

**Instability of National Agricultural
Research Systems
in Sub-Saharan Africa:**

Lessons from Nigeria

The International Service for National Agricultural Research (ISNAR) assists developing countries in bringing about lasting improvements in the performance of their national agricultural research systems and organizations. It does this by promoting appropriate agricultural research policies, sustainable research institutions, and improved research management. ISNAR's services to national research are ultimately intended to benefit producers and consumers in developing countries and to safeguard the natural environment for future generations.

ISNAR offers developing countries three types of service, supported by research and training:

- For a limited number of countries, ISNAR establishes long-term, comprehensive partnerships to support the development of sustainable national agricultural research systems and institutions.
- For a wider range of countries, ISNAR gives support for strengthening specific policy and management components within the research system or constituent entities.
- For all developing countries, as well as the international development community and other interested parties, ISNAR disseminates knowledge and information about national agricultural research.

ISNAR was established in 1979 by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force. It began operating at its headquarters in The Hague, the Netherlands, on September 1, 1980.

ISNAR is a nonprofit, autonomous institute, international in character and apolitical in its management, staffing, and operations. It is financially supported by a number of the members of the CGIAR, an informal group of donors that includes countries, development banks, international organizations, and foundations. Of the 16 centers in the CGIAR system of international centers, ISNAR is the only one that focuses specifically on institutional development within national agricultural research systems (NARS).

ISNAR's Research Report series presents the findings of research conducted by the institute and its partners in the areas of agricultural research policy.

ISNAR's Research Report series presents the finding of research conducted by the institute and its partners in the areas of agricultural research policy

**Instability of National Agricultural
Research Systems
in Sub-Saharan Africa:**

Lessons from Nigeria

Copyright © 1997 by the International Service for National Agricultural Research.
All rights reserved
ISNAR encourages the fair use of this material. Proper citation is requested.

About the Author

Francis S. Idachaba, Senior Research Fellow at ISNAR, is on leave of absence from the University of Ibadan where he has taught since 1972 and has been Professor of Agricultural Economics since 1981. He was Pioneer Vice-Chancellor, University of Agriculture, Makurdi, Nigeria, 1988-95, and Pioneer Board Chairman, National Agricultural Land Development Authority (NALDA), 1991-93. Most recently, he served as Chairman, External Program and Management Review Panel, Special Program for African Agricultural Research (SPAAR), c/o World Bank, Washington, July-October 1997. In January 1998, he won ISNAR's Outstanding Performance Award for 1997.

Citation

Idachaba, F.S. 1997. Instability of National Agricultural Research Systems in Sub-Saharan Africa: Lessons from Nigeria. ISNAR Research Report No. 13. The Hague: International Service for National Agricultural Research

AGROVOC Descriptors

agriculture; research; research institutions; management; public sector; financial policy

CABI Descriptors

agricultural research; research institutes; management; public sector; agricultural financial policy

ISSN 1021-4429
ISBN 92-9118-037-8

Contents

Foreword	ix
Acknowledgements	xi
Abstract	xiii
Acronyms	xv
Executive Summary	xvii
1. Introduction	1
Objectives of Study	3
2. The Meaning of NARS Instability	7
Policy Instability	7
Institutional Instability	8
Program Instability	9
Funding Instability	10
A typology of NARS funding instability	11
Uncertainty caused by NARS funding instability	12
Consequences and implications of NARS funding instability	12
Implications of NARS funding instability	13
Implications of analysis for donor funding of NARS	15
Delays in disbursement of budget funds	17
Research Staff Instability	18
A typology of NARS research staff instability	18
Uncertainties created by research staff instability	20
The consequences of research staff instability	21
Research Governance Instability	21
3. Empirical Analysis of NARS Instability	23
Introduction	23
Choice of Nigeria for phase 1 case study	23
Nigerian NARS: An Overview	23
Institutional Instability	28
Consequences of institutional instability	33
Why the high institutional instability?	44
<i>Colonial roots of institutional instability</i>	44
<i>Political instability</i>	45
<i>Lack of sociopolitical consensus</i>	45
<i>Failure of stakeholders</i>	45

Funding Instability	45
<i>Instability of budget allocations</i>	47
<i>Instability of actual fund disbursements</i>	57
<i>Has instability in actual fund disbursements increased over time?</i>	57
<i>Agricultural research expenditures instability</i>	60
Instability of Personnel Costs, Operating Costs, Maintenance Costs, Training Costs and Capital Costs	60
Delays in Disbursement of Budget Funds	66
Two Illustrative Examples	67
<i>National Cereals Research Institute (NCRI)</i>	67
<i>Rubber Research Institute of Nigeria (RRIN)</i>	72
Summary of delays in fund disbursement	73
Agricultural Research Staff Instability	76
The First Generation Research Institutes	78
West African Institute for Trypanosomiasis Research (WAITR)/ Nigerian Institute for Trypanosomiasis Research (NITR)	78
West African Cocoa Research Institute (WACRI), Ibadan Substation	80
Cocoa Research Institute of Nigeria (CRIN)	80
West African Institute for Oil Palm Research (WAIFOR)	80
Federal Institute for Industrial Research (FIIRO)	81
Institute for Agricultural Research (IAR)	81
The Second Generation Research Institutes	81
National Cereals Research Institute (NCRI)	81
The National Research Institute for Chemical Technology (NRICT)	81
National Institute for Freshwater Fisheries Research (NIFFR)	83
Forestry Research Institute of Nigeria (FRIN)	83
Rubber Research Institute of Nigeria (RRIN)	83
National Animal Production Research Institute (NAPRI)	84
Nigerian Veterinary Research Institute (NVRI)	84
National Agricultural Extension and Research Liaison Science (NAERLS)	84
The West African Stored Products Research Unit (NSPRI/WASPRU)	84
Governance Instability	87
Governance instability in research institutes and the private sector compared	90
Policy Instability	93
4. Constraints of the Nigerian NARS	95
A Framework for the Constraints Analysis of NARS	95
A hierarchy of constraints	95
Primary constraints	96
<i>Secondary and tertiary constraints</i>	97
Macroeconomic instability	103
Agricultural policy constraints	104
Political instability	107
External constraints	108
Technology constraints	108

5. Strengthening the Stability of the Nigerian NARS: Summary and Conclusions	109
Summary of Findings	110
Implications of findings	116
Strategies for strengthening NARS stability and sustainability in Nigeria	119
Appendix I	145
Probabilities of NARS Funding Allocations and Disbursements	145
Appendix II	147
The Effect of Funding Diversification on NARS Funding Stability	147
Appendix III	153
Assessing when Research Staff may Exit from a NARS/NARO	153
The probability distribution of NARS research staff instability	153
Bibliography	157

List of Figures

Figure 1. Total expenditures on agricultural research, Nigeria, 1961-1992	29
Figure 2a. Capital fund allocations to selected research institutes, Nigeria, 1961-1996	49
Figure 2b. Capital fund allocations to selected research institutes, Nigeria, 1961-1996	49
Figure 2c. Capital fund allocations to selected research institutes, Nigeria, 1954-1996	50
Figure 2d. Capital fund allocations to selected research institutes, Nigeria, 1954-1996	50
Figure 3a. Recurrent fund allocations to selected research institutes, Nigeria, 1962-1996	51
Figure 3b. Recurrent fund allocations to selected research institutes, Nigeria, 1962-1996	51
Figure 3c. Recurrent fund allocations to selected research institutes, Nigeria, 1954-1996	52
Figure 3d. Recurrent fund allocations to selected research institutes, Nigeria, 1954-1996	52

List of Tables

Table 1. The Distribution of Agricultural Research Institutes, Nigeria, 1997	25
Table 2. The Distribution of Agricultural Universities and Faculties of Agriculture and Veterinary Medicine of General Universities in Nigeria, 1997	27
Table 3. Agricultural Research Institutes and their Precursors, Nigeria, 1912-1996	32
Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96	34
Table 5. Frequent Changes in Parent Ministry or Parastatal in charge of Agricultural Research Institutes, Nigeria, 1912-96	43
Table 6. Estimated Coefficients of Variation(1) as Measures of Funding Instability of Research Institutes, Nigeria, Selected Periods	53
Table 7: Classification of Research Institutes by Degrees of Funding Instability, Nigeria, Selected Periods	55
Table 8. Estimated Indices of Instability of Actual Budget Disbursements to Research Institutes, Nigeria, Selected Periods	58
Table 9. Classification of Research Institutes by Degrees of Instability of Actual Budget Disbursements, Nigeria, Selected Periods	59
Table 10. Estimated Indices of Instability of Actual Expenditures of Research Institutes, Nigeria, Selected Periods	61
Table 11. Classification of Research Institutes by Degrees of Instability of Actual Research Expenditures, Nigeria, Selected Periods	62
Table 12. Estimated Indices of Instability of Agricultural Research Expenditure Categories of Research Institutes, Nigeria, Selected Periods	64
Table 13. Delays in the Release of Budget Funds to NCRI, Nigeria, 1990-96	68
Table 14. Delays in the Release of Budget Funds to RRIN, Nigeria, 1985-96	70
Table 15. Computed Indices of Delays in the Release of Capital Budget Funds to Research Institutes, Nigeria, 1985-96	74
Table 16. Computed Indices of Delays in the Release of Recurrent Budget Funds to Research Institutes, Nigeria, 1985-96	75
Table 17. Computed Indices of Agricultural Research Staff Instability, First Generation Research Institutes, Nigeria, 1954-96	79
Table 18. Computed Indices of Agricultural Research Staff Instability, Second Generation Research Institutes, Nigeria, Selected Periods	82

Table 19. Summary and Classification of Research Staff Instability of Research Institutes, Nigeria, Selected Periods	85
Table 20. Computed Indices of Governance Instability of Research Institutes, Nigeria, 1954-96	88
Table 21. Computed Indices of Governance Instability of Some Blue Chip Companies Quoted on the Nigerian Stock Exchange, 1975-95	91
Table 22. The Distribution of Commodity Divisions, Disciplinary Divisions and Substations of Research Institutes, Nigeria	98
Table 23. The Exit of Researchers with a Ph.D from the Research Institutes, Nigeria, 1963-96	101
Table 24: Responses on Ranking of Constraints of Research Staff, by Research Institutes, Nigeria, 1996	105

List of Appendix Tables

Appendix Table 1. Main Features of Nigeria's Agricultural Zones, 1997	123
Appendix Table 2. Delays in the Release of Budget Funds to NIFOR, Nigeria, 1985-96	127
Appendix Table 3. Delays in the Release of Budget Funds to IAR, Nigeria, 1991-96	129
Appendix Table 4. Delays in the Release of Budget Funds to IAR+T, Nigeria, 1990-96	131
Appendix Table 5. Delays in the Release of Budget Funds to NSPRI, Nigeria, 1988-96	133
Appendix Table 6. Delays in the Release of Budget Funds to NRICT, Nigeria, 1989-96	135
Appendix Table 7. Delays in the Release of Budget Funds to NIOMR, Nigeria, 1989-95	137
Appendix Table 8. Delays in the Release of Budget Funds to NAPRI, Nigeria, 1985-96	139
Appendix Table 9. Delays in the Release of Budget Funds to NIFFR, Nigeria, 1985-94	141
Appendix Table 10. Delays in the Release of Budget Funds to NIHORT, Nigeria, 1985-96 (Dates of Release, with Number of Days Delay and Delay Indices)	143

Foreword

ISNAR has in the past played a strong advocacy role in mobilizing increased domestic and international resource support for national agricultural research systems (NARS). This role has become urgent in the face of declining real research resources, and in recognition of the fact that, without adequate resources, the NARS cannot produce the research knowledge and related new technologies.

Of equal concern to the NARS is the problem of the instability of the policy environment, institutional arrangements, funding, staffing, and governance. NARS leaders and managers are as concerned about the stability of their institutional and policy environment and resource support as they are about the level of support. While considerable analysis has been done on resource support levels over the years, there has been little or no analysis of the problem of NARS instability. What are the types and characteristics of instability confronting the NARS and what are the consequences for research planning and management?

Research Report 13 represents ISNAR's first major effort in the analysis of NARS instability. It develops an analytical framework for characterizing the general instability of research funding, staffing, and governance, with important implications for conventional thinking on such issues as diversification of research funding, donor research aid, and research aid co-ordination. The analysis shows that diversification, donor research aid, and aid co-ordination should be viewed not only from their positive impact on the level of resource support, but also for their consequences for the stability of the NARS. Sometimes the gains from resource augmentation need to be balanced against the increased instability of funding that might result when funding from the different sources tends to co-vary in the same direction and when the co-variations tend to be mutually reinforcing. The study highlights the harmful effects of funding instability that is severe and chronic, and research staffing and governance instability that is chronic and systemic in nature.

The empirical analysis from the Nigerian case study shows that the Nigerian NARS has witnessed excessive instability in institutional arrangements for the macromanagement of research institutes that have had to operate under conditions of institutional uncertainty. Estimated instability indices show that funding has been highly unstable in most research institutes, as measured by the trend-corrected coefficient of variation. Furthermore, the estimates are consistent with *a priori* expectations that capital budget allocations, disbursements, and expenditures tend to be more unstable than recurrent. The Report also presents the first empirical evidence and analysis of delayed releases of promised or approved budgets that continue to plague many, if not most, NARS. Research budget funds are released too little, too late. Evidence from this study is consistent with *a priori* expectations that capital funds tend to be delayed much longer than recurrent funds. Excessive delays in the release of budget funds have harmed research activities that are dependent on seasons.

The analysis of research staff instability shows rapid turnover of staff in many research institutes over short periods of time, while computed indices of governance instability show that institute governance has been excessively unstable, with most boards of governors being replaced in fewer than five years. The report contains a most revealing comparison of governance instability in public research institutes and private-sector blue-chip companies quoted on the Nigerian Stock Exchange: the excessive instability of the former contrasts sharply with the relative stability of the latter.

The convolution of institutional, funding, staffing, and governance instabilities poses daunting challenges for NARS leaders and managers. This study provides analytical and empirical tools with which NARS leaders and managers can engage in domestic and international dialogue on the nature, causes, and measurement of NARS instability, and on strategies for coping with instability. The Nigerian case study has been painstaking in data collection and analysis, not only of the instability experience of the Nigerian NARS but of its underlying constraints. These are critical aspects of NARS governance which is one of ISNAR's four new strategic thrusts.

The study will be extended in the second phase to cover Ghana, Zimbabwe, Uganda, Tanzania, Kenya, and Côte d'Ivoire. This second phase is also expected to provide the analytical framework for agricultural research policy analysis with particular reference to sub-Saharan Africa.

Stein W. Bie
Director General
ISNAR

Acknowledgements

I owe a heavy debt of gratitude to the following: Christian Bonte-Friedheim and Stein Bie whose support made this study possible; Howard Elliott, Hellio Tollini, Paul Perreault, Warren Peterson, Willem Janssen, Han Roseboom, Ted Brush, Steve Tabor, Michael Loevinsohn, Helen Hambly-Odame and two anonymous external referees for their extremely useful comments on earlier drafts. I am particularly grateful to Duro Adegeye, Gbolagade Ayoola and Oladeinde Akingbade for the untiring efforts in organizing the field work under very tight schedules.

I reserve special gratitude for Directors and staff of Nigeria's research institutes for their exceptional co-operation and assistance in the huge database effort culminating in this publication. In recognition, this publication is dedicated to Directors and staff of the Nigerian National Agricultural Research System (NARS).

I am grateful to the authorities of the University of Ibadan for granting me sabbatical leave and leave of absence to undertake this study immediately after my recent stint (1988-95) as Foundation Vice Chancellor, University of Agriculture, Makurdi.

Finally, I wish to thank Maaike Vergeer, Elizabeth Dauksch-Reid and Joyce Voorn for secretarial support, and Kathleen Sheridan and Judy Kahn for editorial work.

I alone am responsible for any remaining errors and ambiguities.

Francis S. Idachaba
ISNAR
The Hague

Abstract

NARS leaders and managers are concerned not just about an adequate level of resources, but also the stability of resources and institutional sustainability. Here, we examine six types of instability (policy, program, institutional, funding, research staff, and governance instability) using estimated instability indices to give empirical results on the levels of instability in Nigeria's research institutes. Among other results, the findings confirm the proposition that capital budgets tend to be more unstable than recurrent budgets. The report presents empirical indicators and analyses at the institute-specific level that NARS leaders and managers can use in their discussions with decision makers and in regional and global policy dialogues. The constraints on research institutes that induce instability are examined within the framework of a hierarchy of constraints. The implications of the analysis are examined and strategies for strengthening the stability of the Nigerian NARS are suggested.

Abrege

Comment s'assurer non seulement un niveau adéquat de ressources mais, de plus, un appui financier stable et des institutions durables ? Voilà des questions qui préoccupent les responsables et les gestionnaires des SNRA. La présente étude porte sur six types d'instabilité affectant respectivement (1) les politiques, (2) les institutions, (3) les financements, (4) les programmes, (5) les personnels de recherche et (6) la gouvernance. L'examen de ces différents types, en créant des indices d'instabilité, a conduit à une analyse empirique des niveaux d'instabilité dans les instituts de recherche du Nigeria. Les résultats ont, entre autres, confirmé l'hypothèse que les budgets d'investissement tendent à être plus instables que les budgets de fonctionnement. Les analyses et les indicateurs empiriques se rapportant spécifiquement au niveau de l'institut, ils serviront d'outils aux gestionnaires et responsables des SNRA à la fois pour dialoguer avec les décideurs politiques et pour présenter leurs systèmes dans des conférences politiques régionales et mondiales. En outre, l'auteur utilise une hiérarchie des contraintes comme cadre analytique pour mettre en évidence les facteurs induisant l'instabilité, sous ses différentes formes, dans les instituts de recherche nigériens. Enfin, sur cette base, il propose des stratégies pour renforcer la stabilité au sein du SNRA du Nigeria.

Resumen

Los líderes y directores de los sistemas nacionales de investigación agrícola (SNIA) no sólo se interesan en obtener recursos adecuados pero también en la estabilidad del apoyo de los recursos y en la sostenibilidad institucional. En este documento examinaremos seis tipos de inestabilidad (política, programática, institucional, de fondos, de investigadores y de administración) usando índices estimados de inestabilidad para lograr resultados empíricos sobre los niveles de inestabilidad en los institutos de investigación nigerianos. Algunos ejemplos de estos resultados indican que la inestabilidad de fondos ha aumentado con el tiempo y que los presupuestos de capital, los desembolsos y los gastos son generalmente mas inestables que sus contrapartes recurrentes. Por lo tanto, el resultado es que los presupuestos de capital tienden a ser mas inestables que los presupuestos recurrentes. Resultados empíricos detallados específicos de los institutos y su análisis son presentados aquí como herramientas e indicadores empíricos, los cuales pueden ser usados por líderes y directores de los SNIA en diálogos sobre políticas con la presidencia y con ministerios de finanzas y agricultura, así como también en los diálogos políticos regionales y globales. Las restricciones en los institutos de investigación que inducen inestabilidad son investigadas dentro de un marco de jerarquía de restricciones. Las implicaciones del análisis son examinadas y se sugieren estrategias para fortalecer la estabilidad de los SNIA nigerianos.

Acronyms

ABU	Ahmadu Bello University
ADPs	Agricultural Development Projects
ARCN	Agricultural Research Council of Nigeria
CRIN	Cocoa Research Institute of Nigeria
FAO	Food and Agriculture Organisation
FIIRO	Federal Institute for Industrial Research
FMST	Federal Ministry of Science & Technology
FRIN	Forestry Research Institute of Nigeria
GDP	Gross Domestic Product
IAR	Institute for Agricultural Research
IAR+SS	Institute for Agricultural Research & Special Services
IAR+T	Institute of Agricultural Research and Training
IBRD	International Bank for Reconstruction and Development (The World Bank)
ICAR	Indian Council of Agricultural Research
ICSA	Interim Common Services Agency
ISNAR	International Service for National Agricultural Research
LCRI	Lake Chad Research Institute
NAERLS	National Agricultural Extension and Research Liaison Service
NARO	National Agricultural Research Organisation (herein equivalent to National Agricultural Research Institute)
NAPRI	National Animal Production Research Institute
NARS	National Agricultural Research System
NCRI	National Cereals Research Institute
NCST	National Council for Science & Technology
NIFFR	National Institute for Freshwater Fisheries Research
NIFOR	Nigerian Institute for Oil Palm Research
NIHORT	National Horticultural Research Institute
NIOMR	Nigerian Institute for Oceanography and Marine Research
NITR	Nigerian Institute for Trypanosomiasis Research
NRCRI	National Root Crops Research Institute
NRICT	National Research Institute for Chemical Technology
NSPRI	Nigerian Stored Products Research Institute
NSTDA	National Science and Technology Development Agency
NVRI	Nigerian Veterinary Research Institute
PRODA/PDI	Products Development Agency/Products Development Institute
RRIN	Rubber Research Institute of Nigeria
SPAAR	Special Program for African Agricultural Research
SSA	Sub-Saharan Africa
UNDP	United Nations Development Program

WACRI	West African Cocoa Research Institute
WAIFOR	West African Institute for Oil Palm Research
WAITR	West African Institute for Trypanosomiasis Research
WASPRU	West African Stored Products Research Unit

Executive Summary

NARS leaders and managers are concerned not just about the adequacy of the resources available to them, but also about the stability of resource support and institutional sustainability. There are many causes of instability, including political instability, the colonial legacy and its aftermath, insufficient commitment to the NARS, exogenous worldwide economic and political changes, and the failure of the stakeholder community to develop any means of resistance to the supply-side causes of instability (to mention a few).

There are also many kinds of instability. In this Report, we identify six main types involving policy, program, institution, funding, research staff, and governance. Four kinds of funding instability are identified, based on the severity and the duration of the instability, and the corresponding types of research-staff instability are also examined.

Nigeria's research institutes are the focus of this study, and empirical results using estimated instability indices show high levels of institutional instability, as well as high and severe levels of instability of funding allocations. Other components of funding exhibiting high levels of instability include actual disbursements, actual capital and recurrent expenditures, and specific actual expenditure categories. Capital budgets, disbursements, and expenditures are generally more unstable than their recurrent counterparts, a finding consistent with the proposition that capital budgets tend to be more unstable than recurrent budgets—and funding instability has increased over time. Computed indices of delays in budget release reveal excessively long delays in the release of budget funds, with delays in the release of capital funds exceeding delays in the release of recurrent funds. The causes of these delays include shortfalls in government revenues, bureaucratic failure, and political instability.

Computed indices for research staff reveal high degrees of instability, with many institutes losing the majority of their research staff within periods of five and 10 years. This is a serious problem—high rates of staff turnover result in poorly executed or abandoned research projects. The causes of the high instability among research staff include the mass exit of colonial research staff, poor service and career conditions, and the effects of poor domestic macroeconomic management. Computed indices for governance instability reveal that governance instability is much worse than instability among research staff, with the governing boards of research institutes being replaced over periods of less than five years. When governance instability in the research institutes is compared with governance instability in blue-chip companies quoted on the Nigerian stock exchange, the indices show that governance in private-sector companies is much more stable than in the institutes.

The constraints that induce instability in research institutes are examined within the framework of a constraint hierarchy. The implications of the analysis are examined, and strategies for strengthening the stability of the Nigerian NARS are suggested.

Detailed institute-specific empirical results and analyses are presented here as empirical tools and indicators that NARS leaders and managers can use in policy dialogues with government and with ministries of finance and agriculture, as well as in regional and global settings.

1. Introduction

The African food crisis remains persistent and elusive. According to the World Bank, (World Bank, 1997), the agricultural gross domestic product in sub-Saharan Africa (SSA) grew at 1.5 percent per annum during 1990-95, compared with 1.9 percent during 1980-90, the lowest growth rate of any developing region. The FAO estimates that aggregate food production in 1995 in sub-Saharan Africa fell 9.5 million tonnes from its 1994 levels (FAO, 1996). The food import bill of food-deficit countries escalated in 1996 in the face of rising cereal import prices caused by shrinking world surpluses. It was estimated that, in 1996, there were 22 million Africans facing food emergencies of varying degrees of severity. Countries facing exceptional food emergencies in 1996 were concentrated in Central Africa (Burundi, Rwanda, Angola, Democratic Republic of Congo (formerly Zaire)), Eastern Africa (Ethiopia, Eritrea, Sudan), Southern Africa (Malawi, Zambia and Lesotho) and Western Africa (Liberia, Sierra Leone). With declining food security, African countries must now compete with Eastern Europe for shrinking international food aid. They not only need to meet the challenges of natural calamities and the demographic transition, but also the large population shifts caused by rural - urban migration, and the mass displacement of populations caused by civil wars and disturbances. Secular trends combined with short-term political disturbances are creating large pools of food-insecure populations in many SSA countries (Idachaba, 1991).

To meet the challenge, National Agricultural Research Systems (NARS) in sub-Saharan Africa must produce and disseminate high-productivity technologies that are consistent with sensible natural resource management. Domestic and international agricultural research resource support—funds, scientific manpower, and research infrastructure—needs to be increased, especially for resource-poor NARS.

Sub-Saharan African countries recorded impressive, though uneven, increases in agricultural research funding, staffing and institutional infrastructures in the last 35 years (Pardey, Roseboom and Beintema, 1995; Pardey, Roseboom and Anderson (Eds), 1991). Resource flows and institutional management in African agricultural research have gone through cycles: the colonial era up to the 1960s, the post-Independence years (1960s and 1970s) and the Structural Adjustment era of the 1980s and 1990s. The colonial era was marked by substantial resource support from colonial multinationals in textiles, oilseeds, and beverages. Export crop research institutes were relatively well funded because the colonial multinationals needed the raw materials made possible by new technologies from research, and also because colonial governments relied heavily on revenues from marketing-board taxes on export crops. Research institutes, in expanding the production potential of export crops, also raised the tax revenues accruing to the government. The abolition of the marketing board system, along with efforts to reduce budget deficits under Structural Adjustment, has been accompanied by reductions in research funding. According to a recent ISNAR study (Pardey, Roseboom and Beintema, 1995), research funding in most of sub-Saharan Africa remains unsatisfactory. Increased

resource flows have become necessary following sharp devaluations of foreign exchange rates and the depreciation of local currencies in most of these countries, given the high import-dependence of most NARS.

Increased resource flows for the NARS are necessary, but not, however, sufficient for sustained agricultural growth. Periods of increased funding in the past have not always been accompanied by sustained increases in agricultural production and food security in many SSA countries. An equally important, and quite often more critical, problem, is the instability of the NARS and their environments. While much attention has focused on research resource allocation issues such as investment levels and returns on investment, and the priorities and quantity of resources, there has been hardly any analysis of the problem of NARS instability: instability of policy, institutional arrangements, funding, governance and research staffing. According to ISNAR's strategy document, "How to sustain performance when funding is stagnant or declining and demands on research are growing will be the single greatest challenge facing national systems in the 1990s. This issue will be critical for public sector research, which will find it increasingly difficult to attract and retain high-quality staff" (ISNAR, 1992). As part of the exercise for the External Review of ISNAR in 1991, it was stated that "The stability of funding for agricultural research has been positively affected in only 20% of the countries in the view of the country officersISNAR's work in ... policy areas will become increasingly important for this reason" (ISNAR, 1991). In spite of these statements, little has been done to date to expand our knowledge of the nature, causes, measurement and consequences of funding instability in the NARS. The recent joint FAO- SPAAR Expert Consultation on Funding of Agricultural Research in Sub-Saharan Africa recognized the "need to increase, diversify and stabilize the funding of agricultural research in the NARS of SSA countries" (FAO, 1994). The FAO-SPAAR Expert Consultation (FAO, 1994) has recommended funding alternatives for Sub-Saharan African NARS.

