations that ensued are presented next.

SECTION 2

(a) This section deals with the membership of the GB, which is envisaged as a lean GB with appropriate capacity and representation from stakeholders. The section suggests that the GB should effectively drive ARCN's policy agenda and ensure that required leadership is provided.

(b) This is a deviation from the political representatives as part of the GB.

Recommendation

(i) The Chairman is expected to be a professor of any field of agricultural science; the Permanent Secretaries of two key Ministries are now on board; i.e., Agriculture and Rural Development and Trade, Industry and Investment.

(ii) The private sector is now represented while specialized academic representation of certain important areas (e.g., crops, livestock, and fisheries) is inadequate.

SECTION 4

(a) The members of the ARCN GN are expected to be paid remuneration and allowances.

(b) This has had colossal effect on the lean resources of ARCN, restraining its ability to carry out activities that impact implementation of ARCN's mandate.

Recommendation

(i) Provide for the payment of only sitting allowances as approved by the federal government.

SECTION 5

Deals with ARCN's functions.

(a) The disconnect that currently exists between ARCN and university-based agricultural research institutes and FCAs plays a critical role in the value chain and align with ARCN functions.

Recommendation

(i) The provision of powers for ARCN to be involved in an advisory role in the appointment of Directors of university-based agricultural research institutes should be inserted in the Act.

(ii) ARCN should be empowered with responsibility to prescribe and give policy direction to FCAs in development of their strategies on training, extension activities, and provision of middle-level manpower for the sector.

SECTION 6

The Executive Secretary and other ARCN staff.

(a) This is the nucleus of ARCN. A non-aligned and inadequately motivated workforce could lead to failure in a short period of time. In preparation for the task ahead, a new structure is being proposed. This should enhance its output.

Recommendation

(i) The ARCN GB should have the ability to appoint, with approval of the Minister, three DESs and such other number of DESs and Assistant ESs as it may deem necessary for implementing the new responsibilities of ARCN.

(ii) The necessary academic skills and managerial experience required are also specified.

SECTION 7

Application of the Pension Reform Act, 2004.

(a) As a prerequisite to sustain the new and improved human resources of ARCN, it is important to ensure that the conditions of service prevent brain drain to universities and other tertiary institutions, and encourage the interflow of human resources.

Recommendation

(i) Remove the application of general civil service conditions of service to ARCN staff.

(ii) Specify clearly that the conditions of service (that is, pensions, retirement, and gratuity benefits) enjoyed by persons holding equivalent grades in universities shall be applicable to ARCN staff.

SECTION 8

Establishment of the National Agricultural Research and Extension Fund (NAREF).

(a) This endowment fund is expected to be applied to the financing of research as part of ARCN's core functions.

(b) ARCN's lean resources have hampered its output. Given the global recession, the ripple effect of insufficient funds will remain.

(c) To complement the output of the research institutes, including ARCN, provision should be made by fiscal pronouncement of the government discouraging the import of agricultural produce by increasing import tariffs on such goods and services and supporting ARCN with the allocation of a part of the import duty to the NAREF for further necessary action.

Recommendation

(i) One percent of import duty paid on agricultural imports should be credited to the NAREF.

SECTION 8

Insertion of new Part V1.

(a) In view of the disconnect between ARCN and FCAs, the need to provide for proper placement of FCAs within the reformed sector cannot be overemphasized.

Recommendation

(i) Empower the Minister of Agriculture to establish FCAs with the approval of the President.

(ii) Provide resources for improving existing FCAs under the ARCN Act.

(iii) The staff of existing FCAs are deemed as ARCN staff for purposes of career progression.

SECTION 17

Savings of certain research institutes.

(a) In view of the need to pull all available human resources to address the gaps within the sector, it is imperative that all staff of research institutes be pulled under ARCN control and management for effectiveness.

Recommendation

(i) The National Agricultural Research Institutes Act 1964 and Research Institutes (Establishment, etc.) Order1975 should be repealed.

(ii) The institutes established under the Act and Order are deemed to have been established under the ARCN Act.

(iii) Staff are transferred as staff of ARCN for purposes of career progression.