Two schools of thought are implicit in the current treatment of resource support for the NARS. One school accords central importance to the gross under-funding of African NARS for financing capital, operations, personnel, maintenance, and training expenditures. ISNAR's recent study shows that per capita research funding in sub-Saharan Africa has fallen sharply over the period (Pardey, Roseboom and Beintema, 1995). What is required to get the NARS moving again is to vastly increase the level of funding. Countries need to widen the spectrum of domestic and international sources of funding to be able to tap a larger pool of resources.¹ The World Bank, in an important initiative through SPAAR, is co-ordinating agricultural research aid from the donors (FAO, 1994) and has launched a Sustainable Financing Initiative (Hill, Toure and Weatherly, 1995). African countries should, according to this school of thought, dramatically raise the level of research funding towards desirable norms, for example, the frequently quoted, but poorly defended, "2 percent of Agricultural GDP" (Tabor, 1996).

1 For a comprehensive treatment, see the ISNAR volume *Agricultural Research Finance Sourcebook*.

The second school of thought holds the view that, though increased resource flows are critical and should be vigorously canvassed for, many NARS leaders and managers are equally, if not more, worried about the instability of policy, funding, institutional arrangements, staffing and governance. Frequent fluctuations in NARS resources and institutional environment have serious negative consequences for the effectiveness and efficiency of NARS.

Objectives of Study

The general objective of this study is to develop analytical and empirical tools that will assist sub-Saharan African countries in strengthening the stability of their NARS. The specific objectives are to: (i) define the types, characteristics, causes and consequences of NARS instability; (ii) provide NARS instability indicators for policy dialogue at national and global levels; and (iii) recommend strategies for strengthening the stability of NARS to make them more effective.

The central propositions of the study are as follows:

- 1) Increased levels of funding and staffing of NARS in sub-Saharan Africa (SSA) tend, under certain circumstances, to be accompanied by substantial degrees of funding and staffing instability. Increased research funding in many NARS tends to be the product of discrete episodes rather than any sustained commitment to year-to-year increases in resource allocations to research. Also, when increased research funding comes from an increasingly narrow fund base, or a diversified funding base with significant co-movements among different sources of research funding, increased funding tends to become more unstable.
- 2) The higher the degree of political instability, the greater the degree of institutional and governance instability in the NARS.² Countries with high levels of political instability tend to have high levels of instability in their institutional arrangements for the NARS, while countries with low levels of political instability tend to have low levels of institutional instability. For a given country, periods of high political instability tend to be accompanied by high levels of NARS instability.
- 3) Instability in NARS funding tends to be accompanied, after some time lag, by instability of research staffing. The higher the funding instability, the higher, after some time lag, the agricultural research staff instability. When NARS managers and NARS leaders suffer unexpected budgetary cuts, industrial union and political constraints prevent them from instantly downsizing—retrenching research staff and rationalizing personnel costs. Research staff do not instantly exit from a NARS at the first sign of funding instability. They tend to exit when unstable funding results in

2 Political instability affects most other government institutions as well, but these are beyond the purview of this study.

unstable funding support for the operation of research programs and the maintenance of research equipment and infrastructures.

- 4) Capital budgets tend to be more unstable than recurrent budgets. Capital budgets finance discrete projects with cycles in their cash flow requirements. The stakeholders in a given research institute are pockets of researchers in different disciplines and programs, and with different professional interests. It is not easy organizing all research staff to protest about wide fluctuations in the capital funding of assorted projects that may not be related. Fluctuations in recurrent funds, on the other hand, directly affect research staff and non-research staff alike, as they translate directly into fluctuations and delays in salary and wage payments. Governments have a political stake in industrial peace and harmony and they tend to protect workers' salaries and wages before protecting research program activities. Upswings in government revenue and in research funding tend to be accompanied by increased capital budgets for the NARS, while downswings in government revenues tend to lead to direct cuts in their capital budgets. On the other hand, while upswings in government revenues lead to increased recurrent funds for the NARS, downswings in government finances tend not to result in corresponding cuts in recurrent funds of the NARS.³
- 5) Capital budget funds are subject to greater delays in disbursements than recurrent budget funds. This is perfectly logical because governments loathe the industrial unrest caused by non-payment or delayed payment of workers' salaries and wages in the research institutes.

This study will address the following questions. What is the meaning of policy and NARS instability? What are the nature, characteristics, causes and consequences of NARS instability? What are the system and component indicators of NARS instability? How much does observed NARS instability owe to colonial legacy? What is the effect of the "catchment area indigene factor" on the degree of research staff instability? Has NARS instability increased or decreased over time? And what are the suggested strategies for NARS leaders and managers to cope with NARS instability?

Past failure to analyze NARS instability can be attributed to several factors. First is the belief that the most critical funding issue is underfunding. While ISNAR, FAO and SPAAR have done highly commendable and innovative work in sensitizing the international donor community as well as national governments to the need for increased research funding (FAO, 1994), they have not gone beyond the recognition of instability of funding as a critical constraint of the NARS. The problem has escaped analysis, with the possible exception of de Janvry, Trigo and Pineiro (de Janvry, 1985; Trigo and Pineiro,

3 Two possibilities are suggested: one, that NARS capital funding is elastic with respect to government revenues; two, there is asymmetry in the response of NARS recurrent funding to changes in overall government revenue: while NARS recurrent funding may be elastic with respect to government revenues during upswings in government revenue, it may be inelastic during the downswing. For asymmetry in supply response, see Johnson, 1958, 1960

1984), whose analysis was limited to country-level data.⁴ While analysis of aggregate country-level funding instability is useful for inter-country comparisons, it conceals the intra-NARS variations in instability that are central to the relative effectiveness of individual research institutes. Research institutes do not experience the same degree of instability, and national policy makers identify more easily with empirical results for individual institutes in relation to their commodity mandates and national priorities than they do with aggregate country data. To capture the attention of policy makers for the improved effectiveness of the NARS, research must confront them with data and empirical analysis of previous policies towards individual institutes. Second is the implicit belief, rooted in casual empiricism, of some people, that funding or staffing instability is not important. The empirical results from this study show that funding and staffing instability is not only important, but both serious and pervasive; and that policy makers need to be provided with empirical results on NARS instability as an essential ingredient in defining any future agricultural research policy agendas. Third is the belief held by some that research staff levels in African NARS are stable because people have few alternative employment opportunities and, as a result, tend to “hang around” on the job, no matter what the circumstances. This is a dangerous myth: a myth because it is clearly contradicted by the evidence from Nigeria in this study, and dangerous because it prevents policy makers from coming to grips with the problem of staff instability, thereby delaying the design and implementation of remedial strategies.

The output of this study is relevant for the governance and institutional sustainability of NARS. The data requirements compel NARS managers to establish databases that they would not have otherwise done, and these can be continuously updated. The empirical analysis provides a unique opportunity for confronting policy makers in the Ministries of Finance, Agriculture and Planning and the Presidency with hard-core evidence on NARS instability, and could induce a much-needed shift in emphasis from preoccupation with levels of resource support to issues concerning the stability of resource support for the NARS. The output of this study will motivate NARS leaders and managers to develop a domestic institutional capacity for generating empirical indicators for policy dialogue at national, regional and global levels on governance and institutional sustainability in the NARS.

The report is structured as follows. Section II defines the different types of NARS instability, their characteristics, causes and consequences. The analytical framework in this section is developed for general application to the whole sub-Saharan Africa study, while the empirical analysis in Section III applies specifically to Nigeria. Nigeria was selected as the first case study because it has arguably the largest and most complex NARS in sub-Saharan Africa, and because the evolution of its NARS provides a classic case study for validating the concepts and tools of this study. The lessons from the Phase I case study will be incorporated in Phase II, which is expected to cover Ghana, Zimbabwe, South Africa, Kenya, and Tanzania. Subsequent reports will present comparative empirical analyses of the other African countries covered in this project, with

4 See also Idachaba, 1980; 1981; 1987a; 1987b.

successive applications of the analytical framework presented in Section II. Section IV presents NARS constraints analysis in relation to the observed instability, while Section V draws some conclusions and presents strategies for strengthening the stability of NARS in Nigeria, and possibly other countries in sub-Saharan Africa.

2. The Meaning of NARS Instability

Six types of instability are examined in this study. These include policy instability, institutional instability and program instability. Others are funding instability, staffing instability and governance instability.

Policy Instability

Policy instability occurs when there are frequent changes, modifications and reversals in policy. Policy changes could result from supply-side and demand-side factors.

On the supply side, changes in macroeconomic policy and agricultural (sector) policy could result in changes in national agricultural research policy. Changes in macroeconomic targets such as GDP growth rate, current account targets for balance of payments equilibrium or poverty alleviation targets could result in equal or disproportionate changes in agricultural research policy targets. Similarly, changes in agricultural policy targets can result in changes in agricultural research policy. The greater the frequency of macroeconomic and agricultural sector policy changes, the greater will be the instability in agricultural research policy induced by such changes, as well as other types of instability. Political instability can be a major source of agricultural research policy instability, for three reasons. One, new regimes may have genuinely different priorities that they want to see reflected in national agricultural research policy, programs and projects. For example, new targets aimed at restoring external economic balance may call for new agricultural research policies and targets to boost the domestic production of export crops, livestock and fisheries, or of agricultural commodities for import substitution. Two, new regimes may scuttle existing policies or introduce cosmetic changes in policy as a legitimizing political exercise to demonstrate how seemingly different the new regime's policies are from those of its predecessors, especially when it has no clear policy ideas of its own. For example, a new regime may revive a new wave of economic nationalism through slogans of self-sufficiency and self-reliance that may lead to quantitative barriers on trade, and define new agricultural research agendas in response to the new challenges and opportunities. Three, new regimes may introduce policy changes because of genuine errors in the formulation or execution of old policies or because of the unintended consequences of policies which require corrective action. For example, concern about the environment might lead to new agricultural research initiatives in natural resource management, environmental impact assessment and agroecology. Exogenous factors such as unanticipated developments in world markets, changes in external political arrangements or the formation of new economic groupings or regulatory international agencies, such as the World Trade Organization, may call for drastic changes in national agricultural research policy. In some countries, donors can be a source of instability by introducing policy changes that reflect changing priorities in the donor countries. The adverse impact of political instability is compounded by the lack of sociopolitical consensus on the basic thrusts of agricultural research policy.

On the demand side, though users and beneficiaries of agricultural research may, in principle, induce changes in policy that result in considerable policy instability, they are, however, too widely dispersed and unorganized in SSA to cause frequent changes in agricultural research policy.

Though policy instability can be induced by political instability, high levels of policy instability can also prevail in politically stable regimes when the key actors in policy making are frequently changed. The impact of frequent changes in key actors is also compounded when the apex political leadership (and authority) has no coherent macroeconomic and agricultural sector agenda of its own, leaving sector and research policy initiatives to the biases and preferences of key actors in the agricultural sector and the national research community. In the worst-case scenario, political instability leads to frequent changes of key policy actors, the apex political leadership has no coherent macroeconomic policy frame, and there is no broad sociopolitical consensus in the society on the basic thrusts of policy. Under these circumstances, agricultural research policy is in a perpetual state of flux.

Institutional Instability

Institutional instability occurs when there are frequent changes in institutional arrangements for organizing and conducting agricultural research.

Political instability involving frequent changes of regime often leads to frequent changes in institutional arrangements. Institutional changes might involve changes in individual NAROs or in the entire NARS. Ministries or parastatals responsible for agricultural research can be created, scrapped, or merged with other ministries or agencies. External forces also sometimes influence institutional changes.

Institutional instability is related to the nature of the political regime. Democratic regimes require political consultations among groups before initiating major institutional changes. The need for consensus building tends to moderate the frequency of changes in institutional arrangements for managing agricultural research. On the other hand, authoritarian regimes, especially military regimes with a rapid turnover, require only limited consultations or consensus building, and they have a built-in tendency to introduce abrupt changes in existing institutions without fear of reprimand from any segment of the society. The concentration of power in military or civilian dictatorships tends to create the environment for sudden institutional changes. This suggests the proposition that the more authoritarian a regime, the greater the tendency to higher degrees of institutional instability, while more democratic regimes tend to experience lower degrees of institutional instability. Authoritarian regimes, especially the military, tend to create and scrap institutions by administrative fiat, “with immediate effect”. They often remind their civilian populations that military regimes, being self-styled “corrective regimes”, owe civilian society no explanation or apology for their actions. Authoritarian regimes tend to behave as if they derive special pleasure or satisfaction from the suddenness or abruptness of institutional changes. The move towards democratic regimes should, all other things being equal, lead to less institutional instability.

New regimes may reorganize existing institutional arrangements to make them more effective in achieving set goals or because they feel that the existing arrangements are incapable of meeting new priorities and challenges. They may introduce institutional changes to create new avenues for political patronage that cannot be accommodated by inherited institutional structures. A new ministry might be created to handle Science and Technology, not because of the regime's belief in the intrinsic value of science and technology, but because new ministerial portfolios need to be created to satisfy political constituencies, and a Ministry of Science and Technology sounds respectable in domestic and international quarters. Under such circumstances, when there is a sudden adverse twist in the country's economic fortunes requiring rationalization, the new Ministry of Science and Technology may be the first casualty. It may be merged with another ministry or scrapped altogether, or recreated in the future when economic and political conditions permit. In addition to domestic sources, external forces also sometimes influence institutional changes.

On the demand side, stakeholders (users and beneficiaries of agricultural research) could demand institutional changes in the furtherance of their interests. To the extent that they are able to exercise ownership rights over institutional arrangements, they could constitute a potential source of institutional instability. In practice, demands of stakeholders for institutional change can be presumed to be relatively stable. Also, stakeholders in sub-Saharan Africa remain unorganized and ineffective in the articulation of their demands for institutional changes both at institute and NARS levels. With relatively stable or ineffective demands for institutional change, supply-side variables become the major determinants of institutional instability in the NARS.

Program Instability

Program instability refers to frequent changes in programs that have adverse consequences for research productivity. It can take the form of changes in program structure and processes which involve frequent changes in program objectives, program execution and the organizational modes for program implementation. Frequent changes in policy and institutional arrangements lead to program instability; other causes are funding, research staffing and governance instability, to be defined shortly. Changes in institute and program leadership lead to program instability. This may reflect the changing program priorities of successive leaders and managers; the greater the frequency of changes in NARO and program leadership, the higher the degree of program instability tends to be.

Funding Instability

NARS or NARO funding is unstable when there are significant, uncontrollable and undesirable fluctuations in allocated and disbursed funds. Funding instability can be **transient** or **chronic**.⁵

Transient funding instability is temporary and random in nature. A temporary and once-in-a-while dip in government revenues caused by unanticipated temporary falls in foreign exchange earnings could result in instability in agricultural research funding. A temporary surge in foreign exchange earnings and in government revenues, on the other hand, could result in dramatic increases in agricultural research funding. Sudden but temporary appearances or exits on the political scene of the believer or non-believer in agricultural research in the Ministries of Finance and Agriculture, the Presidency or the Cabinet Office can result in temporary fluctuations in NARS or NARO funding. If research funding comes from a tax (cess) on agricultural exports, a temporary glut on the world market for such exports could result in a temporary fall in NARS or NARO funding. A temporary surge in world market prices for a country's agricultural exports under such a cess regime—especially for *ad valorem* export taxes—could, on the other hand, result in a temporary surge in NARS or NARO funding.

Chronic instability in NARS funding occurs when there are prolonged, persistent year-to-year fluctuations in annual budget allocations or disbursements to the NARS. Chronic instability is of long-term duration and its causes are random. Prolonged political instability and frequent changes in political regimes produce frequent changes in the political leadership of the Ministries of Agriculture, Finance, and Science and Technology, as well as in the Presidency/Cabinet Office. Such changes lead to frequent movements or deployments of key actors who determine the levels of NARS funding. Frequently changing decision makers could have different agricultural research policy preferences, priorities and program agendas that translate into fluctuating levels of NARS or NARO funding. Prolonged political instability often leads to prolonged economic instability and government revenue instability which could result in prolonged or chronic NARS funding instability.

Frequent changes in key actors caused by prolonged political instability produce relays of ministers and supporting advisors and bureaucrats with varying individual capacities for succeeding in the annual competition for budgetary resources in support of agricultural research. Some ministers can obtain huge funding for NARS because of their personal relationship with the President or the Minister of Finance, or their powers of persuasion; others are simply ineffective. Some ministers and NARS leaders are more gifted in the art of winning annual “budget wars” in the Ministry of Finance or the Presidency.

5 For a classification of food insecurity into transitory and chronic food insecurity, and a good treatment of food insecurity issues, see World Bank, 1986.

Prolonged instability in world markets for a country’s main agricultural exports could result in chronic NARS funding instability through the effects on total government revenue instability, or through the direct revenue effects when the NARS or NARO is funded by a cess. The inability of end users and beneficiaries of research to organize effective lobbies to demand more stability in NARS funding compounds the dominance of supply-side determinants of chronic NARS funding instability.

NARS funding instability, transient or chronic, can be **mild** or **severe**, depending on the amplitude of the fluctuations. Mild funding instability refers to minor deviations from the norm in NARS funding, while severe NARS funding instability refers to large deviations from the norm. This leads to four classifications of NARS funding instability: **mild-transient**, **mild-chronic**, **severe-transient**, and **severe-chronic** (see matrix below).

A typology of NARS funding instability

Duration: Fluctuation:	Transient	Chronic
Mild	Least Harmful I	Harmful II
Severe	Harmful III	Most Harmful IV

With mild-transient funding instability, instability is mild with respect to the magnitude of fluctuations and is of limited duration, while funding instability is mild-chronic when funding fluctuates mildly, but is of a much longer duration, say, longer than three years.

With severe-transient funding instability, instability is of much greater magnitude, but is of limited duration. Wild gyrations in the world market prices of agricultural exports over a short period of, say, three years, which produce large fluctuations in NARS funding fall into this category. Funding instability is severe-chronic when there are large fluctuations in funding over a prolonged period of time. Both in terms of magnitude and duration, this class of funding instability is the most deleterious for the effectiveness of NARS.

A country’s NARS or NARO has the worst case of funding instability when it is both chronic and severe. The least harmful is the mild-transient funding instability case. The severe-transient and mild-chronic funding instability cases are both harmful, though we cannot say, *a priori*, which is more harmful. The challenge is to move the NARS from quadrants II, III and IV to quadrant I, the least harmful case, and, because we cannot determine, *a priori*, which of quadrants II and III is more harmful, we cannot prescribe the optimal time path for the movement from quadrant IV to quadrant I. For severe-chronic instability to cause the most harm, institutional memory is presumed to be unable to ac-

curately predict the levels of funding that will be realized in the future, based on the history of past instabilities.

Uncertainty caused by NARS funding instability

Unforeseen fluctuations in NARS funding reduce budget allocations and future disbursements to chance outcomes whose values are unknown in advance to NARS leaders and managers. NARS leaders and managers, from the moment they begin until they complete their annual programming and budgeting exercises and submit budgetary requests to the Finance Ministry, do not know what levels of funds will be allocated in the following financial year, and, much more important, what levels of funds will actually be disbursed to them. Actual disbursements depend on developments in world commodity markets, the revenue situation of government and the domestic economic and political situation. Actual budget disbursement depends also on the effectiveness of the political and professional leadership of the NARS within the public bureaucracy outside agriculture (Finance, Central Bank, the Presidency/Cabinet Office, etc.).

These being, as argued above, chance outcomes, the allocations and disbursements to a NARS/NARO that will materialize in a given year can be regarded as random variables, the probability distributions and parameters of which may not be known. The outcomes are the product of the annual budgetary process, the political environment and its macro-priorities, and the qualities of the NARS/NARO leadership. Other determinants include the external environment, the revenue situation of government, the domestic economic and political situation and the preferences of the Ministry of Finance, the Cabinet Office and the Presidency, to name but a few. In any given year, a NARS leader or NARO manager does not know the level of funds that will be allocated or disbursed to his organization in the next budget year. In some, if not most, cases, funds are not released in one lump sum at the beginning of the fiscal year but on a quarterly basis (budgetary releases every three months) in line with the flow of government revenues. NARS leaders and managers need to know the range of probabilities of possible funding outcomes (see Appendix 1 on some probabilities).

Consequences and implications of NARS funding instability

Uncontrollable and undesirable fluctuations in funding introduce uncertainties and risks in the financial planning and management of NARS. In any given year, NARS leaders and managers are not sure whether disbursement will actually match the approved budgets, or whether there will be shortfalls. Funding instability introduces two types of management risk for NARS leaders and NARO managers: residual risk and systematic risk.⁶ Systematic management risk relates to the risks of managing prolonged fluctuations in fund disbursements, the underlying causes of which are persistent. Mild-chronic instability and severe-chronic instability introduce systematic risk for research management, with the most problematic form of systematic risk being that introduced by the severe-

⁶ For application of residual risk and systematic risk in portfolio analysis, see Francis and Archer, 1971.

chronic type of funding instability. Residual research management risk relates to risks introduced by mild-transient funding instability and severe-transient funding instability. NARS leaders and NARO managers need to acquire the management capacity for coping with the management risks introduced by the different categories of NARS funding instability

Funding instability and the effectiveness of NARS. Uncontrollable fluctuations in research funding reduce the effectiveness of research as the non-availability of funds in the amounts and at the times they are most needed reduces the productivity of research and of researchers. Research materials are not purchased in the amounts and at the times they are most needed, while research projects are abruptly scaled down and some projects are abandoned.

Capacity effects of funding instability. Wide fluctuations in funding distort research activities in favor of short-duration research, because medium to long-term research entails medium to long-term funding profiles that contain large elements of uncertainty. Physical research infrastructures are not maintained and research capacity fails to grow because of the rapid depreciation of research physical capital. Huge shortfalls in the capital budget lead to the abandonment of construction projects, which are reactivated only after the payment of heavy penalties. Of equal importance, but often neglected, is the depreciation and obsolescence of research human capital caused by the failure to re-train research staff and to update skills and acquire new technical competences.

Resource allocation inefficiencies. When funding expectations fail to materialize, researchers improvise and substitute research inputs in proportions that may not be efficient for attaining given research objectives. For example, unstable power supplies knock out computer systems and delicate laboratory equipment that compel researchers to substitute manual labor for electronic inputs in research design and analysis.

Implications of NARS funding instability

The analysis of the types and consequences of the funding instability of NARS has several implications for donor funding, aid co-ordination and the diversification of research funding.

Donor funding of agricultural research: Conventional analysis of donor funding concentrates on its important role in augmenting government resources to raise the overall level of research funding. In many SSA countries, donor funding continues to play a strategic role in the NARS, sometimes accounting for up to almost 70 percent of the total funds available to a NARS (Pardey, Roseboom and Beintema, 1995). Donor funds can also play catalytic roles in NARS funding, with the intention of prodding countries to develop a culture of funding their own agricultural research. The focus on funding instability suggests the need to view donor funding not just in this narrow augmentation or supplementation role, but as a diversification strategy. If domestic government funds for NARS are liable to transient or chronic instability, the diversification of funds through donor funding is one feasible strategy for coping with government funding instability. If

donor funds or any other new sources of funds exhibit compensating fluctuations, they might offset fluctuations in government funds for the NARS. NARS funding with the new sources of funding might experience less instability than would have been the case had these new sources of funding not been available.

However, if the new sources of funding tend to covary in the same direction as government research funds, the introduction of new sources of funds for the NARS might make NARS funding more unstable than would otherwise have been the case. The conditions under which the diversification of NARS funding can decrease or increase NARS funding instability can be examined more precisely.

Funding instability and the diversification of NARS funding: The questions facing NARS leaders and NARO managers are: When might new sources of research funding reduce the total NARS funding instability? When might new sources of funding increase NARS funding instability? And when might new sources of research funding leave NARS funding instability unchanged?

It can be shown with a simple model using variance as a measure of funding instability (see Appendix II),⁷ that diversifying from one source of funding to two sources of funding will (i) reduce NARS funding instability whenever the correlation coefficient between the two sources of funding is greater than -1 but less than $-\frac{1}{2}$; (ii) increase NARS funding instability whenever the correlation coefficient between the two funding sources is greater than $-\frac{1}{2}$ but less than 1 ; and (iii) leave NARS funding instability unchanged whenever the correlation between the funding sources is negative and equal to one half the ratio of the variance of the new funding source to the variance of the old funding source. Roughly, this states that diversification of funding sources will result in a reduction of NARS funding instability when the two funding sources exhibit strong compensating fluctuations, that is, when the two funding sources are strongly negatively correlated; that diversification of funding sources will increase NARS funding instability under a larger set of circumstances, ranging from when the correlation between the old and the new funding sources is weakly negative to when the correlation is strongly positive; and that diversification has no effect on NARS funding instability when the correlation between the two funding sources is equal to minus half the ratio of the standard deviation of the new funding source to the standard deviation of the old funding source, and, in the special case where the two funding sources have the same variance, that diversification will leave NARS funding instability unchanged whenever the correlation coefficient is equal to minus one-half.

Over a planning period for a NARS, the correlation between sources of funding might change from one sub-period to another. NARS leaders and managers are interested in the following questions. How does NARS funding instability respond to changes in correlations between different funding sources? Does increasing correlation between fund-

⁷ For the classic treatment, though with slightly different formulation within the context of employment stabilization, see Friedman, 1953.

ing sources reduce or increase funding instability? In the two -sources-of-funding case, it can be shown (see Annex II) that:

- Increases in correlation between funding sources always leads to increases in NARS funding instability whenever the correlation is positive, that is, the elasticity of NARS funding instability with respect to the correlation coefficient is positive whenever the correlation coefficient is positive. For example, loan agreements for financing a NARS/NARO may stipulate a schedule of domestic (budgetary) matching grants as a condition for draw-down on the loan. This means that the more the borrower-recipient country releases domestic counterpart funds, the more loan funds it can draw down. Suppose, then, that there are two periods, one in which the loan conditions are not strictly enforced and the lender condones defaults in matching grants, followed by a second period in which the lender seriously enforces the loan conditions by releasing loan funds in line with releases of counterpart funding, and withholding loan funds whenever there are defaults in domestic counterpart funding profiles. Stricter enforcement of loan conditions over time results in a stronger correlation between domestic funding and loan funding, which may make NARS funding more unstable, as the (positive) correlation between funding sources increases over time.
- Increases in correlation between funding sources always lead to increases in NARS funding instability whenever the correlation coefficient is negative but less than minus half the ratio of the standard deviation of the new funding source to the standard deviation of the old funding source, that is, the elasticity of NARS funding instability with respect to the correlation coefficient is positive whenever the correlation coefficient is negative but less than minus half the ratio of the standard deviation of the new funding source to the standard deviation of the old funding source.
- Increases in correlation between funding sources lead to reductions in NARS funding instability whenever the funding sources exhibit compensating fluctuations but the correlation coefficient is greater than minus half the ratio of the standard deviation of the new funding source to the standard deviation of the old funding source.

Implications of analysis for donor funding of NARS

The analysis suggests that the contribution of donor aid to NARS should not be seen only in terms of the additive (augmentation) funding effect. Of equal or greater importance is the contribution of donor aid to the stability of NARS funding. This is important where donor funds exhibit compensating fluctuations that offset uncontrollable and undesirable fluctuations in the domestic government funding of the NARS. Donors can target their funding profiles to neutralize the instability of government funding of NARS. Donor funding can, however, render NARS funding more unstable when it reinforces the funding instability of domestic government funding. High degrees of dependence on donor funding could contribute to NARS funding instability, because donors often operate project cycles that normally do not have a long-term view, operating only for limited

time periods. Also, the lack of donor funding flexibility may limit the extent to which donor funding can neutralize fluctuations in government funding.

Donor aid co-ordination: Conventional wisdom urges government aid co-ordination among different donors to eliminate conflicts, waste, and duplication of efforts. This advocacy is eminently reasonable and useful, especially in countries with 20 or more different international agencies all flying their national flags and targeting the same clientele. However, effective co-ordination that leads to common positions among donors on funding support for a NARS, by leading to common swings in funding support profiles, may produce more NARS funding instability. If actual funding levels of donors are uncertain outcomes, they can be regarded as random variables which, under effective donor co-ordination, have joint probability distributions that cannot be presumed to be independent. Decisions of donors on funding of a NARS tend, with effective co-ordination, to covary positively, especially when donors take common positions on such important issues as human rights, democratization and other issues of common concern to the donor community. When funding decisions under effective donor co-ordination covary in the same direction, such as the simultaneous suspension or resumption of aid, the positive correlation between donor funding sources may destabilize NARS funding more than would have otherwise been the case in the absence of effective donor aid co-ordination. If effective donor aid co-ordination leads to increased NARS funding instability, this introduces a new risk element in research management that needs to be balanced against the benefit of the increased inflow of resources accruing to the NARS from donor aid.

Regional donor aid and NARS funding instability: Regional groupings of donors, such as the European Union or the Nordic countries, sometimes participate in aid programs under a common umbrella. They sometimes take joint political action to impose sanctions on countries on such important issues as human rights abuses, democratization or corruption. Such sanctions could include drastic cuts in or the complete suspension of donor funding of NARS. Though such common sanctions might achieve highly laudable policy objectives for the benefit of society as a whole, they might make NARS funding instability worse than it would otherwise have been in the absence of joint action by the donors.

Counterpart funding, matching grants and NARS funding instability: Conventional wisdom has it that matching grants in research funding are good funding arrangements because they result in an increased flow of funds to the NARS. However, this analysis suggests that when domestic and donor funding covary in the same direction (for example donor funds are reduced when the host government fails to provide counterpart funding, and increased when the government pays up), NARS funding may become more unstable than would have otherwise been the case in the absence of such funding arrangements. This is not an argument for scrapping matching grant and counterpart funding arrangements, because they have obvious beneficial effects on the level of funding. What is suggested is the need to recognize the trade-offs between the increased NARS funding levels made possible by such arrangements and the increased NARS funding instability that might result, and the attendant research management risks as possible unin-

tended consequences. Donors, policy makers and NARS leaders need to incorporate this dimension into future funding arrangements without sacrificing their benefits for overall levels of research funding.

Is all funding instability bad? Donors or national governments might reduce or suspend research funding to compel a better performance by the NARS or NARO or force necessary reorganization or reprogramming. This could lead to a leaner and more efficient NARS/NARO. Such funding sanctions may cause transient instability, mild or severe, depending on the magnitude of the instability caused by the sanction. The use of such ultimate sanctions suggests underlying problems with monitoring, priority or management audit that need to be promptly addressed long before there is any need for the extreme measures of the punitive suspension of donor or government funding. Ideally, a non-performing NARS/NARO ought to be diagnosed for its constraints for remedial action long before the ultimate funding sanction becomes necessary. The use of aid suspension as an ultimate sanction to compel better NARS performance may be an admission that less disruptive sanctions and leverage points have either not been effectively applied or have failed.

Delays in disbursement of budget funds

Annual funding levels and figures may look impressive on the surface, but they may conceal delays in the disbursement of budget funds, a key element in the dynamics of the budgetary process in most developing countries. Undue delays in budget releases are caused by flaws in a country's budgetary process that are rooted in an inadequate public bureaucracy. In some cases, budgets are not announced on time, and when they are announced, the "cash backing" may take several weeks. The delay is at three levels: one, at the level of inadequate flows of revenue receipts and accruals to the government treasury; two, at the level of the Ministry of Finance in delaying the disbursement of funds to government ministries and parastatals; and three, at the level of the Ministry of Agriculture or the Ministry of Science and Technology in not promptly releasing funds to agencies under its supervision. And, when funds are disbursed, deficiencies in the banking system introduce further delays especially for outlying research institutes far removed from the main commercial centers. Sometimes, disbursements may be delayed for good macroeconomic reason, affecting all sectors. One mechanism for coping with delays in budget disbursements is to set up reserves over time. In reality, however, capital and recurrent budget commitments prevent NAROs from building up significant reserves. In other instances, statutory regulations do not permit the NAROs to carry over budgets from one budget year to the next, and unused budget funds lapse at the end of the fiscal year.

Institutional memory by which NAROs incorporate perennial delays into their planning may help to ameliorate the adverse consequences of delays in actual disbursements of budget funds. However, this institutional memory cannot completely eliminate the consequences of disbursement delays for delayed planting on experimental plots and research farms that must comply with the seasonal calendar. In many instances, whole planting seasons are lost. Conventional analysis which focuses on *ex-post* funding fig-

ures fails to capture the adverse consequences of delays in fund disbursement on the operations of a NARO: abandoned capital projects, disruptions to the normal operations of research staff and distortions in time-dependent research activities. Furthermore, institutional memory cannot capture the difference between actual fund disbursements and anticipated fund disbursements based on past experience, as past experience cannot perfectly forecast future funding levels and dates of release of funds.

Research Staff Instability

Research staff instability exists when there are frequent exits of staff over and above normative attrition rates from retirements and deaths. Two levels of instability are identified: **individual research staff instability** and **systemic research staff instability**.

Individual instability is random in nature, where an individual researcher’s decision to leave or remain with a NARO or within a NARS comes under influences that can be regarded as individual-specific, with no discernible pattern across individuals, disciplines or NAROs within the NARS. Such influences could be period-specific or last over periods.

Systemic research staff instability, on the other hand, is system-wide, affecting a whole discipline, a whole NARO or several NAROs within the NARS. Systemic and individual staff instability can be transient or temporary in duration; or chronic, or of much longer duration. This leads to four categories of research staff instability: **transient-individual**; **transient-systemic**; **chronic-individual** and **chronic-systemic**. (see matrix below).

A typology of NARS research staff instability

Duration:	Type:	Individual	Systemic
Transient		Least Harmful	Harmful II
Chronic		Harmful III	Most Harmful IV

Transient - individual staff instability. Transient research staff instability resulting in the exits of individuals tends to be of limited duration with no discernible secular trend. It tends to be caused by individual circumstances, either from push factors such as dissatisfaction with one’s superiors or colleagues, or to pull factors such as attractive offers from outside the NARO/NARS. Such push/pull factors are random and are repeated over time with no particular pattern.

Transient - systemic staff instability. Once and for all systemic staff instability can occur when, for example, the government simultaneously creates new NAROs that offer attractive alternative career opportunities and lure staff away from existing NAROs. Occasional political and economic instability may create perturbations that result in the systemic exit of staff over a short period of time. The random influences on individual decisions to leave or stay in a NARO/NARS under these circumstances are not independently distributed across individual staff members.

Chronic - individual staff instability. Influences affecting individual decisions to stay or leave the NARO/NARS are of prolonged occurrence, though they are still presumed to be independently distributed across individual staff members.

Chronic - systemic staff instability. This is the worst form of staff instability because it is prolonged and system-wide, affecting whole disciplines, NAROs or NARS. Chronic - systemic staff instability can result from progressive secular decline in real wages of research staff leading to the system-wide exit of staff from NARS, sometimes due to a failure to adjust staff salaries in line with spiraling inflation. Chronic-systemic staff instability could be due to poor incentive systems that fail to reward the peculiarities of particular disciplines involved in long gestation work, such as genetics, tree crop research, breeding, and rotational farming systems agronomy that entails long research lags.

Chronic - systemic staff instability may be rooted in protracted problems with the location of a NARO that succeeds in driving generations of researchers away. The hostile location of a NARO may be due to: poor road and telecommunication links with the outside world leading to frustrating isolation for researchers; harsh weather; an unfriendly local environment or catchment area; poor social infrastructures (schooling for children, health facilities for households of staff with special emphasis on referral facilities); and lack of employment opportunities for spouses, to name but a few.

Protracted political instability may result in frequent changes in key actors involved with agricultural research policy making and research management that may demoralize research staff and lead to mass exits from the NARS. It may also result in frequent changes in institutional arrangements for managing research.

Chronic - systemic staff instability may be caused by an entrenched and profound lack of appreciation on the part of the political leadership of the role of agricultural research in agricultural and economic development and of the need to provide an enabling environment for agricultural research staff.

Macroeconomic policy reforms (e.g. Structural Adjustment Programs) involving the drastic devaluation of the foreign exchange rate might render local salaries of NARS scientists non-competitive in dollar terms, resulting in significant emigration abroad.⁸

⁸ For a good treatment of the impact of Structural Adjustment Programs on the NARS, see Tabor, 1995.

Countries differ in their responses to changes in the structure of local domestic wages and salaries of scientists relative to international wages of scientists abroad. Those countries that are slow in responding tend to have the most serious chronic-systemic staff instability in their NARS, resulting in the mass exodus of their researchers. Countries that respond swiftly and adjust the salaries of their researchers tend to retain staff in their NARS. Prolonged declines in the terms of trade of agricultural exports of a developing country lead to protracted domestic economic depression, decreased government revenues, prolonged cuts in NARS funding and the atrophy of research programs leading to a mass exodus of research staff.

When research projects suffer wide fluctuations in funding, research staff become demoralized and leave the NARO, either for other research institutions perceived to have more stable funding, such as the universities, the public service or the private sector; or they emigrate overseas as a final solution. Unstable funding introduces unduly long time lags between the commencement of research, the attainment of research objectives, and the generation of new technologies. Finally, on the demand side, the grossly underdeveloped capacity to mobilize all stakeholders to demand more stable research staffing for the NARS exacerbates the chronic-systemic staff instability problem.

A NARS/NARO has the least harmful form of research staff instability in the transient-individual case and the worst form when it is both systemic and chronic. The chronic-individual and transient-systemic categories of instability are harmful but it cannot be said, *a priori*, which is more harmful.

Uncertainties created by research staff instability

As with budget allocations and disbursements, the NARS leader or NARO manager does not know which of his research staff might leave employment in a given year. For planning and management purposes, the NARO manager needs to know the chances of his research staff leaving or remaining on the job in any given year. This is because of the disabling environment of many country NARS and the attractions of alternative employment opportunities for scientists.

It is reasonable to assume that the decision of a research staff to stay or to leave the job in a NARO in any given year is a chance outcome (random variable) that can be represented as a Bernoulli trial with two possible outcomes: to leave or to remain on the job. The decision is influenced by the individual researcher's experiences, job satisfaction, constraints and opportunities. In principle, the chances (probabilities) of research staff leaving the NARO after a given time interval can be calculated assuming a particular probability distribution such as the binomial or uniform probability distribution. These theoretical probabilities can be compared with empirical probabilities of research staff leaving or staying on the job derived from actual responses from the scientific community in the NARS (see Appendix III).

The consequences of research staff instability

Research staff instability has serious consequences for the effectiveness of NARS. Unanticipated exits by research staff disrupt the operation of research programs, and program effects may be limited to the specific program or to many programs, depending on whether the instability is individual or systemic in nature. Research staff instability leads to half-completed, poorly completed, or abandoned research projects. Staff instability disrupts the knowledge production processes within the NARS. It makes the lags in the knowledge production process unduly long: the lag between the existence of a problem and its recognition as a researchable problem; between recognition of the problem and the formulation of a research proposal; between problem formulation and research entrepreneurship to procure funds to commence research, and the lag between commencement of research and the production of validated knowledge that throws up a menu of new agricultural technologies. A NARS or NARO experiencing chronic-systemic research staff instability may suffer such a reduction in effectiveness as to threaten the institutional sustainability which remains a major concern of most SSA NARS (Eicher, 1990).

Research staff instability prevents a NARS or NARO from continuously building up a body of knowledge or niche for which the NARS or NARO is uniquely recognized within the scientific community. Bedeviled by high staff instability, many research projects that are started with high hopes quickly atrophy. The instability-induced abandonment of research projects raises the ultimate cost of doing research. In extreme cases, chronic-systemic research staff instability involving the loss of competent and experienced researchers may result in a low level “stable” equilibrium in which many of those left behind are those that are locked in the NARO, either because of the special attractions of the environment, or lack of alternative employment opportunities.

Research Governance Instability

Damage caused by high levels of research staff instability can be controlled if there is continuity in research institute governance, defined rather narrowly for this purpose as the institute’s Board of Governors. When research governance instability is added to policy, institutional, funding and staffing instabilities, the result is a convolution of instabilities which makes the challenge of running an effective NARS truly daunting. Research governance is unstable when there are frequent changes in the Board of Governors. Governing Boards have responsibility for general policy guidelines consistent with government priorities. They also act as custodians of resources allocated by government to the NARS. Most of the instability in NARS/NARO governance is not from the voluntary exit of individual members of the Governing Boards but from the frequent mass dissolution and reconstitution of the Boards. Unlike the private sector, Governing Board members of research institutes in most SSA countries have a fixed non-overlapping tenure in which members are appointed and removed at the same time by government. This mode of appointing and removing Board members leaves no scope for “institutional memory” in research institute governance. In some instances, NAROs are left for years without Governing Boards, leaving a void in institutionalized research program and financial accountability.

Research governance instability is mostly caused by political instability. Frequent changes in government bring new sets of ministers who dissolve existing Governing Boards and replace them with their own appointees, whether or not the tenures of Board members have expired. Countries with high political instability also tend to have high levels of research governance instability, as new ministers dissolve and reconstitute Governing Boards, not necessarily because of proven incompetence but because of the patronage system. And unlike the private sector, there may be no other Executive Directors on the Board apart from the Institute Director. Where Institute Directors are frequently removed, this further worsens the prospects for continuity in institute governance.

3. Empirical Analysis of NARS Instability

Introduction

This Section presents empirical results from Nigeria aimed at validating the analytical tools developed in Section II. While Section II presents the general analytical framework for the sample of African countries to be covered in the whole study, this Section presents some empirical applications of the analytical tools using Nigerian data. It is expected that most of the analytical tools will be validated with the completion of the remaining African case studies. Furthermore, some of the empirical tools here presented should be regarded as empirical proxies of the analytical tools whenever there is no exact correspondence.

Choice of Nigeria for phase 1 case study

The choice of Nigeria for the Phase 1 case study was dictated by three considerations. First, Nigeria has arguably the largest and most complex NARS. It has the largest network of agricultural universities, agricultural research institutes, faculties of agriculture and veterinary medicine in general universities, as well as the research facilities of the Consultative Group on International Agricultural Research. Nigeria generates the largest value-added in agricultural GDP of all African countries and has the largest population. Second, the elements of the evaluation of the Nigerian NARS provide a classic example of NARS instability. Finally, Nigerian data was relatively accessible for a trial run. While some elements of the Nigerian NARS experience are unique—as with any country-specific case study—it is hoped that some of the empirical findings will have general applicability to the other countries in Africa and the other regions.

Data was collected from the agricultural research institutes using a combination of questionnaires, documents and personal meetings with NARS leaders and NARO managers. Time and resources did not permit data collection from the faculties of agriculture of general universities, and the agricultural universities. Only those aspects of the data relating to NARS instability are analyzed for the purpose of this report—other aspects relating to agricultural research policy frameworks in sub-Saharan Africa will be presented in the Phase II reports. Though NARO managers (Institute Directors) initially grumbled about the large amounts of funding and staffing data required in this study, they soon quickly realized the value of the new database for institute management and extended their full co-operation. Institute Directors have expressed their gratitude to ISNAR for the database that this project compelled them to build.

Nigerian NARS: An Overview

Nigeria, with a land area of 924,000 Km², has an estimated population of almost 112,000,000, about 19 percent of the population of sub-Saharan Africa. It is a federation with three tiers of government (federal, state and local) that started off at Independence

(1960) with three regions (states) but now has 36 states, created by successive military administrations. Nigeria has been under the military for 27 out of 37 years since Independence.

Recent developments on the national and international scenes have implications for the Nigerian national agricultural research system. At the national level, these developments include rapid increases in aggregate population, the massive rural-urban migration and the changes in demographic structure in which over 45 percent of the population is younger than 15 years. Other trends include dramatic increases in personal nominal incomes and successive devaluations of the foreign exchange rate that have raised the prices of food imports and created demand pressures on domestic substitutes for food imports. On the supply side, upward adjustments in the foreign exchange rate have resulted in dramatic increases in prices of imported inputs such as fertilizers, farm machinery and implements, and pesticides, at the same time that policy reforms have compelled reductions in farm-input subsidies. Deforestation, desertification, soil erosion and reduced rotational bush fallow periods are on the increase, and, at the same time, incidents of reported conflicts between nomadic herdsman and arable crop farmers over land property rights are increasing and are a manifestation of increased pressures on resources.

At the international level, global trends in economic liberalization, deregulation and the globalization of factor and product markets on the one hand, and the globalization of agricultural research on the other, place new emphasis on competitiveness of Nigerian (and African) agriculture. Of equal importance are the rapid advances in biotechnology, information and communication technology, and computing that are creating new inequalities to which Nigerian (indeed African) agriculture must develop the capacity to respond, if it is not to be marginalized.

The Nigerian national agricultural research system currently consists of 18 agricultural research institutes⁹ (see Table 1), three agricultural universities, and 28 faculties of agriculture and veterinary medicine (see Table 2). In addition, the International Institute for Tropical Agriculture has its headquarters in Ibadan while four other Centers of the Consultative Group on International Agricultural Research have stations in different locations in Nigeria: the International Crops Research Institute for Semi Arid Tropics; International Livestock Research Institute, International Rice Research Institute and the West African Rice Development Association. The main features of Nigeria's agricultural zones are summarized in Appendix Table 1. Features of the distribution of research facilities include the following:

- the South-West Zone has the largest concentration of research institutes (9 institutes, or 50 percent) while the North-East and South-East Zones have the least with one institute each (5% each).

9 The National Research Institute for Chemical Technology (NRICT), formerly Leather Research Institute of Nigeria, is included in the sample for this study though it only has a partial mandate in agriculture. The mandate of NRICT covers leather auxiliaries, industrial chemicals, chemical pollution, etc.

Table 1. The Distribution of Agricultural Research Institutes, Nigeria, 1997

Institute	Headquarters location	Zone	Sub-stations	Commodity mandate
1. Cocoa Research Institute of Nigeria (CRIN)	Onigambari, Ibadan, Oyo	South-West	Owena, Ikom, Udonmora, Ibeke, Manbilla, Ochaja	Cocoa, cola, cashew, coffee, tea
2. Nigerian Institute for Oil Palm Research (NIFOR)	near Benin City, Edo	South-West	Ibesit, Abak, Dutse, Ikoga-Badagry, Onuebum	Oil palm, coconut, date palm, raffia palm
3. Forestry Research Institute of Nigeria (FRIN)	Ibadan, Oyo	South-West	Samaru, Kano, Sapoba, Umuahia, Onne	Forestry and forest products utilization, agroforestry and wildlife management
4. Institute of Agricultural Research and Training (IAR&T)	Ibadan, Oyo	South-West	Ikenne, Orin-Ekiti, Ile-Ife, Ilora, Balla-Ilorin, Mokwa (dormant)	Maize, kenaf, jute, sisal hemp
5. National Horticultural Research Institute (NIHORT)	Ibadan, Oyo	South-West	Mbato, Bagauda	Fruits and vegetables, ornamental plants.
6. Nigerian Institute for Oceanography and Marine Research (NIOMR)	Lagos, Lagos	South-West	ARAC	Resources and physical characteristics of Nigeria's territorial waters and high seas.
7. Federal Institute for Industrial Research (FIRO)	Oshodi, Lagos, Lagos	South-West	—	Industrial processing of local raw materials.
8. Nigerian Stored Products Research Institute (NSPRI)	Ilorin, ¹ Kwara	South-West	Ibadan, Kano, Lagos, Port Harcourt, Sapele	Handling and storage of crops
9. Rubber Research Institute of Nigeria (RRIN)	Iyanomo, Edo	South-West	Akwete, Igbotako, Gashua	Rubber, rubber products, gum arabic, latex-producing plants
10. Institute for Agricultural Research (IAR)	Zaria, Kaduna	North-West	Kadawa, Kano, Talata Mafara, Bakura	Sorghum, ground-nut, cotton, cowpea, sunflower.

Table 1. The Distribution of Agricultural Research Institutes, Nigeria, 1997 (continued)

Institute	Headquarters location	Zone	Sub-stations	Commodity mandate
11. National Animal Production Research Institute (NAPRI)	Shika-Samaru, Zaria, Kaduna	North-West	Otukpo, Talata Mafara, Ubiaja, Gwada	Cattle, sheep, goats, poultry, other livestock
12. Nigerian Institute for Trypanosomiasis Research (NITR)	Kaduna, Kaduna	North-West	Vom, Gboko, Suleija, B/Ladi, Kano, Bida, G/Wuja, Akwanga, Bauchi	Trypanosomiasis and oncho-cerciasis
13. National Agricultural Extension and Research Liaison Service (NAERLS)	Zaria, Kaduna	North-West	Zaria, Maiduguri, Badeggi, Ibadan, Umudike	Development, collection and dissemination of appropriate agricultural technologies; monitoring and evaluation of agricultural information
14. Nigerian Veterinary Research Institute (NVRI)	Vom, Plateau	Central	18 Sub-stations	Animal diseases
15. National Cereals Research Institute (NCRI)	Badeggi Niger	Central	Ibadan, Mokwa, Umuahia, Uyo, Birnin Kebbi, Bacita, Yandev, Warri, Numan	Rice, soybean, beniseed, sugar cane
16. National Institute for Freshwater Fisheries Research (NIFFR)	New Bussa, Niger	Central	Lade Chad Research Institute	Development and co-ordination of freshwater fisheries
17. Lake Chad Research Institute (LCRI)	Maiduguri, Borno	North-East	4 Out-stations	Wheat, millet, barley.
18. National Root Crops Research Institute (NRCRI)	Umudike, Abia	South-East	Vom, Igbariam, Otobi	Yam, cassava, sweet potato, cocoyam, ginger.

¹ The National Centre for Agricultural Mechanization, Ilorin, also carries out some applied research on farm mechanization.

Table 2. The Distribution of Agricultural Universities and Faculties of Agriculture and Veterinary Medicine of General Universities in Nigeria, 1997

University	Location	Agricultural zone
1. University of Agriculture	Makurdi, Benue	Central
2. University of Ilorin • Faculty of Agriculture	Ilorin, Kwara	Central
3. Federal University of Technology • School of Agriculture and Agricultural Technology	Minna, Niger	Central
4. Ahmadu Bello University • Faculty of Agriculture • Faculty of Veterinary Medicine	Zaria, Kaduna	North-West
5. Usman Dan Fodio University • Faculty of Agriculture • Faculty of Veterinary Sciences	Sokoto, Sokoto	North-West
6. University of Maiduguri • Faculty of Agriculture (National Centre for Arid Zone Research) • Faculty of Veterinary Medicine	Maiduguri, Borno	North-East
7. Federal University of Technology • School of Agriculture and Agricultural Technology	Yola, Adamawa	North-East
8. Abubakar Tafawa Balewa University of Technology • School of Agriculture	Bauchi, Bauchi	North-East
9. University of Agriculture	Abeokuta, Ogun	South-West
10. University of Ibadan • Faculty of Agriculture and Forestry • Faculty of Veterinary Medicine	Ibadan, Oyo	South-West
11. Obafemi Awolowo University • Faculty of Agriculture	Ile-Ife, Osun	South-West
12. Federal University of Technology • School of Agriculture and Agricultural Technology	Akure, Ondo	South-West
13. Ogun State University • College of Agricultural Sciences	Ago-Iwoye, Ogun	South-West
14. Ladoke Akintola University of Technology • Faculty of Agriculture	Ogbomosho, Osun	South-West
15. Edo State University • College of Agriculture and Natural Resources	Ekpoma, Edo	South-West
17. Delta State University	Asaba, Delta	South-West
16. University of Benin • Faculty of Agriculture	Benin City, Edo	South-West
18. University of Agriculture	Umudike, Abia	South-East
19. Federal University of Technology • School of Agriculture and Agricultural Technology	Owerri, Imo	South-East
20. University of Nigeria • Faculty of Agriculture • Faculty of Veterinary Medicine	Nsukka, Enugu	South-East
21. University of Calabar • Faculty of Agriculture	Calabar, Cross-River	South-East

Table 2. The Distribution of Agricultural Universities and Faculties of Agriculture and Veterinary Medicine of General Universities in Nigeria, 1997 (continued)

University	Location	Agricultural zone
22. Abia State University of Technology • Agriculture and Veterinary Medicine College	Umuahia, Abia	South-East
23. Rivers State University of Science and Technology • Faculty of Agriculture • Rivers Institute of Agricultural Research and Training	Port Harcourt, Rivers	South-East
24. Nnamdi Azikiwe University • Faculty of Applied Biological Sciences	Awka, Anambra	South-East
25. Enugu State University of Science and Technology • Faculty of Agricultural Sciences	Enugu, Enugu	South-East
26. University of Uyo • Faculty of Agriculture	Uyo, Akwa Ibom	South-East

- the South-West Zone has the largest concentration of faculties of agriculture and veterinary medicine and universities of agriculture (both federal and state-owned), while the North-West has the smallest number of university-based agricultural research institutions.

The growth of the Nigerian NARS¹⁰ has been impressive as regards structure, number of research institutions and the level of resource support. According to a recent study (Roseboom, Beintema, Pardey and Oyedipe, 1994) total expenditure on agricultural research institutes rose from an annual average of N 4.208 million during 1961-64 to N 98.982 million during 1981-84 and N 210.161 million during 1987-91. While average expenditures show impressive growth rates, they also show considerable year-to-year variation (see Figure 1). Agricultural research has received a boost in funding in the last five years from the World Bank-assisted National Agricultural Research Project (NARP) which became operational in 1992. Research staff have similarly shown an impressive growth in numbers: from 136 full-time equivalent researchers in 1961 to 1012 researchers in 1991, an increase of 644 percent.

Institutional Instability

Agricultural research in Nigeria was born into institutional instability.¹¹ Over 100 years of government presence in agricultural research, institutional instability does not appear

¹⁰ "Nigerian NARS" in this study refers to:

- national agricultural research institutes
- faculties of agriculture of general universities (federal and state)
- universities of agriculture
- international agricultural research centers domiciled in Nigeria
- private sector agricultural research
- non-governmental agricultural research

For the most part, the empirical results in this study apply to the agricultural research institutes only.

¹¹ For an earlier discussion, see Idachaba, 1980.