FIRST SCHEDULE

Committees of the GB

(a) With the enriched capacity of ARCN management and staff, it is important for the GB to have a standing science and technical research committee.

Recommendation

(i) This committee will be charged with responsibility of advising the GB and ARCN on research and innovation matters.

SECOND SCHEDULE

GBs of research institutes.

(a) In view of the multiplicity of NARI GBs and the desire to have all staff pooled under ARCN, the need for individual GBs in NARIs is superfluous.

(b) Repeal the NARIs Act 1964 and the Research Institutes.

(c) Order 1975, the retention of paragraph 1(1) and (2) of the Schedule becomes unnecessary.

Recommendation

(i) Delete paragraph 1(1) and (2).

(ii) Provide the ARCN GB of and ARCN with responsibility for NARIs.

INSERTION OF NEW THIRD SCHEDULE

(a) No legislation currently backs the establishment of FCAs, despite major steps taken to streamline the mandate of FCAs with ARCN.

Recommendations

(i) Provide for ARCN to give policy directions to FCAs.

(ii) Properly enshrine establishment of FCAs in the ARCN Act.

(iii) List FCAs in a new Third Schedule to the Act.

7. IMPLEMENTATION OF THE TRANSFORMATION PROCESS

The main process of transformation of ARCN is expected to be gradual but geared to continuously adjust to changes in Nigeria's national development goals, while being regularly aligned with the international development paradigm. The overall process will be geared to build:

- An institution that can foresee and incorporate new principles, values, and approaches
- Institutions that are less dependent on public money and satisfy all the major conditions for governability
- Greater efficiency to deliver benefits to the larger society
- Conceptual, organizational, administrative, and structural capacity to conceive and carry out plans, priorities, and strategies accepted by most segments of the society.

The process must therefore be guided by an organizational behavior with an open posture for change that: places a high value on the intelligence and creativity of staff; conducts regular monitoring of the external environment and effectiveness of satisfying public demands; has a strong commitment to the future; and can manage conflicts and resistance through technical and political negotiations.

A phased approach projected over a two-year period and beginning with ARCN is proposed. The major steps are to: review internal documents; develop scenarios for future agricultural research; form a Secretariat for Strategic Management; define guiding principles for the change process; publish and influence discussions in the NARS environment; organize seminars; provide training in strategic planning; formulate baseline strategic plans; evaluate institute and Research Center plans with relevant stakeholders; formulate a condensed strategic plan and evaluate its consistency with international partners; conduct political negotiation with relevant authorities; and implement the strategic changes.

8. CONCLUSIONS

Many developing nations reformed their NARS with very satisfactory results for their economies. Nigeria should not be an exception, especially as the country is mobilizing to address persistent poverty, youth unemployment, and declining revenue from other sectors. The strategy proposed in this report will ensure stable planning and implementation of reforms; national cohesion in NARS and restored confidence of donors and partners; avoidance of duplication and building of synergy among scientists; and more stabilized inflow of funds for research.

The ARCN GB should review the existing organizational structure in line with the proposed reform and thus begin a transitional process by determining a new organogram. Meanwhile, ARCN's budgeting process needs to be reviewed by the Committees on Agriculture of the National Assembly and the budget office of the Federation in line with its structure as a single system with a secretariat driving the operations of the constituent institutions. In addition, the capital aspect of the budget of the institutions needs a reclassification to reflect physical, administrative, and program components to enhance increased funding toward core research programs and projects.

The reform of ARCN into a more responsive organization will enhance the efficiency and effectiveness of Nigeria's NARS. The reform process will restructure ARCN and strengthen it through appropriate legal and administrative instruments to sustainably support the repositioning of agriculture as a driver of economic growth. The reform intends to:

- Increase the administrative system's effectiveness and efficiency;
- Increase research focus, coordination, and budget allocation;
- Create a balanced distribution of projects between institutions, leveraging synergy and reducing duplication;
- Increase research impact for end users;
- Ensure greater autonomy in decision making;
- Improve budget distribution and long-term research planning;
- Increase clarity in definition of legal parameters of agricultural research;
- Reduce researcher turnover;
- Better equip, train, and remunerate researchers;
- Create a centralized knowledge management system;
- Improve branding, advocacy, and lobbying with government and private institutions; and
- Improve visibility of research results and technologies.