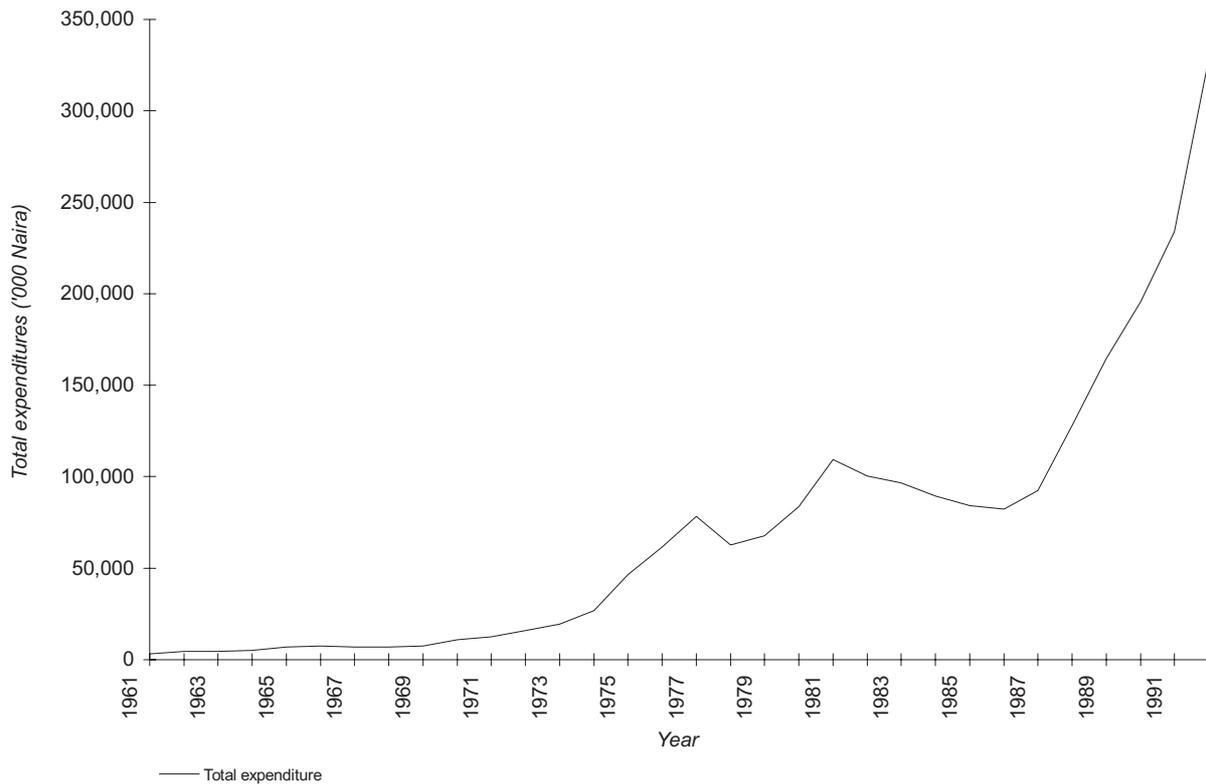


Figure 1. Total expenditures on agricultural research, Nigeria, 1961-1992

to be getting better. Three eras can be defined for the evolution of institutional arrangements for agricultural research: the pre-1951 period, the 1951-73 period and the 1973-97 period.

The pre-1951 era: Four pan-territorial research institutions were established by the Colonial Government within the framework of the West African Research Organization: the West African Cocoa Research Institute (WACRI), Tafo, Ghana (1944) with the Ibadan Substation (1953); the West African Institute for Oil Palm Research, near Benin City (1951); the West African Institute for Trypanosomiasis Research (WAITR), Kaduna (1947) and the West African Stored Products Research Unit (WASPRU), Lagos (1948). These institutes conducted research mainly on cocoa, oil palm, and the tse-tse fly and sleeping sickness in man, as well as the storage problems of export crops.

Research at Samaru, Zaria on cotton, groundnuts, pastures, livestock, and soils as a Unit of the old Department of Agriculture dates back to 1928. With regionalization, the Agricultural Research Station in Samaru became the Research and Specialist Services Division of the Northern Nigeria Ministry of Agriculture and Natural Resources. Soil investigations and food crop research were conducted at Moor Plantation, Umudike, Badeggi and Mokwa during this period. Industrial research commenced at Oshodi on agroindustrial processing investigations. The Department of Forestry, like the Department of Agriculture, had a research unit at Moor Plantation, Ibadan.

The 1951-73 era: In 1951, progress towards establishing Nigeria as a federation accelerated with the submission of proposals for regional self-government. By 1954, the Federal Department of Agricultural Research was created with headquarters at Moor Plantation. The Regions (West, East, and North) quickly established research arms of their Ministries of Agriculture, with headquarters research stations in Moor Plantation, Umudike and Samaru, Zaira, respectively. The maiden World Bank Mission recommended that the federal government should focus on basic research while the regional governments should concentrate on applied research (IBRD, 1955). The dissolution of the West African Research Organization (1962), following the attainment of independence in Anglophone West Africa, resulted in the establishment of three successor institutes by the Research Institutes Act (1964): Cocoa Research Institute of Nigeria (CRIN), Nigerian Institute for Oil Palm Research (NIFOR), and the Nigerian Institute for Trypanosomiasis Research (NITR). The Rubber Research Institute of Nigeria (RRIN) was established by the same Act.

The distribution of research institutes and units across ministries created a need for a mechanism for co-ordination. The National Council for Science and Technology (NCST) was created in February 1970 to establish priorities in science and technology in relation to national economic and social policy, and advise the federal government on national science policy, general planning and financial allocations and of the results of scientific research in agriculture, industry and social welfare. Other functions were the co-ordination of different agencies involved in the formulation of science policy and the promotion of public confidence in scientific expenditure and an enabling environment conducive to scientific research (Olayide, 1981).

To facilitate the co-ordinating role of the NCST, Councils were established to cover research institutes in agriculture, industry, medicine and the natural sciences. The Agricultural Research Council of Nigeria (ARC�) was established by Decree (1971) to co-ordinate all research institutes and research in agriculture.

The post-1973 era: The Research Institutes Decree 33 (1973) listed all the research institutes that were to come under the control of the Agricultural Research Council of Nigeria (ARC�) and vested powers in the Federal Government to take over the assets and liabilities of any existing State government-owned research institute. As noted elsewhere (Idachaba, 1980), this was a landmark development. In one fell swoop, it replaced the 1954-73 paradigm of joint State - federal government responsibility for agricultural research with a new monolith by which the federal government became the only tier of government funding all the Agricultural Research Institutes in Nigeria.¹² The takeover

¹² Pre 1954, only the Central Nigerian government funded agricultural research, with no role for the provincial governments. Both the 1954 and 1963 Constitutions placed agricultural research on the concurrent legislative list, meaning that the two tiers of government could constitutionally conduct research and establish institutions to conduct agricultural research. State government research institutions in the 1951-73 era included the Institute for Agricultural Research and Special Services (IAR+SS), the Institute of Agricultural Research and Training (IAR+T), the Agricultural Research and Training Station, Umudike (up to 1972), Livestock Research Station of IAR+SS, Shika, Samaru; Rubber Research Institute, and the Special Services (Extension) Unit of IAR+SS. At another level, the East Central State Government established the Products Development Agency (PRODA).

of State-run agricultural research institutes by the federal government occurred in an oil boom era when the federal government believed it could run virtually everything. It was the era in which State-owned universities (ABU, Ife, Nsukka) and State-owned hospitals were also taken over by the federal government (1976). It is both remarkable and unfortunate that, because of the enormous powers granted to the federal government under Decree 33 (1973) and the readiness of State governments to abdicate fiscal responsibilities at the first opportunity, no State government has established an autonomous research institute since 1973. The federal government has been busy trying to digest all the research institutes it swallowed as a result of the 1973 decree and has created no new institutes.¹³ A dysfunctional dualism has been created in the Nigerian NARS: while State governments have constitutional responsibility for agriculture, including extension, the federal government, constitutionally jointly responsible with State governments for research, has effectively usurped all the powers for agricultural research since 1973, surprisingly with no objections from any State government.

The Research Institutes Establishment Order (1975) transferred all the 18 agricultural research institutes to the Agricultural Research Council of Nigeria (ARCN).¹⁴ Decree 5 (1977) established the National Science and Technology Development Agency (NSTDA) as the new umbrella organization for co-ordinating all research in Nigeria and scrapped the NCST and ARCN. In January 1980, barely three years later, the NSTDA was itself scrapped and replaced with the new Federal Ministry of Science Technology.

Table 3 shows frequent changes in ministries/parastatals supervising agricultural research since independence (1960). In 36 years, agricultural research institutes have been under five different ministries, giving an average parentage life of 7.2 years per ministry, not counting those occasions when a ministry was recreated in exactly its old form. Agricultural research institutes were statutorily under two parastatals for 4 years, giving an average parentage life of just 2 years per parastatal. The Federal Ministry of Science and Technology has had many lives: it was created or recreated three times over a period of 13 years. The fluctuating life of the Ministry mirrored the country's political instability: it was created or recreated three times by new in-coming regimes (January 1980, August 1985 and 1993) and scrapped once by a new regime (January 1984). The Ministry's fluctuating fortunes were not even saved by political stability: the same Babangida regime that recreated the Ministry in 1985 did not hesitate to scrap it (again) in 1992.

13 The only exception appears to be the new Center for Genetic Resources and Biotechnology, Moor Plantation, Ibadan (1987).

14 The institutes transferred to the ARCN were: Cocoa Research Institute (CRIN); Forestry Research Institute of Nigeria (FRIN); Nigerian Institute for Oil Palm Research (NIFOR); Nigerian Institute for Trypanosomiasis Research (NITR); Rubber Research Institute of Nigeria (RRIN); Institute for Agricultural Research (IAR); Institute of Agricultural Research and Training (IAR+T); National Cereals Research Institute (NCRI); National Root Crops Research Institute (NRCRI); National Animal Production Research Institute; (NAPRI); Nigerian Institute for Oceanography and Marine Research (NIOMR); Kainji Lake Research Institute (KLRI); Lake Chad Research Institute (LCRI); Nigerian Veterinary Research Institute (NVRI); Nigerian Stored Products Research Institute (NSPRI); Leather Research Institute of Nigeria (LRIN) and Agricultural Extension and Research Liaison Services (AERLS).

Table 3. Agricultural Research Institutes and their Precursors, Nigeria, 1912-1996

Institute	Precursors
1. Cocoa Research Institute of Nigeria (CRIN)	i. West African Cocoa Research Institute Substation, Oni Gambari, Ibadan (1953)
2. Nigerian Institute for Oil Palm Research (NIFOR)	i. West African Institute for Oil Palm Research (WAIFOR), near Benin City (1951)
3. Nigerian Institute for Trypanosomiasis Research (NITR)	i. West African Institute for Trypanosomiasis Research (WAITR), Kaduna 1947
4. Rubber Research Institute of Nigeria (RRIN)	i. Rubber Research Station, Iyanomo, near Benin 1961
5. Federal Institute of Industrial Research (FIIRO)	i. Institute of Applied Technical Research, Oshodi, Lagos (1955)
6. Institute for Agricultural Research (IAR)	i. Agricultural Research Station, Samaru (1922) ii. Research and Specialist Services Division Headquarters, Northern Nigeria Ministry of Agriculture and Natural Resources (1957) iii. Institute for Agricultural Research and Special Services, Ahmadu Bello University, Zaria (1962)
7. National Cereals Research Institute (NCRI)	i. Food and Soil Research Unit, Department of Agriculture (1924) ii. Federal Department of Agricultural Research (1954)
8. National Root Crops Research Institute (NRCRI)	i. Provincial Experimental Farm (1923) ii. Eastern Nigeria Experimental Research Station (1956) iii. Agricultural Research and Training Station (1965) iv. Federal Agricultural Research and Training Station (1972)
9. National Horticultural Research Institute (NIHORT)	i. National Fruit and Vegetable Experimental and Demonstration Center (1971)
10. Institute of Agricultural Research and Training (IAR+T)	i. Research and Investigations Division, Western Nigeria Ministry of Agriculture and Natural Resources (1956)
11. National Animal Production Research Institute (NAPRI)	i. Shika Stock Farm (1928) ii. Animal and Pasture Section, Northern Nigeria Ministry of Natural Resources (1954) iii. Substation of IAR (1962)
12. Nigerian Veterinary Research Institute (NVRI)	i. Veterinary Research, Zaria ii. Nigerian Veterinary Department, Vom (1924) iii. Federal Department of Veterinary Research (1954)
13. National Institute for Freshwater Fisheries Research (NIFFR)	i. Kainji Lake Research Project (FAO) (1965) ii. Kainji Lake Research Institute (1975)
14. Lake Chad Research Institute (LCRI)	i. Lake Chad UNDP/FAO Project (1971)
15. Nigerian Institute for Oceanography and Marine Research (NIOMR)	i. Marine Biology Division, Federal Department of Fisheries (1971)

Table 3. Agricultural Research Institutes and their Precursors, Nigeria, 1912-1996 (continued)

Institute	Precursors
16. Forestry Research Institute of Nigeria (FRIN)	i. Department of Forestry (1912) ii. Federal Department of Forestry Research (1954)
17. National Research Institute for Chemical Technology (NRICT)	i. Hides and Skins Demonstration Project (1964) ii. Federal Hides, Skin, Leather Institute (1972) iii. Leather Research Institute of Nigeria (1975)
18. National Agricultural Extension and Research Liaison Service (NAERLS)	i. Research and Specialist Services Division, Northern Nigeria Ministry of Agriculture and Natural Resources (1957) ii. Institute for Agricultural Research and Special Services (1962) iii. Agricultural Extension and Research Liaison Services (1975)
19. Nigerian Stored Products Research Institute (NSPRI)	i. West African Stored Products Research Unit (WASPRU) (1948) ii. Nigerian Stored Products Unit (1962)
20. Product Development Institute (PRODI)	i. Products Development Agency (PRODA) (1971)

Note: "Agricultural" as used here denotes research institutes with direct and indirect relevance to agriculture. The Agricultural Research Institutes currently under the Federal Ministry of Agriculture and Natural Resources are CRIN, NIFOR, RRIN, FRIN, IAR, IAR+T, NCRI, NRCRI, NAPRI, NAERLS, NIHORT, NVRI, NIFFR, LCRI, NIOMR.

A "macro" view of instability of institutional arrangements for managing agricultural research institutes conceals variations in the changing parentage of individual research institutes. Tables 4-5 present individual institute experiences, including the experiences of precursors of these institutes. From Table 5, the median number of ministerial or parastatal parents per institute (and its precursors) was 9 over the period, ranging from 7 ministries/parastatals for NIHORT, NIFFR, LCRI, NIOMR and PDI to 11 ministry/parastatal parents for NRCRI, NAPRI and NVRI.

Consequences of institutional instability

The high institutional instability has had adverse effects on the Nigerian NARS. First, after more than 100 years of government presence in agricultural research, Nigeria still does not have a national agricultural research policy. Policy makers have perennially been swept from office long before they have had time to think strategically about the Nigerian NARS. Second, NARS leaders and managers have been left almost dazed by the frequency of institutional changes and what these have meant for research planning and priority setting. Third, frequent changes have meant that there was no constant advocacy at the highest levels of government on behalf of the Nigerian NARS. Funding of research depended on what caught the fancy of the political leadership of the moment.

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96

Institute	Headquarters	Historical antecedents	Ministry or supervisory agency
1. Cocoa Research Institute of Nigeria (CRIN)	Oni Gambari Ibadan, Oyo State	<ul style="list-style-type: none"> • Substation of West African Cocoa Research Institute (1953) • Cocoa Research Institute of Nigeria (1964) 	<ol style="list-style-type: none"> i. Home Secretary, London through West African Research Organization, 1953-62 ii. Federal Ministry of Economic Development, 1962-1966 when CRIN was transferred to the new Federal Ministry of Agriculture and Natural Resources iii. Federal Ministry of Agriculture and Natural Resources, 1966-75 iv. Agricultural Research Council of Nigeria (ARC/N), National Council for Science and Technology (NCST), 1975-77 v. National Science and Technology Development Agency (NSTDA), 1977 - January 1980 vi. Federal Ministry of Science and Technology, 1980-83 vii. Federal Ministry of Education, Science and Technology, January 1984 - August 1985 viii. Federal Ministry of Science and Technology, September 1985 - 1992 ix. Federal Ministry of Agriculture and Natural Resources, 1992 - to date
2. Nigerian Institute for Oil Palm Research (NIFOR)	near Benin City, Edo State	<ul style="list-style-type: none"> • West African Institute for Oil Palm Research (WAIFOR), 1951 • Nigerian Institute for Oil Palm Research (1964) 	Same parental history as CRIN.
3. Nigerian Institute for Trypanosomiasis Research (NITR)	Kaduna, Kaduna State	<ul style="list-style-type: none"> • West African Institute for Trypanosomiasis Research (WAITR), 1947 • Nigerian Institute for Trypanosomiasis Research (1964) 	<ol style="list-style-type: none"> i. Colonial office through West African Research Organization, 1947-62 ii. Federal Ministry of Economic Development, 1962-75 iii. Medical Research Council of Nigeria/NCST, 1975-77 iv. National Science and Technology Development Agency (NSTDA), 1977-January 1980 v. Federal Ministry of Science and Technology, January 1980-December 31, 1983 vi. Federal Ministry of Education, Science and Technology, October 1985-August 1992 vii. Federal Ministry of Health 1992-January 1993 viii. Federal Ministry of Health, January 1, 1993 to date

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
4. Nigerian Stored Products Research Institute (NSPRI)	Lagos, up till 1987; Ilorin, Kwara State	<ul style="list-style-type: none"> West African Stored Products Research Unit (WASPRU), 1948 Nigerian Stored Products Unit, 1962-75 Nigerian Stored Products Research Institute (1979) 	<ol style="list-style-type: none"> Colonial Office, West African Research Organization 1947-62 Federal Ministry of Trade, 1962-75 NSTDA, 1977-January 1980 Federal Ministry of Science and Technology, January 1980-Dec 31, 1983 Federal Ministry of Education, Science and Technology, January 1984-Aug 1985 Federal Ministry of Science and Technology, October 1985-August 1992 Federal Ministry of Commerce and Industry, August 1992-January 1993 Federal Ministry of Science and Technology, January 1993 to date
5. Institute for Agricultural Research (IAR)	Samaru, Zaria, Kaduna State	<ul style="list-style-type: none"> Agricultural Research Station, Department of Agriculture, 1922-57; Headquarters, Research and Specialist Services Division, Ministry of Agriculture and Natural Resources, Kaduna, 1957-62. Institute for Agricultural Research and Special Services, October 1962-75; Institute for Agricultural Research, 1975 to date 	<ol style="list-style-type: none"> Central Department of Agriculture (All Nigeria), Northern Nigeria, 1922-57 Northern Nigeria Ministry of Agriculture and Natural Resources, 1957-62 Ahmadu Bello University, Zaria, established by the Northern Nigeria Government in 1962, and Northern Regional Government, October 1962-1967 Ahmadu Bello University, Zaria and Northern States Interim Common Services Agency, May 1967- November-75 Ahmadu Bello University, Zaria and ARCN/NCST, November 1975-77 Ahmadu Bello University, Zaria and NSTDA, with the scrapping of ARCN, NCST 1977, 1977 - January 1980 Ahmadu Bello University (itself taken over by the Federal Government in 1976), and Federal Ministry of Science and Technology, January 1980-December 1983 Ahmadu Bello University and Federal Ministry of Education, Science and Technology, January 1984 August-85 Ahmadu Bello University and Federal Ministry of Science and Technology, September 1985-August 1992 Federal Ministry of Agriculture and Natural Resources and Ahmadu Bello University, August 1992 to date.

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
6. National Cereals Research Institute (NCRI)	<ul style="list-style-type: none"> i. Moor Plantation 1910-1985 ii. Baddegi, 1985 to date 	<ul style="list-style-type: none"> • Food and Soil Research Unit of the Department of Agriculture, 1924-54 • Federal Department of Agricultural Research, 1954-1975; • National Cereals Research Institute, 1975 to date. 	<ul style="list-style-type: none"> i. Department of Agriculture (All Nigeria), 1921-54 ii. Federal Ministry of Economic Development, 1954-1965 iii. Federal Ministry of Natural Resources and Research, 1965-66 iv. Federal Ministry of Agriculture and Natural Resources, 1966-75 v. ARC/N/CST, 1975-77 vi. NSTDA and Ahmadu Bello University, 1977-January 1980 vii. Federal Ministry of Science and Technology and Ahmadu Bello University, January 1980-December 1983 viii. Federal Ministry of Education, Science and Technology, January 1984-August 1985 ix. Federal Ministry of Science and Technology, October 1985-August 1992 x. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
7. National Root Crops Research Institute (NRCRI)	<ul style="list-style-type: none"> Umudike, Abia State 	<ul style="list-style-type: none"> • Provincial Experimental Farm (1923) • Eastern Nigeria Agricultural Research Station (1956) • School of Agriculture (1955) • Agricultural Research and Training Station (1965) • Federal Agricultural Research and Training Station (1972) • NRCRI (1975) 	<ul style="list-style-type: none"> i. Department of Agriculture (All Nigeria), 1923-56 ii. Eastern Nigeria Regional Ministry of Agriculture and Natural Resources, 1956-67 iii. Nigerian Civil War; Station became Biafran War Research Centre, 1967-70 iv. East Central State Ministry of Agriculture and Natural Resources, 1970-72 v. Federal Ministry of Agriculture and Natural Resources, 1972-75 vi. ARC/N/CST, 1976-77 vii. NSTDA, 1977-Jan 1980 viii. Federal Ministry of Science and Technology, January 1980-December 1983 ix. Federal Ministry of Education, Science and Technology, January 1984-August 1985 x. Federal Ministry of Science and Technology, October 1985-August 1992 xi. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
8. National Animal Production Research Institute (NAPRI)	Shika-Samaru, Zaria Kaduna State	<ul style="list-style-type: none"> • Shika Stock Farm (1928) Northern Region • Animal and Pasture Section Ministry of Natural Resources (1954). • Substation of IAR (1962). • NAPRI (1975) 	<ol style="list-style-type: none"> i. Department of Agriculture (All Nigeria), 1928-54 ii. Northern Region Ministry of Natural Resources, 1954-April 1962 iii. Northern Region Ministry of Animal and Forestry Resources, April-October 1962 (6 months) iv. Institute for Agricultural Research, Ahmadu Bello University and Northern Region Ministry of Agriculture and Natural Resources, 1962-66 v. Institute for Agricultural Research (IAR) Ahmadu Bello University (ABU) and Interim Common Services (ICSA) of the Northern States, 1966-1975 vi. ABU and ARCN (NCST), 1975-77 vii. NSTDA, and ABU, 1977 - January 1980 viii. ABU and Federal Ministry of Science and Technology, January 1980-December 1983 ix. ABU and Federal Ministry of Education, Science and Technology, January 1984-August 1985 x. ABU and Federal Ministry of Science and Technology, October 1985-August 1992 xi. ABU and Federal Ministry of Agriculture and Natural Resources, August 1992 to date.

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
9. Nigerian Veterinary Research Institute (NVRI)	Vom, Plateau State	<ul style="list-style-type: none"> • Veterinary Research, Zaria (1914) • Nigerian Veterinary Department, Vom, (1924) • Federal Department of Veterinary Research (1954); • Nigerian Veterinary Research Institute (1975) 	<ol style="list-style-type: none"> i. Department of Agriculture, 1914-51 ii. Federal Veterinary Department, 1951-54 iii. Federal Ministry of Economic Development, 1956-65 iv. Federal Ministry of Natural Resources and Research, 1965-66 v. Federal Ministry of Agriculture and Natural Resources, 1966-75 vi. ARC/NCS, 1975-1977 vii. NSTDA, 1977-January 1980 viii. Federal Ministry of Science and Technology, January 1980-December 1983 ix. Federal Ministry of Education, Science and Technology, January 1984-August 1985 x. Federal Ministry of Science and Technology, October 1985-August 1992 xi. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
10. Forestry Research Institute of Nigeria (FRIN)	Ibadan, Oyo State	<ul style="list-style-type: none"> • Department of Forestry (1912) 	<ol style="list-style-type: none"> i. Department of Forestry (All Nigeria), 1912-54 ii. Federal Ministry of Economic Development, 1954-65 iii. Federal Ministry of Natural Resources and Research, 1965-66 iv. Federal Ministry of Agriculture and Natural Resources, 1966-75 v. ARC/NCS, 1976-77 vi. NSTDA, 1977-January 1980 vii. Federal Ministry of Science and Technology, January 1980-December 1983 viii. Federal Ministry of Education, Science and Technology, January 1984-August 1985 ix. Federal Ministry of Science and Technology, October 1985-August 1992 x. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.

Table 4. Changing Parental Ministries of Research and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
11. Rubber Research Institute of Nigeria (RRIN)	Iyanomo, Edo State	<ul style="list-style-type: none"> • Rubber Research Station, Western Nigeria • Ministry of Agriculture and Natural Resources (1961) • Rubber Research Station, Mid West Region (1963) • Rubber Research Institute of Nigeria through merger of the two stations at Iyanomo and Akwete (1971) • RRIN (1975) 	<ol style="list-style-type: none"> i. Western Nigeria Ministry of Agriculture and Natural Resources, 1961-63 ii. Mid Western Nigeria Ministry of Agriculture and Natural Resources, 1963-1971 iii. ARCN/NCST, 1971-77 iv. NSTDA, 1977-January 1980 v. Federal Ministry of Science and Technology, January 1980-December 1983 vi. Federal Ministry of Education, Science and Technology, January 1984-August 1985 vii. Federal Ministry of Science and Technology, October 1985-August 1992 viii. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
12. Institute of Agricultural Research and Training (IAR+T)	Ibadan, Oyo State	<ul style="list-style-type: none"> • Research and Investigations Division, Western Nigeria Ministry of Agriculture and Natural Resources (1956), IAR+T (1969) 	<ol style="list-style-type: none"> i. Department of Agriculture (All Nigeria), 1912-56 ii. Western Nigeria Ministry of Agriculture and Natural Resources, 1956-62 iii. University of Ife and Western Nigeria Ministry of Agriculture and Natural Resources, 1962-75 iv. ARCN/NCST, 1976-77 v. NSTDA, 1977-January 1980 vi. Federal Ministry of Science and Technology, January 1980-December 1983 vii. Federal Ministry of Education, Science and Technology, January 1984-August 1985 viii. Federal Ministry of Science and Technology, October 1995-August 1992 ix. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.

Table 4. Changing Parental Ministries of Research Institute and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
13. National Horticultural Research Institute (NIHORT)	Idi-Ishin, Ibadan, Oyo State	<ul style="list-style-type: none"> • National Fruit and Vegetable Experimental and Demonstration Centre, Joint FMANR - UNDP Project up to 1975 • National Horticultural Research Institute (1975) 	<ul style="list-style-type: none"> i. Federal Ministry of Agriculture and Natural Resources and UNDP up till 1975 ii. ARCN/NCST, 1976-77 iii. NSTDA, 1977-January 1980 iv. Federal Ministry of Science and Technology, January 1980-December 1983 v. Federal Ministry of Education, Science and Technology, January 1984-Aug 1985 vi. Federal Ministry of Science and Technology, October 1985-August 1992 vii. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
14. National Institute for Freshwater Fisheries Research (NIFFR)	New Bussa, Niger State	<ul style="list-style-type: none"> • Kainji Lake Research Institute (1975) • National Institute for Freshwater Fisheries Research (1987) 	<ul style="list-style-type: none"> i. Federal Ministry of Agriculture and Natural Resources, 1966-1975 ii. ARCN/NCST, 1976-77 iii. NSTDA, 1977-January 1980 iv. Federal Ministry of Science and Technology, January 1980-December 1983 v. Federal Ministry of Education, Science and Technology, January 1984-August 1985 vi. Federal Ministry of Science and Technology, October 1985-August 1992 vii. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
15. Lake Chad Research Institute (LCRI)	Maiduguri, Borno State	<ul style="list-style-type: none"> • UNDP/FAO Project up till 1974 • Lake Chad Research Institute (1975) 	<ul style="list-style-type: none"> i. UNDP/FAO/ Federal Ministry of Agriculture and Natural Resources (up till 1974) ii. ARCN/NCST, 1976-77 iii. NSTDA, 1977-January 1980 iv. Federal Ministry of Science and Technology, January 1980-December 1983 v. Federal Ministry of Education, Science and Technology, January 1984-August 1985 vi. Federal Ministry of Science and Technology, October 1985-August 1992 vii. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
16. Nigerian Institute for Oceanography and Marine Research (NIOMR)	Lagos	<ul style="list-style-type: none"> • Marine Biology Division, Federal Department of Fisheries • National Institute for Oceanography and Marine Research (NIOMR), 1975 	<ol style="list-style-type: none"> Federal Ministry of Agriculture and Natural Resources up till 1975 ARC/N/CST, 1976-77 NSTDA, 1977-January 1980 Federal Ministry of Science and Technology, January 1980-December 1983 Federal Ministry of Education, Science and Technology, January 1984 - August 1985 Federal Ministry of Science and Technology, October 1985-August 1992 Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
17. Federal Institute of Industrial Research (FIRO)	Lagos	<ul style="list-style-type: none"> • Institute of Applied Technical Research (1955) • Federal Institute of Technical Research (1958) • Federal Institute of Industrial Research (1975) 	<ol style="list-style-type: none"> Federal Ministry of Commerce and Industry, 1955-75 Industrial Research Council of Nigeria (IRC/N)/NCST, 1976-77 NSTDA, 1977-January 1980 Federal Ministry of Science and Technology, January 1980-December 1983 Federal Ministry of Education, Science and Technology, January 1984-August 1985 Federal Ministry of Science and Technology, October 1985-August 1992 Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
18. National Agricultural Extension and Research Liaison Services (NAERLS)	Samaru, Zaria, Kaduna State	<ul style="list-style-type: none"> • Research and Specialist Services Division, Ministry of Agriculture and Natural Resources, Kaduna (1957); • Institute for Agricultural Research and Special Sources (1962), • Agricultural Extension and Research Liaison Services (1975); • National Agricultural Extension and Research Liaison Service (1991) 	<ol style="list-style-type: none"> Department of Agriculture (All Nigeria), 1922-57 Northern Nigeria Ministry of Agriculture and Natural Resources, 1957-62 Ahmadu Bello University and Northern Nigeria Ministry of Agriculture and Natural Resources, 1962-67 Ahmadu Bello University and Northern States Interim Common Services Agency, 1967-November 1975 Ahmadu Bello University, ARC/N/CST, 1975-77 NSTDA, 1977-January 1980 Federal Ministry of Science and Technology, January 1980-December 1983 Federal Ministry of Education, Science and Technology, January 1984-August 1985 Federal Ministry of Science and Technology, October 1985-August 1992 Federal Ministry of Agriculture and Natural Resources, August 1992 to date.

Table 4. Changing Parental Ministries of Research Institutes and their Historical Antecedents, Nigeria, 1912-96 (continued)

Institute	Headquarters	Historical antecedents	Supervisory ministry or agency
19. National Research Institute for Chemical Technology (NRICT)	Zaria, Kaduna State	<ul style="list-style-type: none"> • Hides and Skin Demonstration Project (1964) • Federal Hides, Skins Leather Institute (1972) • FAO Project ended in (1971) • Leather Research Institute of Nigeria (1975) • National Research Institute for Chemical Technology (NRICT), 1987 	<ol style="list-style-type: none"> i. FAO up to 1971 ii. Federal Livestock Department, Federal Ministry of Agriculture, 1972-75 iii. ARCN/NCST, 1975-77 iv. NSTDA, 1977-January 1980 v. Federal Ministry of Science and Technology, January 1980-Dec 1983 vi. Federal Ministry of Education, Science and Technology, January 1984-August 1985 vii. Federal Ministry of Science and Technology, October 1985-August 1992 viii. Federal Ministry of Agriculture and Natural Resources, August 1992 to date.
20. Products Development Institute	Enugu	<ul style="list-style-type: none"> • Projects Development Agency (PRODA), up till 1975 • Projects Development Institute (1975) 	<ol style="list-style-type: none"> i. East Central State Government, up till April 1976 ii. NCST/IRCN, 1976-77 iii. NSTDA, 1977-January 1980 iv. Federal Ministry of Science and Technology, January 1980-December 1983 v. Federal Ministry of Education, Science and Technology, January 1984-August 1985 vi. Federal Ministry of Science and Technology, October 1985-August 1992 vii. Federal Ministry of Science and Technology, August 1992 to date.

Table 5. Frequent Changes in Parent Ministry or Parastatal in charge of Agricultural Research Institutes, Nigeria, 1912-96

Research institute	Number of changes in parent ministry or supervising parastatal
1. Cocoa Research Institute of Nigeria (CRIN) ⁽¹⁾	9
2. Nigerian Institute for Oil Palm Research (NIFOR) ²	9
3. Nigerian Institute for Trypanosomiasis Research (NITR) ³	8
4. Rubber Research Institute of Nigeria (RRIN) ⁽⁴⁾	8
5. Federal Institute of Industrial Research (FIIRO) ⁽⁵⁾	8
6. Institute for Agricultural Research (IAR) ⁽⁶⁾	10
7. National Cereals Research Institute (NCRI) ⁽⁷⁾	10
8. National Root Crops Research Institute (NRCRI) ⁽⁸⁾	11
9. National Horticultural Research Institute (NIHORT) ⁽⁹⁾	7
10. Institute of Agricultural Research and Training (IAR&T) ⁽¹⁰⁾	8
11. National Animal Production Research Institute (NAPRI) ⁽¹¹⁾	11
12. Nigerian Veterinary Research Institute (NVRI) ⁽¹²⁾	11
13. National Institute for Freshwater Fisheries Research (NIFFR) ⁽¹³⁾	7
14. Lake Chad Research Institute (LCRI) ⁽¹⁴⁾	7
15. Nigerian Institute for Oceanography and Marine Research (NIOMR) ⁽¹⁵⁾	7
16. Forestry Research Institute of Nigeria (FRIN) ⁽¹⁶⁾	10
17. National Research Institute for Chemical Technology (NRICT) ⁽¹⁷⁾	8
18. National Agricultural Extension and Research Liaison Service (NAERLS) ⁽¹⁸⁾	10
19. Nigerian Stored Products Research Institute (NSPRI) ⁽¹⁹⁾	9
20. Product Development Institute (PDI) ⁽²⁰⁾	7

Notes: The periods covered date back to the precursors of these Institutes. (1)1953-96 (2)1951-96 (3)1947-96 (4)1961-96 (5)1955-96 (6)1922-96 (7)1921-96 (8)1923-96 (9)1971-96 (10)1912-96 (11)1928-96 (12)1914-96 (13)1966-96 (14)1971-96 (15)1971-96 (16)1912-96 (17)1971-96 (18)1922-96 (19)1947-96 (20)1971-96

Source: Underlying data sources from (Idachaba, 1980, NGRC, 1981; Olayide, 1981)

Since there was no consistent leadership, funding fluctuated considerably. Research staff were demoralized by the shifting institutional arrangements and loyalties that gave the impression that succeeding governments did not attach much importance to agricultural research or agricultural researchers. Fourth, institutional instability led to research staff instability and the exodus of research staff from the research institutes at rates that were higher than they would otherwise have been in the absence of institutional instability.

Why the high institutional instability?

There are four possible sources of the high degree of institutional instability.

Colonial roots of institutional instability

Agricultural research in Nigeria was a child of institutional instability right from its colonial origins. The British did not have a concept of a NARS in Nigeria and possibly other African colonies as well. Their concept was that of pan-territorial (transnational) research covering export crops in the West African (and the East African) colonies. Export crop research was organized within the umbrella of the West African Research Organization, with each pan-territorial research institute operating a network of substations in the main export crop producing countries. Where there was no pan-territorial institute (e.g. cotton), research was co-ordinated from the multinational headquarters in Britain (e.g. British Cotton Growers Association). The colonial administration conducted food and livestock research in scattered locations with no serious effort at co-ordination. The new post-independence nationalist government inherited from the colonial administration a culture of “muddling through” with institutional arrangements for managing a NARS.

Colonial legacy in Nigeria and India compared: British colonial legacy in institutional arrangements for managing agricultural research in India and Nigeria presents a puzzling lesson of sharp contrasts. While Britain made no serious effort to build a Nigerian NARS, her approach in India was methodical, systematic and comprehensive.

The Royal Commission of 1926 recommended the establishment of the Imperial Council of Agricultural Research (ICAR) to “promote, guide and co-ordinate agricultural research throughout India” [Randhawa, 1979; p. 21]. ICAR was established in May 1929 with a non-lapsing fund to co-ordinate research between the central and provincial governments. In the view of the Commission, ICAR was “to provide provincial governments with an organization embracing the whole research activities of the country, veterinary as well as agricultural” [Randhawa, 1979; p.22]. The Constitution and the *modus operandi* of the ICAR were sufficiently robust to guarantee stability: for example, the Chief Executive of ICAR was also Secretary to the Government of India right from inception to give it sufficient political and administrative clout.

The Indian Council of Agricultural Research had its first change in 1946. And the change was only cosmetic, involving no more than the substitution of “Indian” for “Im-

perial” on the eve of Independence. The first reorganization of ICAR took place in 1965, thirty-six years after its establishment. A suggestion by the Parker Committee to scrap ICAR and replace it with a new “Council for Agricultural and Food Research” was rejected outright by the Government as this would have “meant cutting all the links with the past” [Randhawa, 1979; p.76]. The governing body of ICAR was reconstituted to make it pre-eminently a body of scientists. The second reorganization in 1973 was meant to give ICAR more autonomy and flexibility. Whereas the Agricultural Research Council of Nigeria lasted for only six years before it was scrapped, the Indian Council of Agricultural Research operated for 36 years before its first reorganization and 44 years before the second reorganization. It remains unclear why the same colonial power at about the same period, adopted such contrasting approaches to institutional arrangements for managing agricultural research as Britain did in Nigeria and India. While one was piecemeal and *ad hoc*, the other was holistic and purposeful. With no legacy of stability, the Nigerian system quickly degenerated, exacerbated by other factors, into a chaotic and confusing system of institutional arrangements by trial and error.

Political instability

Frequent changes in government have been accompanied by frequent changes in institutional arrangements for managing the Nigerian NARS. The Federal Ministry of Science and Technology has been the favorite toy of successive governments: whereas the proposal for the establishment of ICAR went through extensive consultations in India, the Nigerian Ministry of Science and Technology, the NCST, ARCN and NSTDA were created by fiat, and scrapped by fiat. While the first creation of the Federal Ministry of Science and Technology by the Shagari civilian administration in 1980 was formally debated in the House of Representatives, succeeding military regimes in the last 15 years have gleefully created, scrapped and recreated the Ministry by military fiat.

Lack of socio-political consensus

The apparent lack of appreciation of the role and value of agricultural research in the society has made it easier for succeeding military regimes to create, scrap, and recreate institutions for managing the Nigerian NARS. Basic beliefs, norms and values, on which there is broad, general, societal agreement regarding agricultural research and its institutional infrastructures do not exist, especially within the civil service.

Failure of stakeholders

Users and beneficiaries of agricultural research who have a lot to gain from institutional stability have failed to articulate the demand for stable institutional arrangements from the government. Commodity associations, researchers, agroindustrialists and the general public have not been able to come together to demand more stable institutional arrangements for agricultural research from government, whether military or civilian.

Funding Instability

Let the Instability Index (I_f) of funding (budget) allocations to a NARS or Institute be defined as the coefficient of variation of allocations over a given time period, that is:

$$I_f = \frac{S}{\bar{X}} \quad (1)$$

where S is the standard deviation of budget allocations to a NARS or Research Institute over a given time period and \bar{X} is the sample mean. This measure does not take account of trend. For this, let the trend-corrected measure of instability, such as the normalized co-efficient of variation (I_f^1), be defined as:

$$I_f^1 = \frac{S^1}{\bar{X}} \quad (1^1)$$

where S^1 is the standard error of the estimated trend equation, and \bar{X} has its previous meaning.

In percentage terms, the corresponding instability indices are:

$$I_f = \left(\frac{S}{\bar{X}}\right) X 100, \text{ and } I_f^1 = \frac{S^1}{\bar{X}} X 100 \quad (1^{11})$$

The estimated trend equation was of the form:¹⁵

$$X_{jt} = \beta_0 + \beta_1 t + \varepsilon_t \quad (2)$$

where X_{jt} is fund allocated to the j^{th} research institute, t is time, β_0 and β_1 are the population regression parameters estimated by ordinary least squares and ε is the disturbance term. Ordinarily, it is expected that the trend-corrected instability indices from (1¹) will be less than the indices from (1).

For simplicity, instability will be characterized based on the following rules of thumb:

- (ii) $0 < S^1 < 0.10 \bar{X}$, mild instability

¹⁵ Funding or disbursements to research institutes from government can reasonably be represented by a linear approximation. Governments, in determining what funds to allocate or disburse to research institutes, are normally guided by the previous year's funding levels or recent funding history. In some cases, governments impose a given percentage annual growth in funding levels, suggesting that government funding can be approximated as a linear function of time. An exponential functional form was considered but much government funding behavior to research institutes can hardly be presumed to follow an exponential population regression trend line: Ministry of Finance officials in annual budget hearings are hardly ever in the mood to consider exponential growth trends in budget allocations, disbursements or the expenditures of research institutes. The usual practice is to stipulate in the budget call circular guidelines on allowable increases over the previous year's allocation. Furthermore, an examination of the residuals shows that the linear form provides a good fit.

- (iii) $0.10 \bar{X} \left\langle S^1 \right\rangle 0.5 \bar{X}$, moderate instability
- (iv) $0.5 \bar{X} \left\langle S^1 \right\rangle \bar{X}$, high instability
- (v) $S^1 \geq \bar{X}$, or $I_f^1 \geq 1$, severe instability

Data on budget allocations, disbursements and expenditures was collected from all research institutes in Nigeria, including those not under the administrative supervision of the Federal Ministry of Agriculture and Natural Resources. In addition to having overall measures of funding instability, NARS leaders and NARO managers are also interested in knowing if funding instability has increased or decreased over time. This requires sufficiently long periods to provide funding instability indices for different sub-periods in each institute or NARS for comparison. Instability indices were also computed separately for capital budgets and recurrent budgets to determine whether the empirical evidence was consistent with the proposition that capital budgets are more unstable than recurrent budgets. The Nigerian NARS has had little or no donor contribution for most of its history, unlike most sub-Saharan African countries. The effect of diversification through donor aid on funding instability could not be determined in this pilot phase. The sub-periods for which funding instability indices were computed were determined by the availability of data and the funding history of each Institute. For each institute, funding instability indices were estimated for three periods: the longest period for which funding data is available, the periods of the mid-1970s to the early 1980s and the mid-1980s to the mid-1990s, the two periods marking relatively good funding during economic prosperity, and relatively poor funding during the Structural Adjustment Program, respectively. For the trend-connected coefficients of variation, linear trend equations were estimated for each institute for each funding category and for each time period to derive the estimated standard errors of the estimated trend equations. This required the estimation of a large number of linear trend-equations to estimate the trend-corrected coefficient of variation, for each institute, of each funding (expenditure) category, and for each period, using current naira values.¹⁶

Instability of budget allocations

As expected, trend-corrected coefficients of variations of fund allocations to research institutes were less than the uncorrected coefficients (I^1) (Table 6). Though both measures of funding instability are presented in tables for comparative purposes, only the trend-

¹⁶ The use of real as opposed to nominal naira values might have presented the instability picture in bolder relief, but no satisfactory consumer-price index or GDP deflator of sufficient time coverage was available. Moreover, available GDP deflator series did not capture the entire life history of some institutes to enable a comparison of the pre-independence era with the subsequent periods. Reducing the analysis to the period for which deflator series are available would have left out interesting periods for some of the research institutes that are considered relevant for some of the propositions underlying this study. Converting naira values into dollar equivalents would have served little purpose for policy makers, NARS leaders and NARO managers who need to be sensitized to levels and fluctuations in naira allocations to institutes. For analysis using current dollar values, see Massell, 1970.

corrected coefficient of variation is used as the instability index in evaluating the funding and expenditure instability of the research institutes. The institutes are about evenly divided in the relative magnitude of capital funding instability in the two sub-periods using the trend-corrected coefficient of variation: instability in the latter (largely SAP) period exceeded instability in the earlier sub-period in five institutes (NAPRI, IAR, IAR+T, NRICT and CRIN) and was less in four institutes (NIFFR, NIFOR, NIHORT and NVRI). For the majority of research institutes in the sample (NIFFR, NIFOR, NIHORT, IAR+T, NRICT, CRIN and NVRI), recurrent funding instability in the latter period (mostly 1984-94) exceeded instability in the earlier period (Table 6). This might be partly due to the periodic awards of large salary increases in the public sector during the 1980s and 1990s and the related lump-sum payment of arrears that introduced large fluctuations into recurrent funding flows. Taking the institutes with estimations for sub-periods as a group, capital funding instability for the whole period exceeded instability in the sub-periods, with the exception of NIFOR, CRIN and NVRI. The most unstable institutes in capital funding during the latter sub period (1984-94) were IAR+T, NRICT and CRIN, while the most stable were NIFOR, NVRI and NIFFR. The most unstable in recurrent funding in the latter sub-period (1984-94) were NRCRI, IAR+T and NRICT, while the most stable (least unstable) were IAR, NIFOR and NCRI.

Table 7 shows a classification of research institutes by degree of funding instability. Most institutes had high degrees of funding instability, especially with respect to capital budget funds. It is significant that IAR, an institute with a remarkable historical record, recorded only mild instability of capital funding during the 1962-72 period, its first ten years. However, capital funding instability at IAR went up seven-fold during the 1984-94 period and the 1962-94 period. The 1962-72 period marked the period of solid political and budgetary support of the founding Northern Nigeria Regional Government and its successor, the Interim Common Services Agency (ICSA, during 1967-72 period). This is consistent with the feeling often expressed by the older IAR research community that IAR was financially better off under the old Northern Regional Government than under the Federal Government which took it over in 1975. It could be argued that the Regional Government demanded and received from IAR research results and technologies that were relevant to the regional economy for which it was ready and willing to provide consistent funding, and that this accounts for the stable funding under Regional Government ownership. The funding of IAR+T reveals a similar pattern.

A classification of institutes by degree of funding instability shows that over the 1984-94 period, only NIFOR and NSPRI had moderate capital funding instability; five institutes NFFR, NAPRI, IAR, NRCRI and NVRI had high instability while three institutes (IAR+T, NRICT and CRIN) had severe capital funding instability. NCRI had moderate capital funding instability during 1983-95. On the other hand, eight institutes (NIFFR, NAPRI, NCRI, NIHORT, NIFOR, IAR, CRIN and NSPRI) had moderate recurrent funding instability; three institutes (IAR+T, NRICT and NVRI) had high funding instability; while NRRI had severe recurrent funding instability.

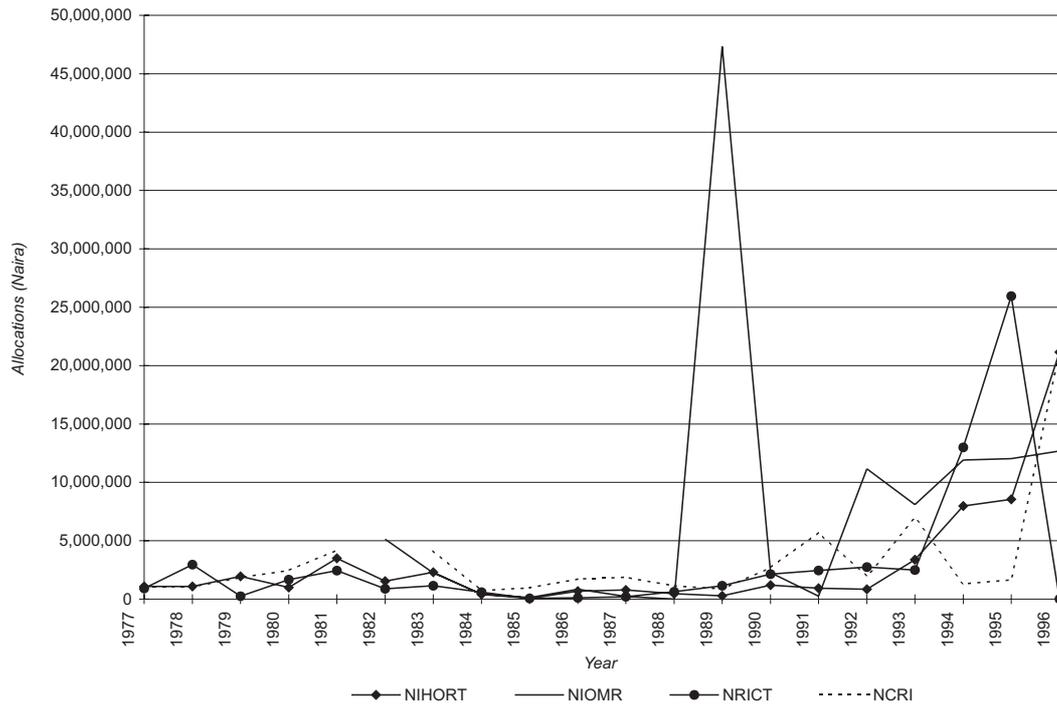


Figure 2a. Capital fund allocations to selected research institutes, Nigeria, 1977-1996

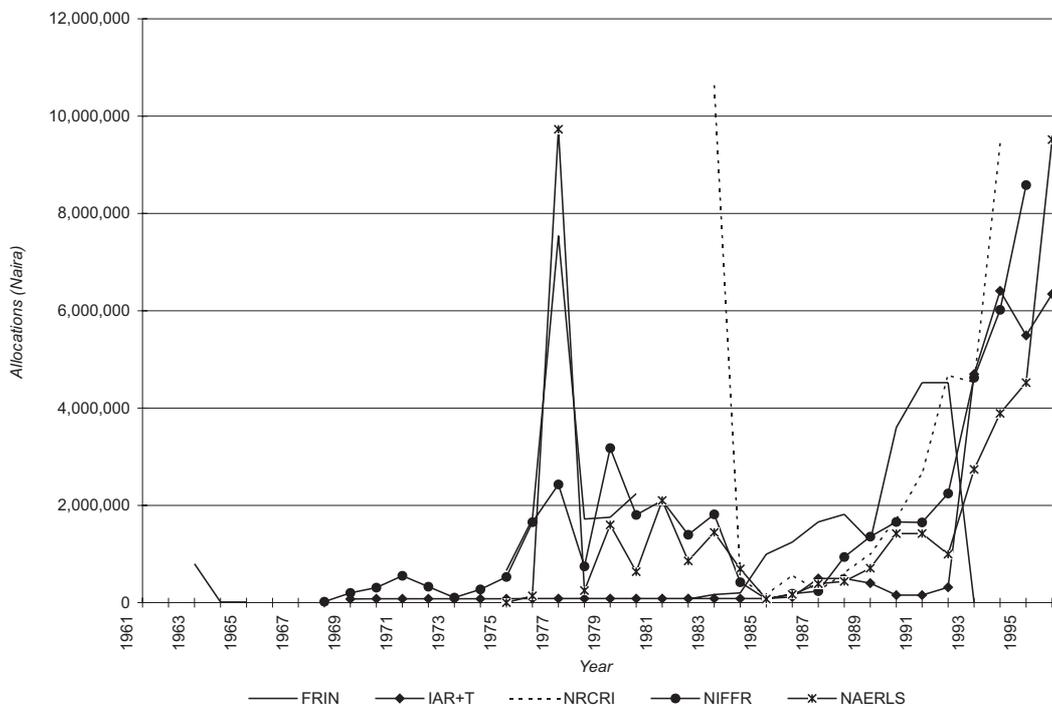


Figure 2b. Capital fund allocations to selected research institutes, Nigeria, 1961-1996

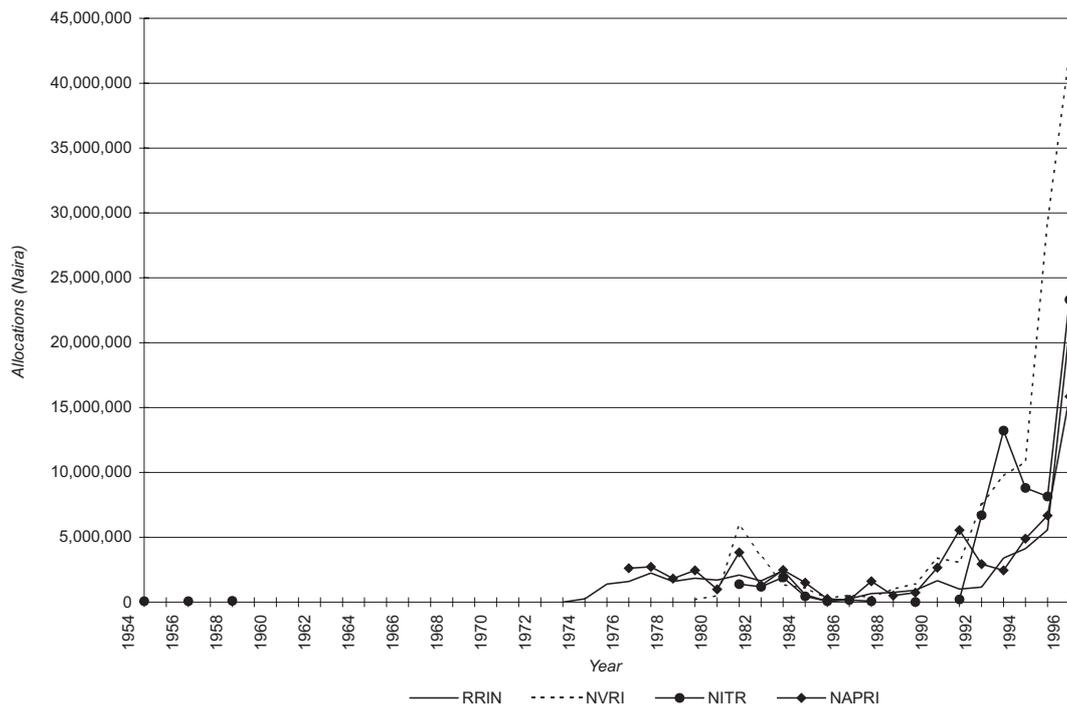


Figure 2c. Capital fund allocations to selected research institutes, Nigeria, 1954-1996