ARCN headquarters will essentially be strengthened mostly from the top by competent, highly qualified, experienced staff to support the new structure and current staff at headquarters. The reform aims to enhance salaries and conditions of service to better compete with universities. Further, it intends to improve funding for headquarters, which will translate to more effective M&E of research programs, using highly qualified staff as team leaders. This will give staff better opportunities to understand the operations of institutes and colleges, and to build capacity through post-graduate training and short-term courses (locally and overseas). The human resource capacity of headquarters will increase, along with the expected role of accommodating relevant offices of international organizations. The reform proposes moving staff with adequate qualifications and experience to other research institutes or FCAs that have vacant positions. Last, the reform aims to enhance opportunities for staff to be more engaged in international activities through sponsored representation, with the Secretariat serving as the single entry point for such collaborations.

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ANNEXES

Annex 1: List of Agricultural Research Universities in Nigeria

University	Location	State	Zone
University of Ibadan	Ibadan	Oyo	SW
Obafemi Awolowo University	Ife	Osun	SW
University of Nigeria	Nsukka	Enugu	SE
Ahmadu Bello University	Zaria	Kaduna	NC
University of Lagos	Lagos	Lagos	SW
University of Benin	Benin City	Edo	SS
University of Calabar	Calabar	Cross River	SS
University of Maiduguri	Maiduguri	Borno	NE
Usman Dan Fodio University	Sokoto	Sokoto	NW
University of Ilorin	Ilorin	Kwara	NC
Federal University of Technology, Owerri	Owerri	Imo	SE
Federal University of Technology, Akure	Akure	Ondo	SW
Federal University of Technology, Minna	Minna	Niger	NC
Abubakar Tafa Balewa University	Bauchi	Bauchi	NE
Federal University of Technology, Yola	Yola	Adamawa	NE
Federal University of Agriculture, Abeokuta	Abeokuta	Ogun	SW
Federal University of Agriculture, Makurdi	Makurdi	Benue	NC
Federal University of Agriculture, Umudike	Umudike	Abia	SE
Nnamdi Azikwe University of Technology	Awka	Anambra	SE
University of Uyo	Uyo	Akwa-Ibom	SS
Ladoke Akintola University of Technology	Ogbomoso	Oyo	SW
Ogun State University	Ago-Iwoye	Ogun	SW
Edo State University	Ekpoma	Edo	SS
Delta State University	Abraka	Delta	SS
Rivers State University of Science and Technology	Port Harcourt	Rivers	SS
Abia State University	Uturu	Abia	SE
Imo State University	Owerri	Imo	SE
Enugu State University	Enugu	Enugu	SE

Annex 2: ARCN Operational Plan – Logical Framework

Narrative Summary	Basis for Verifiable Outcome Indicators	Means of Verification	Assumptions
General Objective Sustainable broad-based agricultural growth and development established	1. Reduction in the importation of agricultural products 2. Increases in agricultural GDP 3. Commercialization of agriculture [provisional]	• Central Bank of Nigeria • Nigeria Customs • National Bureau of statistics • Nigerian Investment Promotion Council	Not applicable at this level
Specific Objective Agricultural productivity, competitiveness and markets sustainably improved	1. Increases in the volume/value of agricultural exports 2. Stable market prices for domestic agricultural products 3. Increases in the quality of agricultural products	• National Institute of Social and Economic Research • Nigerian Export/Import Bank • Export Promotion Council • Central Bank of Nigeria • Nigeria Investment Promotion Council • National Bureau of Statistics • Standard Organization of Nigeria • National Agency for Food and Drug Administration and Control	1. Adequate political stability and commitment exists and is maintained at the appropriate level of govern 2. Macro-economic environment is supportive of benefits gained 3. Appropriate national, subregional and internal trade policy and agreements are supportive 4. Relevant existing policy/law is supportive and effectively enforced 5. Appropriate levels/quality of public and private sector governance exists 6. Adequate levels of industrial growth exist to support benefits gained

Narrative Summary	Basis for Verifiable Outcome Indicators	Means of Verification	Assumptions
			7. Biodiversity loss and environmental degradation does not adversely influence gains 8. Morbidity and mortality due to HIV/AIDS, TB and malaria to not adversely affect gains or benefits
Results 1. Demand-driven agricultural technologies generated and innovation promoted	1.1 Affordability/availability of agricultural products 1.2 Increased quantity and quality of agricultural products 1.3 Increased level of adoption of technologies	• Annual Reports of ARCN Secretariat, Institutes and FCA • Reports of the ARCN GB • External Evaluation Reports • Nation Institute of Social and Economic Research • Nigerian Export/Import Bank • Export Promotion Council • National Bureau of Statistics • Donor Reports	1. Adequate political and economic stability and commitment exists and is maintained at the appropriate level of government 2. Adequate incentive packages at macro-economic level 3. Agro-inputs are available and affordable for farmers 4. Soil and water management is developed to appropriate levels on a national basis 5. Farmer mechanization and food production infrastructure exists at appropriate levels 6. Existing, supportive policies and laws for market development and agricultural growth are enforced or implemented 7. Morbidity and mortality due to HIV/AIDS, TB and malaria to not adversely affect gains or benefits
Results 2. Appropriate policy options for agricultural growth formulated and made available	2.1 Access/affordability of agricultural inputs and services 2.2 Increase in new and revised agricultural policies and laws 2.3 Improved access to agricultural land		
3. Agricultural research, training and extension system strengthened	3.1 Improved performance of human resources and physical infrastructure 3.2 Improved quantity/quality of stakeholder interactions 3.3 Improved ability to attract external support and resources		
3. Agricultural knowledge management system established	4.1 Improvements in capacity of ARCN to respond effectively to demand for information 4.2 Increased demand for, and use of, information and knowledge 4.3 Evidence of increased successful use of information and knowledge		

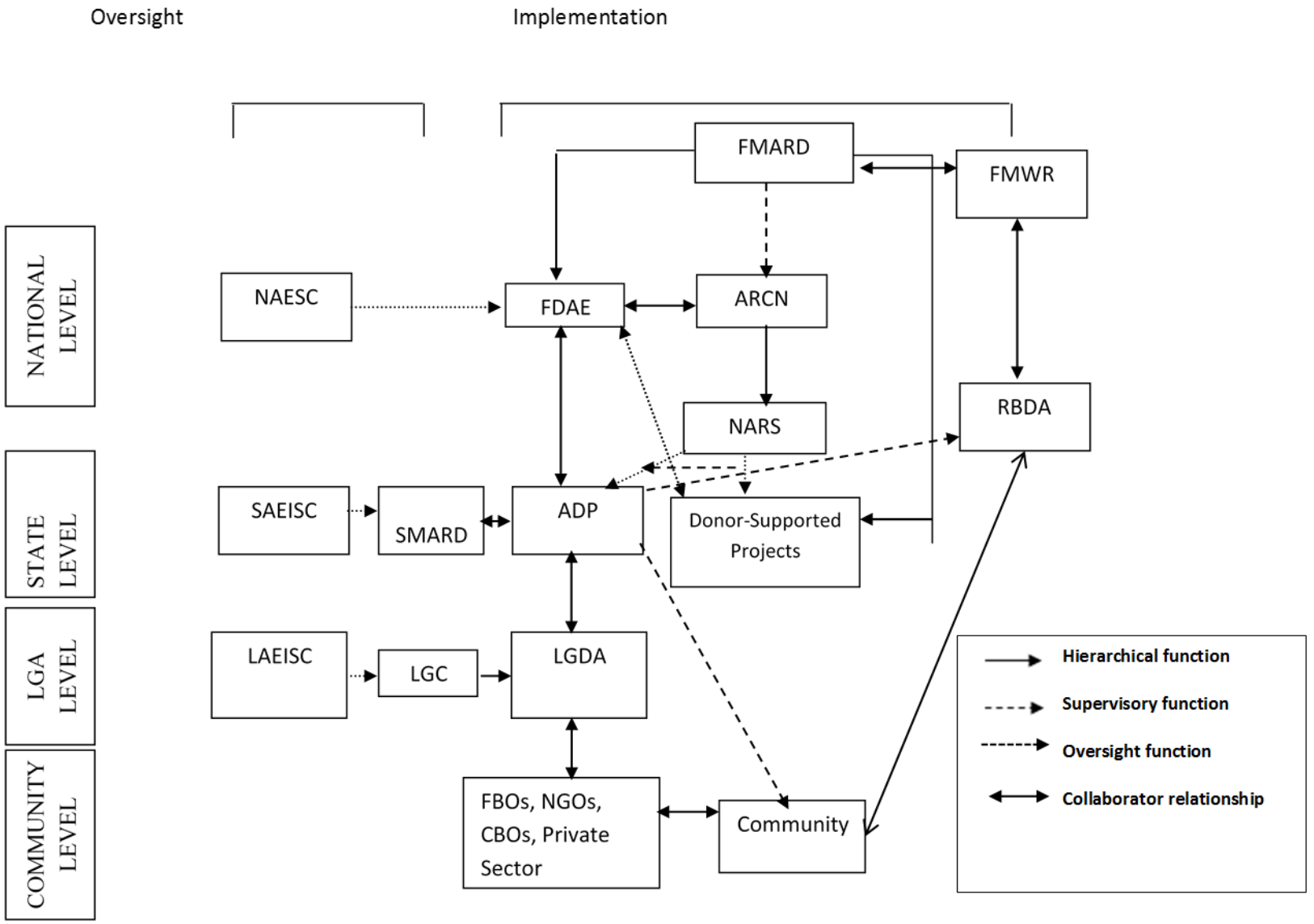
Annex 3: National Research Institutes and Federal Colleges of Agriculture