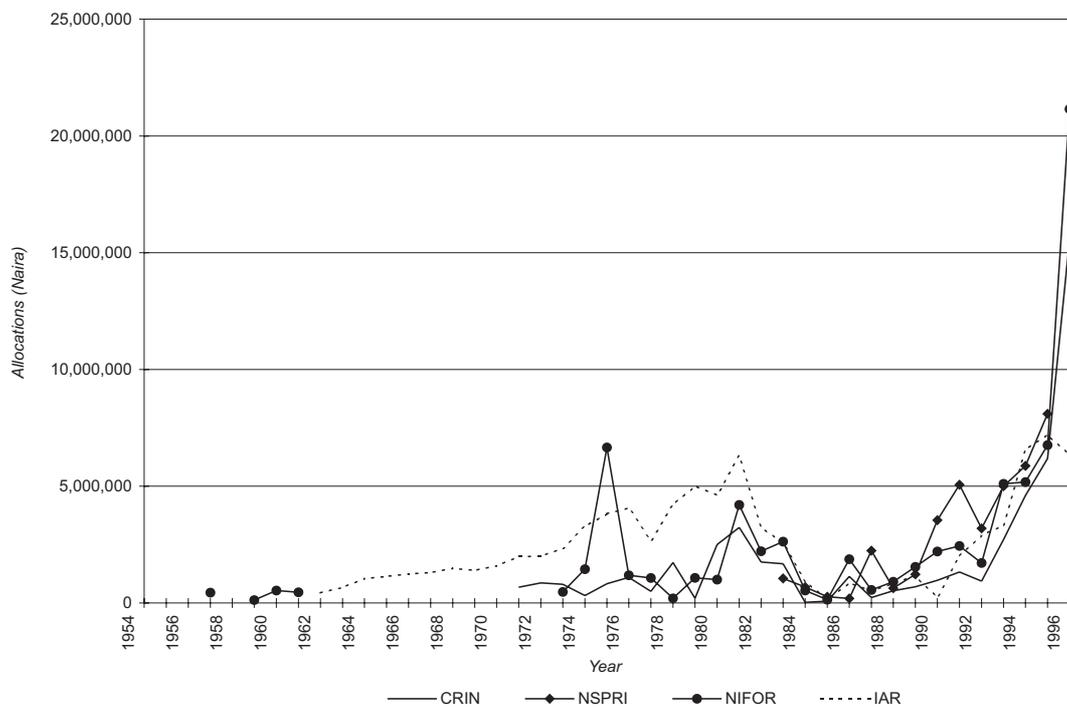


Figure 2d. Capital fund allocations to selected research institutes, Nigeria, 1954-1996

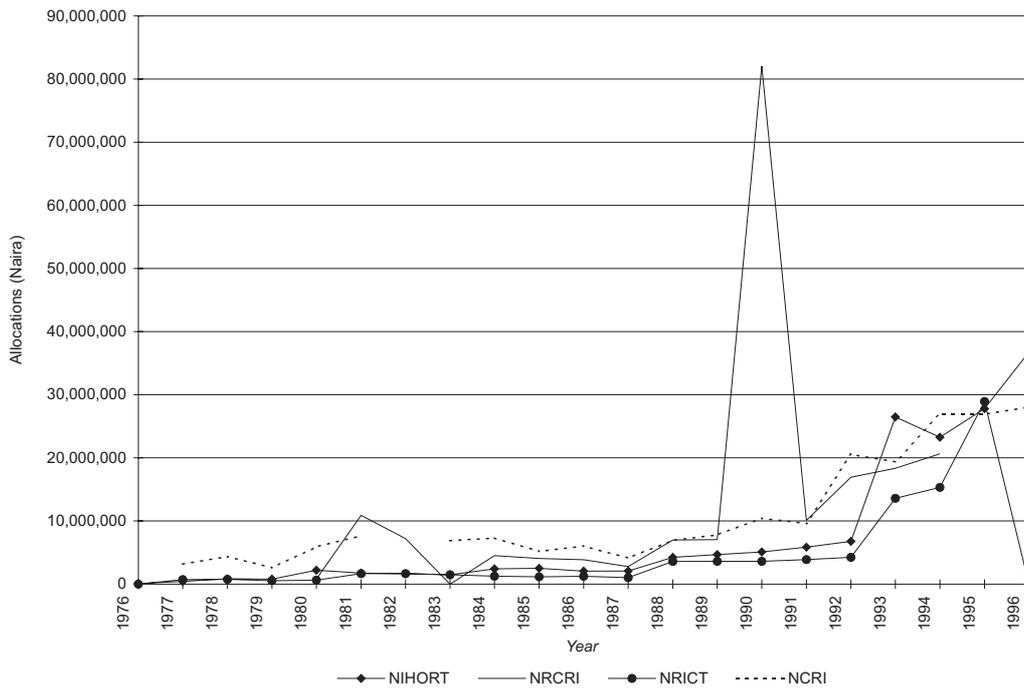


Figure 3a. Recurrent fund allocations to selected research institutes, Nigeria, 1976-1996

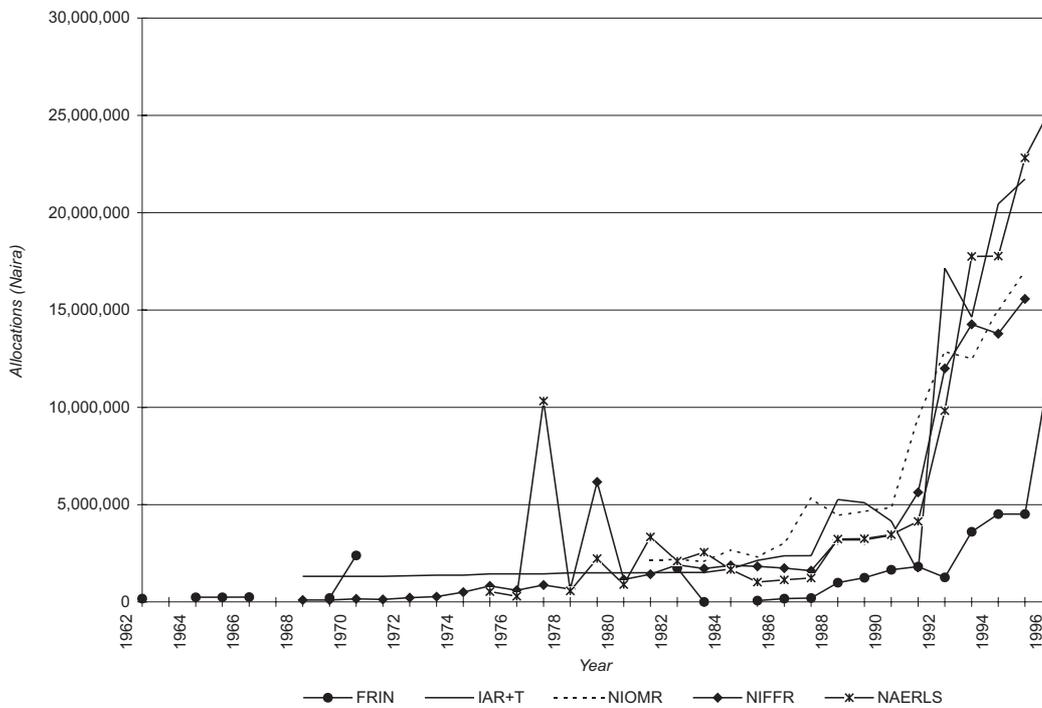


Figure 3b. Recurrent fund allocations to selected research institutes, Nigeria, 1973-1996

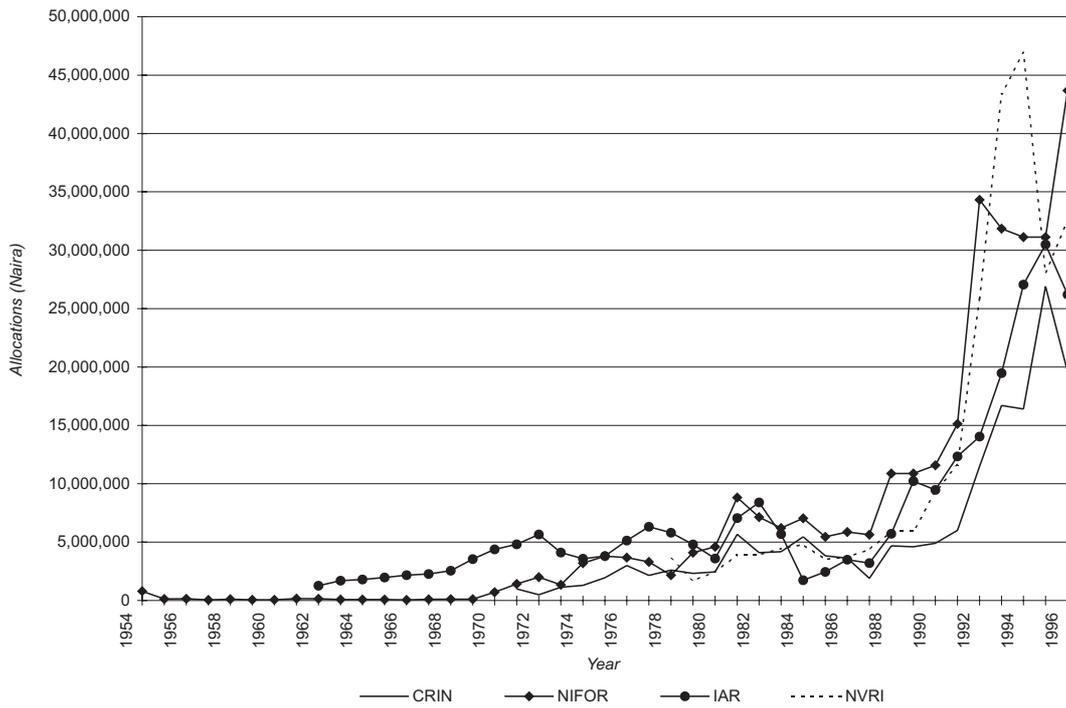


Figure 3c. Recurrent fund allocations to selected research institutes, Nigeria, 1954-1996

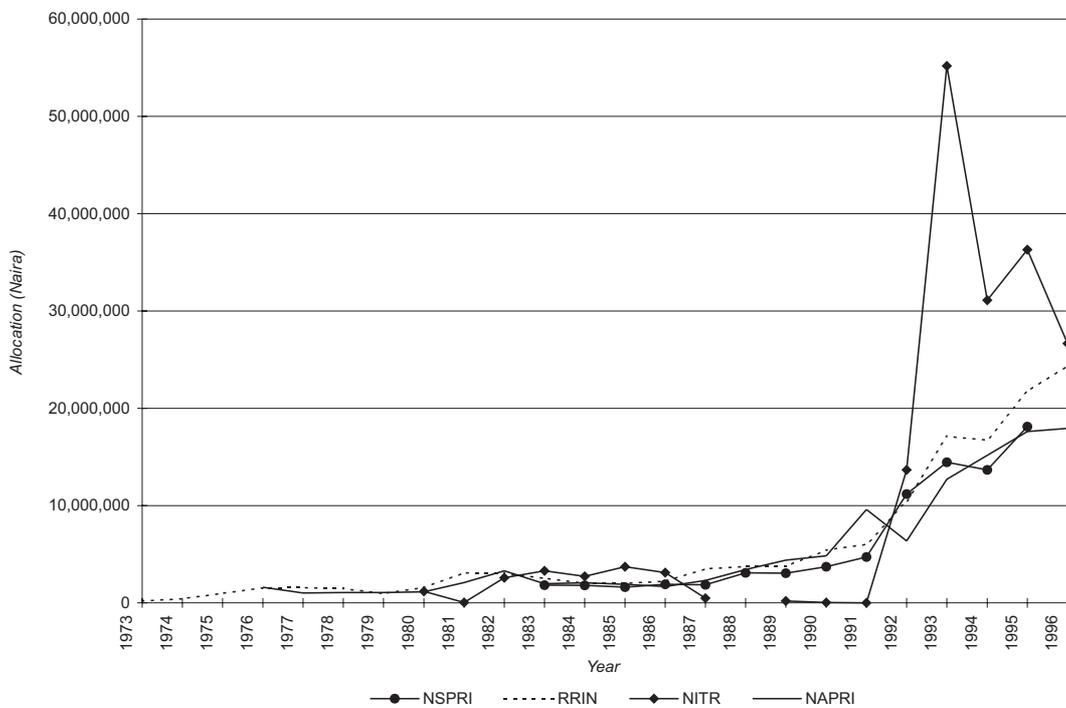


Figure 3d. Recurrent fund allocations to selected research institutes, Nigeria, 1954-1996

Table 6. Estimated Coefficients of Variation⁽¹⁾ as Measures of Funding Instability of Research Institutes, Nigeria, Selected Periods

Institute	Period	Capital		Budget funds		Recurrent funds		Budget funds		Sale of products		Special grants		Total		Funds		Total		Budget and recurrent		Total				
		I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	
1. NIFFR	1968-94	105.51	88.93	138.53	96.47																					
	1968-78	113.58	88.67	73.73	33.33																					
	1984-94	80.51	54.93	86.29	43.15																					
2. NAPRI	1976-94	67.29	67.26	100.26	61.99	120.78	72.37																			
	1976-83	39.50	42.39	50.38	40.16	73.17	74.21																			
	1984-94	85.94	61.81	79.41	36.85	86.61	25.63																			
3. NCRI	1983-95	80.53	40.78	67.90	35.70																					
4. NIFOR	1973-95	84.35	85.74	94.61	59.82	110.02	60.08	200.36	194.09	88.49	53.47															
	1973-83	94.42	96.97	49.82	30.45	51.72	44.47	62.33	60.85	45.52	38.9															
	1984-94	84.47	48.06	73.47	36.79	69.14	24.68	156.84	162.7	67.82	25.47															
5. NIHORT	1977-95	119.65	109.28	137.32	91.98																					
	1977-86	74.04	74.88	44.59	27.31																					
	1987-95	120.52	72.15	90.36	46.29	104.47	20.32																			
6. IAR	1963-94	73.78	72.48	90.41	66.22																					
	1962-72	37.12	10.04	49.52	165.52																					
	1984-94	106.92	70.13	80.19	28.90																					
7. IAR+T	1969-94	265.11	233.84	129.91	106.02	39.53	8.45																			
	1969-79	2.85	1.48	4.87	1.44	30.23	6.8																			
	1984-94	178.71	137.07	103.52	74.63	9.55	6.76																			
8. NRICT	1977-94	146.06	134.97	127.55	89.28	116.53*	6.88*																			
	1977-83	64.73	70.56	47.65	32.25	97.39**	64.53**																			
	1984-94	15.76	119.16	103.93	62.79	89.44	55.86																			
9. NRCRI	1984-94	171.74	95.06	0.14	139.30	70.48	65.21																			

Table 6. Estimated Coefficients of Variation⁽¹⁾ as Measures of Funding Instability of Research Institutes, Nigeria, Selected Periods (continued)

Institute	Period	Capital		Budget funds		Recurrent		Budget funds		Sale of products		Special grants		Total funds		Total Budget		Capital and recurrent		Total
		I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹	I _f	I _f ¹							
10. CRIN	1973-94	90.07	87.87	86.29	58.57	71.87									77.33	55.74	79.94	58.48		
	1973-83	71.45	58.45	48.33	29.41	22.12									47.8	30.08	50.47	32.26		
	1984-94	101.44	111.96	71.57	44.82	70.49									71.54	42.49	74.28	44.74		
11. NSPRI	1984-94	83.09	39.56	89.95	46.11	92.40	81.53								81.45	30.08				
12. NVRI	1979-94	110.04	89.10	126.64	84.73	119.79	61.15										121.21	83.47		
	1979-83	104.96	113.64	35.17	12.53	14.63	16.27										58.14	53.88		
	1984-94	91.53	54.12	492.48	60.75	78.43	29.94										107.96	59.03		

Notes: I_f¹ is the normalized (trend-corrected) coefficient of variation estimated from the linear trend equation, in percentage.

1. NIFFR is National Institute for Freshwater Fisheries Research, Kainji, New Bussa, Niger State.
2. NAPRI is National Animal Production Research Institute, Shika, Samaru, Zaira.
3. NCRI is National Cereals Research Institute, Badeggi, Niger State.
4. NIFOR is Nigerian Institute for Oil Palm Research, Near Benin City, Edo State.
5. NIHORT is National Horticultural Research Institute, Idi-Ishin, Ibadan, Oyo State.
6. IAR is Institute for Agricultural Research, Samaru, Zaria, Kaduna State.
7. IAR+T is Institute of Agricultural Research and Training, Moor Plantation, Ibadan, Oyo State.
8. NRICT is National Research Institute for Chemical Technology, Zaria, Kaduna State.
9. NRCRI is National Root Crops Research Institute, Umudike, Abia State.
10. CRIN is Cocoa Research Institute of Nigeria, OniGambari, Ibadan, Oyo State.
11. NSPRI is Nigerian Stored Products Research Institute, Ilorin, Kwara State.
12. NVRI is Nigerian Veterinary Research Institute, Vom, Plateau State.
13. * 1970-74.
14. ** 1980-83

Table 7: Classification of Research Institutes by Degrees of Funding Instability, Nigeria, Selected Periods

Institute	Period	Capital funding instability		Recurrent funding instability		Total funding instability	
		Index (%)	Classification	Index(%)	Classification	Index (%)	Classification
1. NIFFR	1968-78	88.93	High Instability	96.47	High Instability		
	1984-94	88.67	High Instability	33.33	Moderate Instability		
	1984-94	54.93	High Instability	43.15	Moderate Instability		
2. NAPRI	1976-94	67.26	High Instability	61.99	High Instability		
	1976-83	42.39	Moderate Instability	40.16	Moderate Instability		
	1984-94	61.81	High Instability	36.85	Moderate Instability		
3. NCRI	1983-95	40.78	Moderate Instability	35.70	Moderate Instability		
4. NIFOR	1973-95	85.74	High Instability	59.82	High Instability	53.47	High Instability
	1973-83	96.97	High Instability	30.45	Moderate Instability	38.9	Moderate Instability
	1984-94	48.06	Moderate Instability	36.79	Moderate Instability	25.47	Moderate Instability
5. NIHORT	1977-95	109.28	Severe Instability	91.98	High Instability	90.77	High Instability
	1977-86	74.88	High Instability	27.31	Moderate Instability	35.07	Moderate Instability
	1987-95	71.15	High Instability	46.29	Moderate Instability	45.48	Moderate Instability
6. IAR	1962-94	72.48	High Instability	62.22	High Instability	59.66	High Instability
	1962-72	10.04	Mild Instability	165.52	Severe Instability	11.85	Moderate Instability
	1984-94	70.13	High Instability	28.90	Moderate Instability	34.29	Moderate Instability
7. IAR+T	1969-94	233.84	Severe Instability	106.02	Severe Instability	122.7	Severe Instability
	1969-79	1.48	Mild Instability	1.44	Mild Instability	1.34	Mild Instability
	1984-94	137.07	Severe Instability	74.63	High Instability	83.27	High Instability
8. NRICT	1977-94	134.97	Severe Instability	89.28	High Instability	96.36	High Instability
	1977-83	70.56	High Instability	32.25	Moderate Instability	47.29	Moderate Instability
	1984-94	119.16	Severe Instability	62.79	High Instability	68.79	High Instability
9. NRCRI	1984-94	95.06	High Instability	139.30	Severe Instability	103.27	Severe Instability

Table 7. Classification of Research Institutes by Degrees of Funding Instability, Nigeria, Selected Periods (continued)

Institute	Period	Capital funding instability		Recurrent funding instability		Total funding instability	
		Index (%)	Classification	Index (%)	Classification	Index (%)	Classification
10. CRIN	1973-94	87.87	High Instability	58.57	High Instability	55.74	High Instability
	1973-83	58.45	High Instability	29.41	Moderate Instability	30.08	Moderate Instability
	1984-94	111.96	Severe Instability	44.82	Moderate Instability	42.49	Moderate Instability
11. NSPRI	1984-94	39.56	Moderate Instability	46.11	Moderate Instability	30.08	Moderate Instability
12. NVRI	1979-94	89.10	High Instability	84.73	High Instability		
	1979-83	113.64	Severe Instability	12.53	Moderate Instability		
	1984-94	54.12	High Instability	60.75	High Instability		

Notes: Index of Instability is trend-corrected coefficient of variation estimated from the linear equation.

1. NIFFR is National Institute for Freshwater Fisheries Research, New Bussa, Niger State.
2. NAPRI is National Animal Production Research Institute, Shika, Samaru, Zaria, Kaduna State.
3. NCRI is National Cereals Research Institute, Badeggi, Niger State.
4. NIFOR is Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
5. NIHORT is National Horticultural Research Institute, Idi-Ishin, Ibadan, Oyo State.
6. IAR is Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.
7. IAR+T is Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Oyo State.
8. NRICT is National Research Institute for Chemical Technology, Zaria, Kaduna State.
9. NRCRI is National Root Crops Research Institute, Umudike, Abia State.
10. CRIN is Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
11. NSPRI is Nigerian Stored Products Research Institute, Ilorin, Kwara State.
12. NVRI is National Veterinary Research Institute, Vom, Plateau State

Instability of actual fund disbursements

Approved budgets are based on government revenue expectations that may or may not materialize, and actual disbursements may fall short of budget allocations because of government revenue shortfalls. Actual disbursements, not nominal budget allocations, determine the tempo of research at the institutes. From Tables 8-9, all institutes except NSPRI witnessed high or severe instability in actual capital budget disbursements during the 1984-94 period, using the trend-corrected coefficient of variation as a measure of disbursement instability. Actual disbursements of recurrent budgets were generally more stable than capital disbursements: six of the research institutes had moderate instability in recurrent budget disbursements during the same period.

A comparison of instability of actual budget disbursements with instability of budget allocations does not reveal any definite patterns. Over the 1984-94 period, instability in capital fund disbursements ranged from 39.56 percent for NSPRI to 131.68 percent for NVRI; the corresponding range for capital budget allocation (approvals) was from 39.56 percent for NSPRI to 137.7 percent for IAR+T. On the other hand, instability of actual recurrent budget disbursements ranged from 28.90 percent for IAR to 82.03 percent for NAPRI during 1984-94 (and 349.90 percent for NIHORT during 1987-95); the corresponding range for recurrent budget approvals is from 28.9 percent for IAR to 139.3 percent for NRCRI, over the same period.

Has instability in actual fund disbursements increased over time?

In seven out of eight institutes with data on disbursements for sub-periods, instability of actual capital funds disbursements increased over time, while it decreased in one institute (see Table 8). Instability of actual recurrent fund disbursements also increased over time in the same seven institutes and decreased in one institute over the same sub-periods. Table 9 presents a classification of research institutes by degree of instability of actual budget disbursements.

The evidence on the secular trend in instability of budget allocations and disbursements enables NARS leaders and managers to make informed projections of future trends in instability.

Table 8. Estimated Indices of Instability of Actual Budget Disbursements to Research Institutes, Nigeria, Selected Periods

Institute	Period	Capital	Expenditure	Recurrent	Budget
		Disbursements		Disbursements	
		I_D	I^1_D	I_D	I^1_D
<i>Percentage Coefficients of Variation</i>					
1. NIFFR	1969-94	99.95	86.04	131.9	78.83
	1969-79	105.66	86.04	164.44	139.76
	1984-94	68.32	59.31	89.21	49.87
2. NAPRI	1976-94	19.75	101.92	144.83	111.84
	1976-83	39.49	42.38	47.22	39.55
	1984-94	85.94	61.81	119.46	82.03
3. NIFOR (WAIFOR)	1981-94	97.61	79.00	158.17	109.25
	1954-64	66.54	45.99	26.54	7.53
	1984-94	94.18	72.43	78.66	44.32
4. INIHORT	1977-95	116.28	107.21	136.55	91.35
	1977-86	66.06	67.97	45.99	22.44
	1987-95	121.7	77.88	681.02	349.90
5. IAR	1962-94	70.05	67.64	90.41	66.22
	1962-72	37.12	10.04	49.52	19.17
	1984-94	93.13	52.39	80.19	28.90
6. IAR+T	1969-94	216.86	174.07	132.27	104.71
	1969-79	2.85	1.48	4.94	1.65
	1984-94	134.48	80.67	101.62	61.64
7. CRIN	1973-94	101.22	98.04	86.03	58.08
	1973-83	82.78	66.56	48.37	29.56
	1984-94	72.58	72.33	70.99	44.37
8. NVRI	1979-94	150.48	137.99	128.92	88.81
	1979-83	58.73	50.12	31.19	22.83
	1984-94	164.57	131.68	107.82	60.74
9. NCRI	1983-95	127.03	109.86	67.82	35.66
10. NRICT	1984-94	158.38	119.12	103.93	62.79
11. NSPRI	1984-94	83.09	39.56	89.96	46.11

Notes: I_D is Coefficient of variation of disbursements, in percentage, while I^1_D is normalized or trend-corrected coefficient of variation of disbursements estimated from the linear trend equation of disbursements, in percentage.

1. NIFFR: National Institute for Freshwater Fisheries Research, New Bussa, Niger State.
2. NAPRI: National Animal Production Research Institute, Ahmadu Bello University, Shika, Zaria, Kaduna State.
3. NIFOR: Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
4. INIHORT: National Horticultural Research Institute, Idi-Ishin, Ibadan, Oyo State.
5. IAR: Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.
6. IAR+T: Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Oyo State.
7. CRIN: Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
8. NVRI: Nigerian Veterinary Research Institute, Vom, Plateau State.
9. NCRI: National Cereals Research Institute, Badeggi, Niger State.
10. NRICT: National Research Institute for Chemical Technology, Zaria, Kaduna State.
11. NSPRI: Nigerian Stored Products Research Institute, Ilorin, Kwara State.

Table 9. Classification of Research Institutes by Degrees of Instability of Actual Budget Disbursements, Nigeria, Selected Periods

Institute	Period	Capital budget disbursements		Recurrent budget disbursements	
		Index (%)	Classification	Index (%)	Classification
1. NIFFR	1969-94	86.04	High Instability	78.83	High Instability
	1969-79	59.31	High Instability	139.76	Severe Instability
	1984-94	50.46	High Instability	49.87	Moderate Instability
2. NAPRI	1976-94	101.92	Severe Instability	111.84	Severe Instability
	1976-83	42.38	Moderate Instability	39.55	Moderate Instability
	1984-94	61.81	High Instability	82.03	High Instability
3. NIFOR (WAIFOR)	1981-94	79.00	High Instability	109.25	Severe Instability
	1954-64	45.99	Moderate Instability	7.53	Mild Instability
	1984-94	72.43	High Instability	44.32	Moderate Instability
4. NIHORT	1977-95	107.21	Severe Instability	91.35	High Instability
	1977-86	67.97	High Instability	22.44	Moderate Instability
	1987-95	77.88	High Instability	349.9	Severe Instability
5. IAR	1962-74	67.64	High Instability	66.22	High Instability
	1962-72	10.04	Mild Instability	19.17	Moderate Instability
	1984-94	52.39	High Instability	28.9	Moderate Instability
6. IAR+T	1969-94	174.07	Severe Instability	104.71	Severe Instability
	1969-79	1.48	Mild Instability	1.65	Mild Instability
	1984-94	80.67	High Instability	61.64	High Instability
7. CRIN	1973-94	98.04	High Instability	58.08	High Instability
	1973-83	66.56	High Instability	29.56	Moderate Instability
	1984-94	72.33	High Instability	44.37	Moderate Instability
8. NVRI	1979-94	137.99	Severe Instability	88.81	High Instability
	1979-83	50.12	High Instability	26.83	Moderate Instability
	1984-94	131.68	Severe Instability	60.47	High Instability
9. NCRI	1983-95	109.86	Severe Instability	35.66	Moderate Instability
10. NRICT	1984-94	119.12	Severe Instability	62.79	High Instability
11. NSPRI	1984-94	39.56	Moderate Instability	46.11	Moderate Instability

Notes: Index of Instability is trend-corrected coefficient of variation estimated from the linear trend equation fitted to Capital and Recurrent disbursements for each Institute, for each period.