	Institute	Mandate commodities	Outstations	Geopolitical Zone	Level of economic importance	Proposed additional locations
1	National Cereals Research Institute (NCRI), Badeggi, Bida, Niger State	Rice; Soya bean; Beniseed; Sugarcane		North Central	Soya bean; Sugarcane	Northeast
2	National Root Crops Research Institute (NRCRI), Umudike, Umuahia-Ikot Epkene Road, Abia State	Cassava; Yam; Coco-yam; Irish potato; Sweet potato; Ginger; Turmeric	Igbariam (Anambra State); Otobi (Benue) Vom (Plateau) Kajuru (Kaduna); Iresi (Osun) Gassol (Taraba)	Southeast	Potato; Ginger	North Central; Northeast
3	National Horticultural Research Institute (NIHORT) Ibadan, Oyo State	Fruits; Vegetables; Flowers; Ornamental plants		Southwest	Fruits	North Central
4	Lake Chad Research Institute (LCRI), Gamboru-Ngala Road, Maiduguri, Borno State	Millet; Wheat; Barley; Massakwa sorghum		Northeast		
5	Institute for Agricultural Research & Training (IAR&T), Moor Plantation, Ibadan, Oyo State	Kenaf; Jute; Soil and water management	Ibadan, Kishi, Ilora (Oyo State); Ife (Osun State); Ballah (Kwara State); Ikenne (Ogun State); Amakam (Abia State); Mokwa (Niger State)	Southwest		
6	Institute for Agricultural Research (IAR), Ahmadu Bello University, Samaru, Zaria, Kaduna State	Sorghum; Groundnut; Cowpea; Cotton; Sunflower	Kano (Minjibir); Kadawa Talata-Mafara (Zamfara State)	Northwest	Cotton	
7	Cocoa Research Institute of Nigeria (CRIN), Idi-Ayunre, Ibadan, Oyo State	Cocoa; Cashew; Tea; Coffee; Kola		Southwest	Cocoa; Tea	Northeast
8	Rubber Research Institute of Nigeria (RRIN), Iyanomo, Sapele Road, Benin city, Edo	Para-rubber; Gum arabic; Latex	Akwete substation, Abia state; Gashua gum Arabic substation, Yobe state; Manchok station, Kaduna state; Igbotako station, Ondo state	South South	Gum-arabic	Northeast
9	Nigeria Institute for Oil Palm Research (NIFOR), Benin-Akure Road, Benin City, Edo State	Palm Oil; Raphia; Date palm; Ornamental palm; Coconut; Shea tree	Abak, Badagry, Dutse, Onuebum, Acharu, Agbarho, Otegbo, Onishere, Ubiaja, Umuabi, Darazo, Nsukka, Ago-emokpae, Wamba, Usen, Obotme	South South	Date palm	Northwest
10	National Veterinary Research institute (NVRI), Vom-Jos, Plateau State	Animal health; Drug development; Vaccine production	All states of the federation	North Central		
11	National Animal Production Research Institute (NAPRI), Shika, Zaria, Kaduna state	Dairy production; Beef production; Small ruminant; Swine; Poultry; Pig; Rabbitry; Pasture and grassland research	Talata Mafara; Ubiaja; Oturkpo; Gwada; Zangon Kataf	Northwest	Dairy, Beef, Swine, Poultry	North Central; Southeast; Southwest
12	Nigeria Institute for Oceanography and Marine Research (NIOMR), Victoria Island Lagos, Lagos State	Marin water fish species; Brackish water fish species and resources; Oceanography	Badore (Lagos), Badagry (Lagos), Sapele (Delta), Aluu (Rivers), Buguma (Rivers)	Southwest	Brackish fish	South South
13	National Institute for Freshwater Fisheries Research (NIFFR), New Bussa, Niger State	Freshwater fish species	Tiga, Maiduguri, Dadinkowa, Owerri, Asaba, Agenebode, Yauri-Yelwa	North Central		
14	Nigeria Stored Products Research Institute (NSPRI), Asa Dam Road, Ilorin, Kwara State	Food storage technology; Post-harvest technology		North Central		
15	National Agricultural Extension Research and Liaison Services (NAERLS) Ahmadu Bello University, Samaru-Zaria, Kaduna State	Extension; Technology transfer; Training		Northwest		