1. NIFFR is National Institute for Freshwater Fisheries Research, New Bussa, Niger State.
2. NAPRI is National Animal Production Research Institute, Shika, Samaru, Zaria, Kaduna State.
3. NIFOR is Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
4. NIHORT is National Horticultural Research Institute, Idi-Ishin, Ibadan, Oyo State.
5. IAR is Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.
6. IAR+T is Institute of Agricultural Research and Training, Obafemi Awolowoo University, Moor Plantation, Ibadan, Oyo State.
7. CRIN is Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
8. NVRI is Nigerian Veterinary Research Institute, Vom, Plateau State.
9. NCRI is National Cereals Research Institute, Badeggi, Niger State.
10. NRICT is National Research Institute for Chemical Technology, Zaria, Kaduna State.
11. NSPRI is Nigerian Stored Products Research Institute, Ilorin, Kwara State.

Agricultural research expenditures instability

Concern should not stop at the analysis of research funding instability. Of equal importance and relevance is the instability of agricultural research expenditure. While scant attention was paid to the problem of funding instability by previous analysts, virtually no attention at all has been paid to the problem of agricultural research expenditure instability.¹⁷

From Table 10, actual capital expenditure instability ranges from 30.18 percent for CRIN to 84.04 percent for NRICT during the 1984-94 period. Recurrent expenditure instability ranges from 31.08 percent for NRCRI to 62.12 percent for IAR+T during the same period. Total expenditure instability ranges from 27.32 percent for NIFOR to 87.54 percent for NVRI during the 1984-94 period. It is significant to note that capital expenditure instability increased over time in most research institutes (see Table 10); recurrent expenditure instability similarly increased over time. Total expenditure instability also increased over time. These increases in instability partly reflect the expenditures on lump-sum payments of so-called “relief packages” and arrears of new salary and wage scales. They also reflect the more turbulent economic conditions of the 1980s and 1990s. Trends in expenditure instabilities reflect trends in the underlying instabilities in budget disbursements. Table 11 presents a classification of research institutes by degrees of instability of agricultural research expenditures. For the majority of institutes, capital expenditures were more unstable than recurrent expenditures.

Instability of Personnel Costs, Operating Costs, Maintenance Costs, Training Costs and Capital Costs

The combination of subsisting employment contracts, trade union activity and the demand on the part of the political leadership for industrial peace and harmony suggests the proposition that personnel costs will be more stable than operating costs, maintenance costs and capital costs. The evidence is consistent with the proposition (see Table 12). This implies that fluctuations in research budgets impact more adversely on the other expenditure categories than personnel costs. The proposition holds up pretty well even in the 1984-94 period that was characterized by the Structural Adjustment Program and the harmonization of salaries and wages of staff of the research institutes with those of university lecturers, involving lump-sum payments of arrears of the upwardly revised salary scales, post-1987. The evidence on instabilities of expenditure categories suggests that NARS leaders and NARO managers protect personnel costs from high or excessive fluctuations, passing on the burden of research budget instability to the other expenditure categories that are required for effective research.

¹⁷ Of relevance here is the relationship between actual research expenditures and budget approvals and disbursements. Previous analyses have proceeded as if budget approvals and disbursements were the ultimate ends in themselves or as if they were identical with research expenditures. On the contrary, it is the expenditure profiles on capital and recurrent accounts that determine the transformations of goods and services into research knowledge and output, and, ultimately, new technologies. Unfortunately, no work has been done on the specification and empirical measurement of the nature of the relationship between research expenditures (by institute managers) and budget approvals and disbursements. The relationships need to be clarified but this will take us too far afield from the focus of this study.

Table 10. Estimated Indices of Instability of Actual Expenditures of Research Institutes, Nigeria, Selected Periods

Institute	Period	Capital expenditure		Recurrent expenditure		Total expenditure	
		I_E	I_E^1	I_E	I_E^1	I_E	I_E^1
<i>Percentage coefficient of variation</i>							
1. CRIN	1973-94	74.18	59.23	94.73	64.21	91.52	62.33
	1973-83	48.94	48.90	67.76	14.49	42.32	14.68
	1984-94	68.32	30.18	77.90	49.97	24.89	47.69
2. NRICT	1977-94	125.97	103.56	131.04	86.09	123.74	83.95
	1977-83	73.33	31.68	59.04	25.04	63.46	18.68
	1984-94	125.03	84.04	102.96	54.19	104.28	53.33
3. IAR+T	1969-94	209.79	162.75	133.17	105.63	148.89	115.57
	1969-79	18.81	18.28	4.87	1.44	4.24	35.1
	1984-94	125.59	65.17	102.35	62.17	106.35	58.53
4. IAR	1962-94	82.67	83.99	102.21	72.32	80.46	58.53
	1962-72	45.21	46.82	30.7	13.52	31.36	22.11
	1984-94	86.37	76.70	77.26	42.65	75.69	42.11
5. NIHORT	1977-95	130.53	125.34	112.94	78.24	110.11	74.61
	1977-86	88.82	77.66	48.24	30.81	41.40	43.19
	1987-95	136.70	85.92	72.99	25.57	80.99	30.96
6. NIFOR	1981-95	97.61	76.92	72.37	45.55	73.56	62.88
	1954-64	71.10	58.05	26.55	7.53	23.95	14.53
	1984-94	94.19	72.43	70.66	35.21	67.67	27.32
7. NVRI	1979-94	123.11	97.99	161.32	103.42	127.62	100.41
	1979-83	76.76	56.20	53.14	13.18	59.48	26.35
	1984-94	720.75	79.39	104.01	53.63	115.49	87.54
8. NCRI	1977-84	81.05	85.00	88.89	59.34	n.a	n.a
	1977-83	87.25	72.26	47.45	13.82	—	—
	1984-94	98.72	72.69	72.63	37.87	—	—
9. NSPRI	1984-94	103.96	58.14	91.08	47.36	116.7	58.81
10. NRCRI	1984-94	98.09	58.89	64.09	31.08	69.16	32.74
11. NAPRI	1990-95	41.86	39.62	45.36	18.92	41.50	21.82

Notes: I_E is coefficient of variation (%); I_E^1 is normalized or trend-corrected coefficient of variation estimated from the linear trend equations (%).

1. CRIN is Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
2. NRICT is National Research Institute for Chemical Technology, Samaru, Zaria, Kaduna State.
3. IAR+T is Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Oyo State.
4. IAR is Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.
5. NIHORT is National Horticultural Research Institute, Idi-Ishin, Ibadan Oyo State.
6. NIFOR is Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
7. NVRI is Nigerian Veterinary Research Institute, Vom, Plateau State.
8. NCRI is National Cereals Research Institute, Badeggi, Niger State.
9. NSPRI is Nigerian Stored Products Research Institute, Ilorin, Kwara State.
10. NRCRI is National Root Crops Research Institute, Umudike, Abia State.
11. NAPRI is National Animal Production Research Institute, Ahmadu Bello University, Samaru, Zaria, Kaduna State.

Source: Underlying data from Field Surveys, 1996.

Table 11. Classification of Research Institutes by Degrees of Instability of Actual Research Expenditures, Nigeria, Selected Periods

Institute	Period	Capital budget disbursements		Recurrent expenditures		Total expenditures	
		Index (%)	Classification	Index (%)	Classification	Index (%)	Classification
1. CRIN	1973-94	59.23	High Instability	64.21	High Instability	62.33	High Instability
	1973-84	48.90	Moderate Instability	14.49	Moderate Instability	14.68	Moderate Instability
	1984-94	30.18	Moderate Instability	49.97	Moderate Instability	47.69	Moderate Instability
2. NRICT	1977-94	103.56	Severe Instability	86.09	High Instability	83.95	High Instability
	1977-83	31.68	Moderate Instability	25.04	Moderate Instability	18.68	Moderate Instability
	1984-94	84.04	High Instability	54.19	High Instability	53.33	High Instability
3. IAR+T	1969-94	162.75	Severe Instability	105.63	Severe Instability	35.10	Moderate Instability
	1969-79	18.28	Moderate Instability	7.44	Mild Instability	58.53	High Instability
	1984-94	65.17	High Instability	62.17	High Instability	58.53	High Instability
4. IAR	1962-94	83.99	High Instability	72.32	High Instability	58.53	High Instability
	1962-72	46.82	Moderate Instability	13.52	Moderate Instability	22.11	Moderate Instability
	1984-94	76.70	High Instability	43.65	Moderate Instability	42.48	Moderate Instability
5. NIHORT	1977-95	125.34	Severe Instability	78.24	High Instability	74.61	High Instability
	1977-95	77.66	High Instability	30.81	Moderate Instability	43.19	Moderate Instability
	1987-95	85.29	High Instability	25.57	Moderate Instability	30.96	Moderate Instability
6. NIFOR	1981-95	76.92	High Instability	45.55	Moderate Instability	62.88	High Instability
	1954-64	58.05	High Instability	7.53	Mild Moderate	14.53	Moderate Instability
	1984-94	72.43	High Instability	35.21	Moderate Instability	27.32	Moderate Instability
7. NVRI	1979-94	97.99	High Instability	103.42	Severe Instability	100.41	Severe Instability
	1979-83	56.20	High Instability	13.18	Moderate Instability	26.35	Moderate Instability
	1984-94	79.39	High Instability	53.63	High Instability	87.54	High Instability
8. NCRI	1977-84	85.00	High Instability	59.34	High Instability	n.a	High Instability
	1977-83	72.26	High Instability	13.82	Moderate Instability	n.a	Moderate Instability
	1984-94	72.69	High Instability	37.87	Moderate Instability	n.a	High Instability

Table 11. Classification of Research Institutes by Degrees of Instability of Actual Research Expenditures, Nigeria, Selected Periods (continued)

Institute	Period	Capital budget disbursements		Recurrent expenditures		Total expenditures	
		Index (%)	Classification	Index (%)	Classification	Index (%)	Classification
9. NSPRI	1984-94	58.14	High Instability	47.36	Moderate Instability	58.81	High Instability
10. NRCRI	1984-94	58.89	High Instability	31.08	Moderate Instability	32.74	Moderate Instability
11. NAPRI	1990-95	39.62	Moderate Instability	19.92	Moderate Instability	21.82	Moderate Instability

Notes: Index is trend-corrected coefficient of variation estimated from linear trend equation fitted to actual Capital and Recurrent Expenditures for each Institute, for each period

1. CRIN: Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
2. NRICT: National Research Institute for Chemical Technology, Zaria, Kaduna State.
3. IAR+T: Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Oyo State.
4. IAR: Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.
5. NIHORT: National Horticultural Research Institute, Idi-Ishin, Ibadan, Oyo State.
6. NIFOR: Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
7. NVRI: Nigerian Veterinary Research Institute, Vom, Plateau State.
8. NCRI: National Cereals Research Institute, Badeggi, Niger State.
9. NSPRI: Nigerian Stored Products Research Institute, Ilorin, Kwara State.
10. NRCRI: National Root Crops Research Institute, Umudike, Abia State.
11. NAPRI: National Animal Production Research Institute, Shika, Samaru, Zaria, Kaduna State.

Table 12. Estimated Indices of Instability of Agricultural Research Expenditure Categories of Research Institutes, Nigeria, Selected Periods

Institute	Period	Personnel costs		Operating costs		Maintenance costs		Training costs		Capital costs		Total costs	
		I	I ¹	I	I ¹	I	I ¹	I	I ¹	I	I ¹	I	I ¹
Percentage coefficient of variation													
1. NIFFR	1978-94	104.21	62.93	80.33	82.80	129.44	81.15	52.28	45.07	76.38	68.59	97.79	61.03
	1978-83	434.71	12.16	32.62	10.82	27.14	30.11	67.42	53.91	73.32	62.13	19.09	27.97
	1984-94	85.86	42.97	95.10	94.76	87.86	427.55	46.83	24.79	78.42	25.18	83.41	38.19
2. NIFOR	1954-94	182.98	133.5	100.09	50.30	123.24	71.19	87.76	80.28	142.72	102.9	145.74	93.72
	1954-64	26.44	5	22.04	6.45	22.04	6.45	n.a	n.a	66.79	47.08	16.65	7.74
	1984-94	84.95	12.52	37.61	20.74	57.84	21.88	47.21	47.16	80.20	60.75	69.30	28.15
			44.11										
3. NIHORT	1977-95	138.84	86.67	77.11	46.96	77.16	47.03	77.21	46.99	120.12	116.31	97.13	66.37
	1977-86	49.90	25.18	51.74	31.65	51.74	51.63	52.05	51.90	84.86	6722	4049	42.07
	1987-95	86.10	31.22	45.01	37.53	45.10	37.59	45.01	37.53	126.95	78.38	88.49	29.25
4. IAR	1965-95	15.32	94.92	110.79	68.79	103.58	81.22	n.a	n.a	74.99	131.1	142.14	75.78
	1965-95	28.40	11.37	79.76	57.16	101.30	107.17	n.a	n.a	36.12	37.30	26.71	78.31
	1985-95	95.81	43.65	58.50	29.16	75.33	40.80	n.a	n.a	110.81	74.51	110.03	41.19
5. IAR+T	1969-94	132.32	104.7	207.91	160.87	209.64	162.36	209.28	162.36	209.28	162.36	147.45	114.57
	1969-79	4.87	2	2.77	1.48	2.84	1.47	2.85	1.47	2.85	1.48	4.72	1.34
	1984-94	1984.94	1.44	124.67	64.74	125.91	66.15	125.59	65.77	1255.84	65.77	105.69	57.33
			61.67										
6. NRICT	1984-94	99.7	48.94	119.08	66.36	113.94	55.06	150.18	112.74	125.03	84.04	104.28	53.33
7. CRIN	1973-94	105.73	75.84	58.15	31.00	99.89	61.14	88.22	88.43	74.17	59.23	91.40	62.22
	1973-83	6.77	16.19	55.29	38.93	107.85	103.66	74.16	54.07	48.31	48.90	5.22	14.70
	1984-94	89.07	58.59	38.28	25.54	63.75	38.54	63.37	65.73	68.32	30.18	95.34	59.29
8. NSPRI	1984-94	94.54	48.23	95.97	60.68	147.66	83.23	134.34	116.96	103.98	58.18	92.77	46.76
9. NVRI	1979-94	107.88		131.88		154.14				11.32		109.04	
	1979-83	29.37	3.05	73.06	44.36	33.61	3.32	42.17		76.77	56.20	47.84	23.95
	1984-94	93.55		104.81		130.87				120.75		94.84	

Table 12. Estimated Indices of Instability of Agricultural Research Expenditure Categories of Research Institutes, Nigeria, Selected Periods (continued)

Institute	Period	Personnel costs		Operating costs		Maintenance costs		Training costs		Capital costs		Total costs	
		I	I ¹	I	I ¹	I	I ¹	I	I ¹	I	I ¹	I	I ¹
Percentage coefficient of variation													
10. NITR	1984-94	69.8	18.73	77.46	53.05	214.13	197.16	98.07	95.58	160.13	108.88	97.69	34.27
11. NRCRI	1984-94	95.64	51.68	58.79	43.89	26.5	27.22			98.09	58.89	71.04	36.47
12. NCRI	1984-94	76.61	45.7	70.17	35.06	75.67	39.11	74.59	68.99	98.49	72.17	81.96	47.23
13. NAPRI	1990-95	45.36	18.88	20.37	1.38	177.73	1.38	17.77	20.61	41.86	39.62	40.87	21.29

Notes: I is Coefficient of Variation of Expenditure Categories in percentage

I¹ is normalized or trend corrected Coefficient of Variation in percentage, estimated from linear trend equation of expenditure categories.

1. NIFFR: National Institute for Freshwater Fisheries Research, New Bussa, Niger State.
2. NIFOR: Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
3. NIHORT: National Horticultural Research Institute, Idi-Ishin, Ibadan, Oyo State.
4. IAR: Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, Kaduna State.
5. IAR+T: Institute of Agricultural Research and Training, Obafemi Awolowo University, Moor Plantation, Ibadan, Oyo State.
6. NRICT: National Research Institute for Chemical Technology, Zaria, Kaduna State.
7. CRIN: Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
8. NSPRI: Nigerian Stored Products Research Institute, Ilorin, Kaduna State.
9. NVRI: Nigerian Veterinary Research Institute, Vom, Plateau State.
10. NITR: Nigerian Institute for Trypanosomiasis Research, Kaduna, Kaduna State.
11. NRCRI: National Root Crops Research Institute, Umudike, Abia State.
12. NCRI: National Cereals Research Institute, Badeggi, Niger State.
13. NAPRI: National Animal Production Research Institute, Ahamdu Bello University, Shika, Zaria, Kaduna State.

For most research institutes, the instability of different expenditure categories seems to be getting worse over time, as is evident from comparisons of instability indices for the two sub-periods of the respective institutes. This partly reflects declining political commitment to stable funding of research institutes and partly the impact of Structural Adjustment Program of the 1980s and 1990s on research expenditures.

For the 1984-94 period, instability of personnel costs ranged from 18.73 percent for NITR to 61.67 percent for IAR+T. Operating costs ranged from 20.74 percent for NIFOR to 94.76 percent for NIFFR; maintenance costs ranged from 27.22 percent for NRCRI to a whopping 427.55 percent for NIFFR; training costs ranged from 24.79 percent for NIFFR to 116.96 percent for NSPRI; and instability in capital costs ranged from 25.18 percent for NIFFR to 108.88 percent for NITR. For total costs, the range in instability was from 28.15 percent for NIFOR to 59.29 percent for CRIN during the 1984-94 period.

If NARS leaders and managers are constrained by political and trade union constraints to maintain relatively stable personnel expenditure, fluctuations and shortfalls in funding are transmitted more to operational, maintenance and other expenditure categories. NARS leaders and managers are often forced to divert (“vire”) funds meant for capital projects to pay salaries and wages to maintain industrial peace and harmony at the institutes.

Delays in Disbursement of Budget Funds

The effectiveness of budget funding is drastically reduced when there are long and, quite often, unpredictable delays in the release of budget funds to the research institutes. Though the Nigerian NARS has recorded periods of improved funding, *ex post* annual funding data fails to reveal unanticipated delays in the release of approved budgets.

Let the Index of Delay in the release of budget funds (I_b) be defined as:

$$I_b = \frac{(T_a - T_0)}{(T_e - T_0)} \times 100 \quad (3)$$

Where:

- Ta = Date of actual release.
- To = Theoretical date when funds should have been released, that is: January 1 to cover 1st Quarter (January 1–March 31); April 1 to cover 2nd Quarter (April 1–June 30); July 1 to cover 3rd Quarter (July 1–September 30); and October 1 to cover 4th Quarter (October 1–December 31)
- Te = Last date of the quarter for which the funds are meant.

Ta - To	=	Number of days between date of actual release and the theoretical release date, and
Te - To	=	Number of days for which released funds are meant (funds are released in advance of the quarter for which they are meant: 90 days in 1 st Quarter, 91 days in 2 nd Quarter and 92 days both in 3 rd and 4 th Quarters).
I _b	=	0 percent, when funds are released on the date they are supposed to be released, that is, Ta = To.
	=	100 percent when funds are released on the last day of the quarter that the funds are meant for,
	>	100 percent when funds are released after the quarter or period for which the funds are meant, and
	=	α (infinity) when allocation in a given quarter is canceled and is not released, the equivalent of an indefinite delay.

For the special case in which funds for a particular quarter are, for some reason or another, not released, the value of the index of delay approaches infinity as the difference between the actual (asymptotic) release date and the theoretical release date, the numerator in the formula for the index in equation (3), approaches infinity.

Data was obtained from institutes on dates of actual release of capital and recurrent funds meant for each of the four quarters in each year during 1985-96. Prominence is given to these empirical results as tools that NARS leaders and managers can use in policy dialogue at national and global levels. The results for two institutes are presented for illustrative purposes in Tables 13 and 14, while Appendix Tables 2 - 10 show the empirical results for the other institutes. The results presented here mark the first time that empirical analysis of delays in fund disbursement to research institutes has been done so comprehensively.¹⁸

Two Illustrative Examples

National Cereals Research Institute (NCRI)

From Table 13, capital funds suffered the longest delay during 1993-94 when fourth quarter capital funds were not released, the analytical equivalent of an infinite delay. Excluding these years, the worst delay was 1995 with 389 days delay, giving a quarterly av-

18 There might be differences between when the checks and “authority to incur expenditures” were ready in the Ministry and when the institutes collected them. In practice, institutes are normally hard pressed for funds and often have to make several fruitless trips to Abuja (before that, Lagos) at the beginning of each quarter and until the necessary documents and checks are ready for collection. The differences in dates between when release documents are ready and when they are actually collected are minor and insignificant. In any case, it is when the funds are received at the institute that is relevant for institute management for actual expenditure purposes.

Table 13. Delays in the Release of Budget Funds to NCRI, Nigeria, 1990-96 (Date of Release, with Number of Days Delay and Computed Delay Indices)

Year	Capital funds							Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter		First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	
1990 Release date	15-Apr	16-Jun	Sept	Oct				1-Feb	2-May	3-Jul	4-Oct			
Delay in days	105	77			182	91		32	32	3	4	71	18	
Index (%):	116.67%	84.62%						35.56%	35.16%	3.26%	4.35%			
1991 Release date	5-May	10-May	27-Sep	5-Nov				16-Feb	30-May	3-Aug	4-Nov			
Delay in days	125	40	89	36	290	73		47	60	34	35	176	44	
Index (%):	138.89%	43.96%	96.74%	39.13%				52.22%	65.93%	36.96%	38.04%			
1992 Release date	16-Mar	10-Jul	25-Sep	4-Dec				20-Jan	2-Apr	18-Jul	30-Nov			
Delay in days	74	101	87	65	327	82		20	2	18	61	101	25	
Index (%):	82.22%	110.99%	94.57%	70.65%				22.22%	2.20%	19.57%	66.30%			
1993 Release date	15-Apr	2-Jun	15-Sep	Nil				3-Feb	8-May	26-Aug	3-Dec			
Delay in days	105	82	77	∞	264	82		34	38	57	64	173	43	
Index (%):	116.67%	90.11%	83.70%	∞				37.78%	41.76%	61.96%	69.57%			
1994 Release date	15-Apr	15-Jun	20-Sep	Nil				2-Feb	15-May	6-Aug	2-Nov			
Delay in days	108	46	82	∞	236	59		33	45	37	33	148	37	
Index (%):	120.00%	50.55%	89.13%	∞				36.67%	49.45%	40.22%	35.87%			
1995 Release date	26-May	20-Jul	11-Aug	29-Dec				25-Feb	30-May	30-Jun	14-Nov			
Delay in days	146	111	42	90	389	97		56	60	0	45	161	40	
Index (%):	162.22%	121.98%	45.65%	97.83%				62.22%	65.93%	0.00%	48.91%			
1996 Release date	14-May	14-May						18-Mar	2-May	2-Aug	15-Nov			
Delay in days	134	44			178	89		77	32	33	46	188	47	
Index (%):	148.89%	48.35%						85.56%	35.16%	35.87%	50.00%			

Table 13. Delays in the Release of Budget Funds to NCRI, Nigeria, 1990-96 (Date of Release, with Number of Days Delay and Computed Delay Indices) (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
Total												
Delay (days):	797	501	377	191			299	270	182	288		
Average (days)	114	72	75	64 (∞)			43	39	26	41		
Median Release Date:	18 April	16 June	20 Sept	4 Dec			3 Feb	8 May	2 Aug	14 Nov		
Median Days Delay	108	77	82	65			34	38	33	45		
Median Delay Index (%)	120.00	84.62	89.13	70.65			37.78	41.76	35.87	48.91		

Notes:

1. NCRI: Nationals Cereals Research Institute, Badeggi, Niger State.
2. First Quarter: January 1-March 31; Second Quarter: April 1-June 30; Third Quarter: July 1-September 30; Fourth Quarter: October 1-December 31.
3. "Delay" is number of days delay in release of funds.
4. "Index" is index of delay in release of funds.
5. "Full Year" is total delay in days for a given year for all quarters; "Average per quarter" is average number of days delay per quarter for the given year, that is (5) divided by number of quarters.
6. "Total" is total number of days delay for a given quarter, across all years in the sample.
7. "Average" is average number of days delay per year for the given quarter, that is, (7) divided by the number of years in the sample.

Source: Underlying data from NCRI 1996 Field Survey.