Annex 4: Federal Colleges of Agriculture under ARCN

	Name of College	Mandate
1	Federal College of Agriculture Akure, Ondo State	Training of middle-level manpower in Agriculture, Agricultural Business, Crop Production, Crop protection & Agricultural Engineering at both National and Higher National Diploma including Certificate and Vocational Training
2	Federal College of Agriculture Ibadan, Oyo State	Training of middle-level manpower in Agriculture, Agric Business, Crop Production, Crop Protection & Agricultural Engineering at both National and higher National Diploma including certificate and Vocational Training
3	Federal College of Agriculture Ishiagu, Ebonyi State	Training of middle-level manpower in Agriculture, Agric Business, Crop Production, Crop Protection " and Agricultural Engineering at both National and higher National Diploma including Certificate and Vocational Training.
4	Federal College of Animal Health and Production Technology, Ibadan, Oyo State	Middle-level manpower training in animal production and health at Certificate, National and Higher National Diploma and Vocational Training
5	Federal College of Animal Health and Production Technology, Vom, Plateau State	Middle-level manpower training in animal production and Health at Certificate, National and Higher National Diploma and Vocational Training
6	Federal College of Freshwaters Fisheries Technology, New Bussa, Niger State	Training of middle-level manpower at Vocational, Certificate, National and Higher National Diploma in Fisheries Production, Aquaculture, Nutrition, Agric Extension and Management.
7	Federal College of Freshwater Fisheries Technology, Baga, Borno State	Training of middle-level manpower at Vocational, Certificate and National Diploma in Fisheries and Aquaculture
8	Federal College of Fisheries and Marine Technology Lagos, Lagos State	Training of middle-level manpower at National Diploma in Marine Engineering and Nautical Sciences, Fisheries and Aquaculture
9	Federal College of Veterinary and Medical Laboratory Technology, Vom, Plateau State	Training of middle-level manpower in Veterinary & Medical Laboratory Sciences for National Diploma and Associate, Institute of Medical Laboratory Technology
10	Federal College of Agricultural Produce Technology Kano, Kano State	Training of middle-level manpower in Agriculture Technology, Produce & Storage Technology and Agricultural Engineering at Vocational & Certificate levels.
11	Federal College of Horticulture, Dadin Kowa, Gombe State	Training of middle-level manpower at Certificate and Vocational levels in Horticulture and Landscaping Technology.

Annex 5: Organogram for Agricultural Extension in Nigeria



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