Table 14. Delays in the Release of Budget Funds to RRIN, Nigeria, 1985-96

Year	Capital funds						Recurrent funds					
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1985	9-May	7-Sep	3-Dec	-			6-Mar	8-Jun	25-Sep	12-Dec		
Release date	129	160	156		445	148	65	69	87	73	294	74
Delay in days	143.33%	175.82%	169.57%				72.22%	75.82%	94.57%	79.35%		
Index (%)	24-Feb; 15-May	7-May	12-Aug	20-Nov, 30-Dec			13-Feb	7-May	13-Aug	17-Oct		
1986	55	37	43	59	194	49	44	38	44	17	143	36
Release date	61.11%	40.66%	46.74%	64.13%			48.89%	41.76%	47.83%	18.48%		
Delay in days	13 Feb; 15 May	15-May	17-Aug	11-Nov, 20-Dec			14-Feb, 24-Mar	15-May, 3-July	14-Aug	30-Nov		
Index (%)	44	45	48	42	179	45	44	43	45	61	195	49
Release date	48.89%	49.45%	52.17%	45.65%			48.89%	47.25%	48.91%	66.30%		
Delay in days	31-Mar	14-May	17-Aug	8-Dec			8-Feb, 18-Feb	19-May	8-Aug	14-Nov		
Index (%)	90	44	48	69	251	63	39	49	39	45	172	43
Release date	100.00%	48.35%	52.17%	75.00%			43.33%	53.85%	42.39%	48.91%		
Delay in days	23-Mar	2-Jun	25-Aug	6-Nov			13-Feb	4-May	25-Jul	6-Nov		
Index (%)	83	63	56	37	239	60	44	34	25	37	140	35
Release date	92.22%	69.23%	60.87%	40.22%			48.89%	37.36%	27.17%	40.22%		
Delay in days	19-Mar	21-Jun	20-Sep	30-Oct			5-Feb	27-Apr	13-Aug	1-Nov		
Index (%)	79	82	82	30	273	68	36	27	44	32	139	35
Release date	87.78%	90.11%	89.13%	32.61%			40.00%	29.67%	47.83%	34.78%		
Delay in days	5-Apr	30-May	18-Aug	11-Sep			28-Jan	13-May	2-Aug; 11-Sept	31-Oct		
Index (%)	95	60	49	19	223	56	28	43	33	31	135	34
Release date	105.56%	65.93%	53.26%	20.65%			31.11%	47.25%	35.87%	33.70%		
Delay in days												
Index (%)												

Table 14. Delays in the Release of Budget Funds to RRIN, Nigeria, 1985-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1992 Release date	6-Mar	1-Sep	Nil	Nil	Nil	Nil	30-Jan	30-Apr	28-29 July	n.a	n.a	n.a
Delay in days	65	154	106	∞	219 (∞)	73 (∞)	30	30	28	28	88	22
Index (%)	72.22%	169.23%	115.22%	∞	∞	∞	33.33%	32.97%	30.43%	30.43%	30.43%	30.43%
1993 Release date	5-Jul	26-Jul	16-Nov	Nil	442(∞)	147 (∞)	24-Apr	5-Jul	18-Oct	6-Dec	387	97
Delay in days	186	117	139	∞	∞	∞	114	96	110	67	387	97
Index (%)	206.67%	128.57%	151.09%	∞	∞	∞	126.67%	105.49%	119.57%	72.83%	72.83%	72.83%
1994 Release date	2-May	19-Jul	30-Dec	Nil	415	138	15-Mar	9-Jun	30-Dec	30-Dec	418	105
Delay in days	122	110	183	Nil	415	138	74	70	183	91	418	105
Index %	135.56%	120.88%	198.91%	Nil	415	138	82.22%	76.92%	198.91%	98.91%	98.91%	98.91%
1995 Release date	17-Oct	6-Nov	6-Nov	359	359	180	10-Feb	28-Apr	21-Jul	17-Nov	138	35
Delay in days	230	129	129	359	359	180	41	28	21	48	138	35
Index %	252.75%	140.22%	140.22%	359	359	180	45.56%	30.77%	22.83%	52.17%	52.17%	52.17%
1996 Release date	11-Mar	15-Jun	6-Sep	n.a	214	71	28-Jun	n.a	n.a	n.a	n.a	n.a
Delay in days	70	76	68	n.a	214	71	179	n.a	n.a	n.a	n.a	n.a
Index %	77.78%	83.52%	73.91%	n.a	214	71	198.89%	n.a	n.a	n.a	n.a	n.a
Total	1018	1178	1001	∞	∞	∞	738	529	659	502	502	502
Average	93	98	83	∞	∞	∞	62	48	60	50	50	50
Median release date:	23-Mar	8-Jun	20-Sep	8 Nov	8 Nov	15-Nov	13-Feb	13-May	13-Aug	15-Nov	15-Nov	15-Nov
Median no. of days delay:	82	69	20	39	39	46	44	43	44	46	46	46
Median delay index %:	91.11	75.82	21.74	42.39	42.39	47.83	48.88	47.25	47.83	50.00	50.00	50.00

Notes:

1. RRIN: Rubber Research Institute of Nigeria.
2. First Quarter : January 1-March 31; Second Quarter: April 1-June 30; Third Quarter: July 1-September 30; Fourth Quarter: October 1-December 31.
3. "Delay" is number of days delay in releasing funds.
4. "Index (%)" is Index of Late Release of Funds to the Institute.
5. "Full Year" is total delay in days for a given year for all quarters.
6. "Average per Quarter" is average number of days delay per quarter for the given year, that is, (5) divided by the number of quarters.
7. "Total" is total number of days delay for a given quarter across all years in the sample.

erage delay of 97 days. Non-release of approved capital funds compounded the problem of research management because of inability to meet subsisting contractual obligations. Uncertainty as to whether fourth quarter funds would be released or not exacerbated research management difficulties as management, here as in other institutes, did not know up till the last day of the fourth quarter (December 31) whether or not capital funds would be released. Institute Directors kept hoping upon hope that funds would eventually be released, with government making no official pronouncement one way or the other during the 1993-94 period when no capital funds were released to most institutes.¹⁹ The best year was 1991 with 73 days. The worst quarter was the fourth quarter with the non-release of capital funds in 1993-94.

When the non-release years are excluded, the worst quarter was the first quarter with a total delay of 797 days, or an average quarterly delay across all years of 114 days. The corresponding indices for each quarter for each year are presented in Table 13.

Recurrent funds generally suffered far shorter delays in release than capital funds. Unlike the case with capital funds, there was no quarter when recurrent funds were not released, as this would have led to industrial unrest within the system. The worst quarter was the first quarter with a total delay of 299 days across all years, or an average of 43 days delay for the quarter during the period, while the third quarter was the best with a total of 182 days and an average for the quarter of only 26 days delay during the period. The poor record of the first quarter may be due to perennial delays in releasing the budget for the new fiscal year and the attendant delays in processing the first quarter's allocations therefrom.

Rubber Research Institute of Nigeria (RRIN)

With respect to delays in the release of capital funds, the worst quarter was again the fourth quarter when no funds were released during 1992-94, giving a disbursement delay index of infinity (Table 14). When the fourth quarter is excluded, the second quarter is the worst with a total delay of 1178 days, or an average of 98 days for the second quarter during the 1985-96 period, while the best quarter was the third with a total delay of 1001 days, or an average of 83 days for the third quarter during the period. The worst years were 1992-94 when no fourth quarter capital funds were released. The best year was 1987 with a total delay of 179 days over the four quarters, or an average delay of 45 days per quarter during the year.

As with the other institutes, with the exception of NIFFR, delays in the release of recurrent funds were less than the delays in the release of capital funds. The worst year was 1994 with a total delay of 418 days for the four quarters, or an average of 105 days per quarter during the year. The best year was 1992 with a total delay of 88 days, or an average of only 22 days per quarter during the year. The disbursement delay indices for each quarter in each year for capital and recurrent budgets are presented in Tables 13-14.

¹⁹ As Vice Chancellor, University of Agriculture, Makurdi during this period, this author recalls his frustrations in managing capital development projects under these conditions of funding uncertainty.

Summary of delays in fund disbursement

From Table 15, the median number of days delay in the release of first quarter capital budget funds ranges from 50 days at NIFFR to 108 days at NCRI; the corresponding median fund release delay index ranges from 55.55 percent to 120.00 percent for the same institutes.²⁰ The median number of days delay in the release of capital funds in the second quarter ranges from 35 days at IAR to 87 days at NRICT; the corresponding median fund release delay index ranges from 38.46 percent to 95.60 percent for the same institutes. For the third quarter, the range in the median number of days delay is from 20 days at RRIN to 106 days at NIFFR; the corresponding range in the median fund release delay index is from 21.74 percent to 115.22 percent for the same institutes. The median number of days delay in the fourth quarter ranges from 33 days at IAR+T to 67 days at NIFFR; the corresponding range in the median fund release delay index is from 35.87 percent to 72.83 percent for the same institutes. The location of NIOMR in Lagos must have conferred an advantage in the development of institutional capacity for “insider contacts” in the federal bureaucracy in Lagos, compared with NIFFR that is remotely located in far-away Kainji with few “insider contacts” in the federal bureaucracy.

From Table 16, the median number of days delay in the release of recurrent budget funds for the first quarter ranges from 39 days at NIOMR to 57 days at NAPRI; the corresponding range in the median fund release delay index is from 43.33 percent to 63.33 percent for the same institute. For the second quarter, the range in the median number of days delay is from 32 days at NIOMR to 81 days at NIFFR; the corresponding range in the median fund release delay index is from 35.16 percent to 89.01 percent for the same institutes. The median number of days delay in the release of recurrent funds in the third quarter ranges from 29 days at NIOMR to 108 days at NIFFR; the corresponding range in the median fund release delay index is from 31.52 percent to 117.39 percent for the same institutes. For the fourth quarter, the range in the median number of days delay is from 31 days at NAPRI and NIOMR to 71 days at NIFFR; the corresponding range in the median fund release delay index is from 33.70 percent to 77.17 percent for the same institutes.

Detailed empirical results for the other institutes are presented in Appendix Tables 2-10. The main features of these results are the following:

- excessive delays in the release of capital and recurrent funds to virtually all research institutes;
- delays in the disbursement of capital funds tended to exceed delays in the disbursement of recurrent funds;

²⁰ The entries in Tables 15-16 are derived as follows. From the data on number of days delay and the computed indices of delays in fund release for a given quarter (for example, the first quarter) in each year over the 1985-96 period (Tables 13-14) the median number of days delay and the corresponding median fund release delay indices are computed. The median values for each quarter and for each institute are then entered in Tables 15-16.

Table 15. Computed Indices of Delays in the Release of Capital Budget Funds to Research Institutes, Nigeria, 1985-96

Institute	Median date of release of funds				Median no. of days delay in release of funds				Median index of delay			
	First quarter	Second quarter	Third quarter	Fourth quarter	First quarter	Second quarter	Third quarter	Fourth quarter	First quarter	Second quarter	Third quarter	Fourth quarter
1. NIHORT ⁽¹⁾	21-Mar	31-May	22-Aug	26-Nov	80	61	53	57	88.89	67.03	57.61	61.96
2. NCRI ⁽²⁾	18-Apr	16-Jun	20-Sep	4-Dec	108	77	82	65	120.00	84.62	89.13	70.65
3. NIFOR ⁽³⁾	22-Feb	24-May	4-Sep	22-Nov	53	54	66	53	58.89	59.34	71.74	57.61
4. NIFFR ⁽⁴⁾	19-Feb	11-Jun	14-Oct	16-Dec	50	72	106	67	55.55	79.12	115.22	72.83
5. RRIN ⁽⁵⁾	23-Mar	8-Jun	20-Sep	8-Nov	82	69	20	39	91.11	75.82	21.74	42.39
6. IAR+T ⁽⁶⁾	29 Feb	29-May	5-Sep	2-Nov	60	59	67	33	66.67	64.84	72.83	35.87
7. IAR ⁽⁷⁾	3-Mar	5-May	9-Aug	7-Nov	62	35	40	38	68.89	38.46	43.48	41.30
8. NIOMR ⁽⁸⁾	26-Mar	8-Jun	1-Sep	22-Nov	85	67	63	53	94.44	73.63	68.48	57.61
9. NSPRI ⁽⁹⁾	22-Mar	23-May	7-Sep	11-Nov	81	53	69	42	90.00	58.24	75.00	45.65
10. NRICT ⁽¹⁰⁾	6-Apr	26-Jun	7-Sep	2-Dec	96	87	69	63	106.67	95.6	75.00	68.48
11. NAPRI ⁽¹¹⁾	11-Mar	25-May	8-Sep	20-Nov	69	55	78	51	76.67	60.44	84.78	55.43

Notes: First Quarter: January 1 - March 31; Second Quarter: April 1 - June 30.

1. NIHORT: National Horticultural Research Institute (1985-96).
2. NCRI: National Cereals Research Institute (1990-96).
3. NIFOR: Nigerian Institute for Oil Palm Research (1985-92).
4. NIFFR: National Institute for Freshwater Fisheries Research (1985-94); formerly Kainji Lake Research Institute.
5. RRIN: Rubber Research Institute of Nigeria (1985-96).
6. IAR+T: Institute of Agricultural Research and Training (1990-95).
7. IAR: Institute for Agricultural Research (1991-96).
8. NIOMR: Nigerian Institute for Oceanography and Marine Research (1989-95).
9. NSPRI: Nigerian Stored Products Research Institute (1988-96).
10. NRICT: National Research Institute for Chemical Technology (1989-96), formerly Leather Research Institute of Nigeria.
11. NAPRI: National Animal Production Research Institute (1990-96).

Source: Underlying data from Tables 13-14 and Appendix Tables 2-10

Table 16. Computed Indices of Delays in the Release of Recurrent Budget Funds to Research Institutes, Nigeria, 1985-96

Institute	Median date of release of funds				Median no. of days delay in release of funds				Median index of delay			
	First quarter*	Second quarter	Third quarter	Fourth quarter	First quarter	Second quarter	Third quarter	Fourth quarter	First quarter	Second quarter	Third quarter	Fourth quarter
1. NIHORT ⁽¹⁾	15-Feb	10-May	4-Aug	5-Nov	46	40	35	36	51.11	43.96	38.04	39.13
2. NCRI ⁽²⁾	3-Feb	8-May	2-Aug	14-Nov	34	38	33	45	37.78	41.76	35.87	48.91
3. NIFOR ⁽³⁾	24-Feb	15-May	10-Aug	8-Nov	55	45	41	39	61.11	49.45	44.57	42.39
4. NIFFR ⁽⁴⁾	22-Feb	20-Jun	16-Oct	10-Dec	53	81	108	71	58.88	89.01	117.39	77.17
5. RRIN ⁽⁵⁾	13-Feb	13-May	13-Aug	15-Nov	44	43	44	46	48.88	47.25	47.83	50.00
6. LAR+T ⁽⁶⁾	13-Feb	22-May	3-Aug	6-Dec	44	52	34	67	44.89	57.14	36.96	72.83
7. LAR ⁽⁷⁾	25-Feb	28-May	13-Sep	8-Nov	56	58	75	39	62.22	63.74	81.52	42.39
8. NIOMR ⁽⁸⁾	8-Feb	2-May	30-Jul	1-Nov	39	32	29	31	43.33	35.16	31.52	33.70
9. NSPRI ⁽⁹⁾	9-Feb	9-May	3-Aug	10-Nov	40	39	34	41	44.44	42.86	36.96	44.57
10. NRICT ⁽¹⁰⁾	13-Feb	16-May	2-Aug	5-Nov	44	46	33	36	48.89	50.55	35.87	39.13
11. NAPRI ⁽¹¹⁾	26-Feb	14-May	14-Aug	1-Nov	57	44	45	31	63.33	48.35	48.91	33.70

Notes: *First Quarter: January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.

1. NIHORT: National Horticultural Research Institute (1985-92).

2. NCRI: National Cereals Research Institute (1990-96).

3. NIFOR: Nigerian Institute for Oil Palm Research (1985-92).

4. NIFFR: National Institute for Freshwater Fisheries Research (1985-94).

5. RRIN: Rubber Research Institute of Nigeria (1985-96).

6. LAR+T: Institute of Agricultural Research and Training (1990-95).

7. LAR: Institute for Agricultural Research (1991-96).

8. NIOMR: Nigerian Institute for Oceanography and Marine Research (1989-95).

9. NSPRI: Nigerian Stored Products Research Institute (1988-96).

10. NRICT: National Research Institute for Chemical Technology (1989-96).

11. NAPRI: National Animal Production Research Institute (1990-96).

Source: Underlying data from Tables 13-14 and Appendix Tables 2-10.

- there were unusually long delays in the first quarter, reflecting the effects of delayed announcement of the annual budget and the delayed processing of the first release of the new fiscal year;
- there were unusually long delays in disbursement in 1993 and 1994 in many institutes, possibly reflecting the general paralysis accompanying the political crisis in these years following the annulment of the presidential elections in 1993;
- capital funds were not released to most research institutes in the fourth quarter during 1992-94, a problem compounded by the failure of government to make an explicit announcement in advance that such releases were canceled, a step that would have greatly aided research management; and
- though NARS leaders and managers might have partially adjusted to the problem of delayed disbursements through “institutional memory” by which they factored delay experiences into research management and planning, differences between anticipated and realized disbursement delays continued to pose problems for research management.

Agricultural Research Staff Instability

For a given research institute, the index of research staff instability (I) is defined as the ratio of number of staff who have left a research institute over a given period to the number of research staff in the institute at the beginning of the period.²¹ In percentage terms, the index is defined as:

$$I = \frac{\sum_{j=1}^K N_{ij}, t_0 - \sum_j N_{ji}, t_n}{\sum_{j=1}^K N_{ji}, t_0} \times 100 \quad (4)$$

where N_j is the j^{th} individual whose value = 1 if he is in post, and value = 0 if he is no longer in post at the institute; i stands for the institute, K stands for the number of researchers in the institute; t_0 is the base year and t_n is the terminal reference year.

The possible values of I are:

I = 100 percent, the case of perfect instability (or zero stability) when all research staff in the institute in the base year t_0 have all left the institute and are no longer in post, that is, $t_n - t_0$ years later;

²¹ For an earlier treatment of research staff instability, see Idachaba, 1980;1981.

I = 0 percent, the case of zero instability (or perfect stability), when all research staff in the institute in the base year t_0 are still in the post in terminal year t_n , that is, $t_n - t_0$ years later.;

The staff instability index for a whole NARS (I_N) is similarly defined as the ratio of the number of research staff who have left the NARS over a given period to the number of research staff in the NARS at the beginning of the period:

$$I_N = \frac{\sum_{i=1}^R \sum_{j=1}^K N_{ji}, t_o - \sum_{i=1}^R \sum_{j=1}^K N_{ji}, t_n}{\sum_{i=1}^R \sum_{j=1}^K N_{ji}, t_o} \quad (4^1)$$

where N_{ji} is the j^{th} individual research staff in the i^{th} research institute (NARO) whose value = 1 if he is in post and value = 0 if he is no longer in post in a given NARO, and there are K research staff in R NAROs within the NARS, and other symbols have their previous meanings. The instability index measures the “turnover rate” of research staff.

Data on research staff in post in each year was collected from each institute. For the base year, landmarks were selected: for example, 1954 for the few erstwhile pan-territorial research institutes; 1964 to mark the creation of the first generation Nigerian research institutes after the dissolution of the West African Research Organization; 1976 to mark the creation of the second generation research institutes, and 1981 to mark the beginning of the decade of the Structural Adjustment Program and its impact on research staff instability.

Five years was chosen as the minimum length of stay for a researcher to remain on the job and design and execute a substantive research program as well as contribute meaningfully to institutional capacity development in a given NARO. For periods of less than 5 years, research tends to be perfunctory and a researcher would not have developed functional and personal relationships with colleagues, especially within the context of commodity-based multi-disciplinary research teams. From the research staff list in a given base year (say, 1976), each staff member was traced in the reference (terminal) year (say, 1981) to see if he/she was still in post. Base year research staff were individually followed 5, 10 and 20 years from the base year to determine if they were still in post or had left the NARO. Instability indices were computed at intervals of 5, 10, and 20 years from the base year. Where it was not possible to have all the research institutes reduced to a common base year for the computation and comparison of the indices, base periods were chosen according to availability of data and the history of individual research institutes.

The simple rule-of-thumb classification adopted is:

I If 5 years after the base year:

$0 < I \leq 30$, there is mild-individual research staff instability;

$30 < I \leq 50$, moderate instability;

$50 < I \leq 100$, severe-systemic research staff instability;

$I = 100$, perfect instability, severe-systemic instability, zero research staff stability.

II If 10 years after the base year:

$0 < I \leq 30$, very mild-individual research staff instability;

$30 < I \leq 50$, mild instability;

$50 < I \leq 100$, severe-systemic instability;

$I = 100$, perfect instability, zero stability.

III. If 20 years after the base year:

$0 < I \leq 30$, normal attrition;

$30 < I \leq 50$, mild-individual research staff instability;

$50 < I \leq 75$, moderate instability;

$75 < I < 100$, severe-systemic instability

$I = 100$, perfect instability, zero stability

The First Generation Research Institutes

Table 17 shows computed indices of agricultural research staff instability for Nigeria's first generation research institutes.

West African Institute for Trypanosomiasis Research (WAITR)/Nigerian Institute for Trypanosomiasis Research (NITR)

WAITR witnessed severe agricultural research staff instability: within 10 years (1964) only 1 of the 1954 base year staff was still in post. By 1976, the entire 1954 all-expatriate staff had left, resulting in perfect instability. The mass departure coincided with the onset of Nigerian Independence and the dissolution of the West African Research Organization. This probably reflected a fear of the unknown on the part of the expatriate staff in the new political dispensation.²²

The newly established Nigerian Institute for Trypanosomiasis Research (NITR) fared no better: within 5 years (1969) NITR lost 7 of its 11 staff who were in post in 1964, and by

²² WAITR had an academically impressive staff list from its inception in 1954: it had two D.Sc holders (Mulligan and Nash). Unfortunately, little or no effort was made to aggressively develop indigenous scientific research capacity as reflected in the fact that there were no Nigerian research staff in the first ten years.

Table 17. Computed Indices of Agricultural Research Staff Instability, First Generation Research Institutes, Nigeria, 1954-96

Institute	Base year	Terminal year	No. of research staff in base year		No. of those base year research staff still in post in terminal year		Instability index (%)
1.1 WAITR	1954	1959	1954:	11	1959:	4	63.64
		1964			1964:	1	90.91
		1976			1976:	0	100.00
1.2 NITR	1964	1969	1964:	11	1969:	4	63.64
		1976			1976:	2	81.82
		1984			1984:	0	100.00
	1976	1981	1976:	27	1981:	15	44.44
		1986			1986:	10	62.96
1996	1996:	4	85.19				
2.1 WACRI	1954	1959	1954:	3	1959:	1	66.67
		1964			1964:	0	100.00
		1976			1976:	0	100.00
2.2 CRIN	1964	1969	1964:	29	1969:	19	34.48
		1974			1974:	9	68.97
		1984			1984:	2	93.10
	1976	1981	1976:	29	1981:	13	55.17
	1986	1986:			9	68.97	
	1996	1996:	6	79.31			
	1991	1991:	13	38.10			
1996	1996:	12	42.86				
3.1 WAIFOR	1953/54	1963/64	1953/54:	12	1963/64:	1	91.67
3.2 NIFOR	1964	1969	1964:	13	1969:	3	76.92
		1974			1974:	3	76.92
		1984			1984:	1	92.31
	1974	1979	1974:	30	1979:	20	33.33
		1984			1984:	11	63.33
		1994			1994:	9	70.00
	1976	1981	1976:	27	1981:	15	34.88
		1986			1986:	10	55.81
		1996			1996:	17	60.47
1981	1986	1981:	72	1986:	47	34.72	
	1991			1991:	21	70.83	
	1996			1996:	32	55.55	
4. FIIRO	1970/71	1975/76	1970/71:	18	1975/76:	11	38.89
		1976/77			1976/77:	6	66.67
5. IAR	1967/68	1982/83	1967/68:	79	1982/83:	4	94.94
		1987/88			1978/88	0	100.00

Notes:

- 1.1 WAITR is West African Institute for Trypanosomiasis Research.
- 1.2 NITR is Nigerian Institute of Trypanosomiasis Research.
- 2.1 WACRI is West African Cocoa Research Institute.
- 2.2 CRIN is Cocoa Research Institute of Nigeria.
- 3.1 WAIFOR is West African Institute for Oil Palm Research.
- 3.2 NIFOR is Nigerian Institute for Oil Palm Research.
4. FIIRO is Federal Institute for Industrial Research, Oshodi.
5. IAR is Institute for Agricultural Research.

Source: Underlying data from Field Survey, 1996

1976, only 2 were in post. By 1984, all 1963 research staff had left the institute. The instability picture with the 1954 and 1964 base years appears similar.

The degree of instability appears to be less with a 1976 base year compared to the 1954 and 1964 base years. It is worthy of note that within 5 years (1976-81), NITR had lost almost half of its research staff.

West African Cocoa Research Institute (WACRI), Ibadan Substation

Research staff instability was much worse at the West African Cocoa Research Institute (Ibadan Substation): within 5 years (1954-59), only 1 of the original 3 staff was still in post, and within 10 years (1954-64) all research staff in post in 1954 had left the Ibadan substation of WACRI. This meant that by 1964, when the Nigerian Cocoa Research Institute (CRIN) was created, the entire research staff in post in 1954 had resigned.

Cocoa Research Institute of Nigeria (CRIN)

Instability of research staff at CRIN in its first five years (1964-69) was half the instability of its precursor WACRI (Ibadan substation) during the 1954-59 period. Still, CRIN lost over one third of its research staff during this period of five years. Within 10 years (1964-74), 20 of the research staff in post in 1964 had left and in twenty years (1964-84), only 2 out of the 29 staff from 1964 were still in post at CRIN.

The 1976 base year traces research staff stability from the date of the simultaneous establishment of many of the second-generation research institutes. Instability during 1976-81 was worse (at 55.17 percent) than the 1964-69 period, probably reflecting the dramatic exit of CRIN staff for greener pastures in the newly established institutes. CRIN recorded no growth in staff numbers from 1964 to 1976, year-to-year (29 staff, though with exits and entries). The 1986 base year traces staff stability with the commencement of Nigeria's Structural Adjustment Program (SAP). The absolute number of staff had fallen from 29 in 1976 to 21 in 1986 and research staff instability during 1986-91 was higher than during 1964-69, though less than the 1976-81 period. Instability was exacerbated by the rift between management and the governing board during Opeke's term as Director.

West African Institute for Oil Palm Research (WAIFOR)

Instability caused by mass exit of expatriate research staff following Nigeria's independence and the dissolution of the West African Research Organization is evident from the fact that only one of the research staff in post in 1953-54 was still at WAIFOR by 1963-64. Instability remained at a high level in the newly established NIFOR: only 3 of the 13 staff from 1964 were in post in 1969. Research staff instability in 1974 with a 1964 base year, remained at the 1969 level because of the presence of three staff over the period (D.O. Ataga, C.O. Obasola and H.C. Okoye). Twenty years later, only 1 staff from 1964 was still at NIFOR. Stability of research staff with 1976 and 1981 base years

was an improvement over stability with a 1964 base year. It is remarkable that 32 of the 72 research staff from 1981 were still at NIFOR by 1996.

Federal Institute for Industrial Research (FIIRO)

Only 6 of the 18 staff in post in 1970 were in post in 1976 (instability index of 66.67%).

Institute for Agricultural Research (IAR)

The mass exit of expatriate staff from the Institute for Agricultural Research exacerbated the instability: only 4 of the 79 research staff from 1967/68 were still at IAR in 1982/83, and by 1987/88, all the 1967/68 staff had left. In 20 years, the entire research staff of 79 research staff had left. There are three possible reasons for this mass exit of expatriates. First, there were the developments in the political leadership of Ahmadu Bello University and the politicization (indigenization) of the leadership of academic units within IAR and ABU. Expatriate staff were not comfortable with this development. Second, there was the civil war and its aftermath. Third, there was the depreciation of the naira which drastically reduced the dollar equivalents of naira earnings of expatriate staff and made continued employment on a university salary scale unattractive.

The Second Generation Research Institutes

The instability experience of the second-generation research institutes is mixed (see Table 18).

National Cereals Research Institute (NCRI)

Within 5 years of its establishment as an institute in 1976, the National Cereals Research Institute lost half of its research staff. Twenty years later (1996), only 11 of the 150 research staff from 1976 were still on the job at NCRI (an instability index of 92.67 percent). Three factors explain the mass exodus of research staff. First was the migration of staff to the newly established research institutes in search of greener pastures. NCRI served as a source of supply of research staff for the other research institutes. Second was the resignation of staff who did not like the relocation of NCRI from Ibadan to Badeggi in 1985. This was particularly true of research scientists from the southern parts of the country who, for a variety of reasons, did not want to move to the new headquarters location of NCRI. Third was the disparity (until 1987) between the salaries of research staff in the research institutes and those of university lecturers.

The National Research Institute for Chemical Technology (NRICT)

This is arguably the most stable of the research institutes. With a 1976 base year, 50 percent of the research staff were still in post 20 years later (1996). This is the lowest level of instability over a twenty-year period for any research institute. And with a 1981 base year, only 6 of the 15 staff in 1981 had left by 1996, 15 years later. Good stable leadership might be the key explanatory role: Mshelbwala has been Director of the institute

Table 18. Computed Indices of Agricultural Research Staff Instability, Second Generation Research Institutes, Nigeria, Selected Periods

Institute	Base year	Terminal year	No. of research staff in base year		No. of those base year research staff still in post in terminal year		Instability index (%)	
1. NCRI	1976	1981	1976:	150	1981:	76	49.33	
		1986			1986:	32	78.67	
		1996			1996:	11	92.67	
2. NRICT	1976/77	1981	1976/77:	8	1981:	6	25.00	
		1986			1986:	6	25.00	
		1996			1996:	4	50.00	
	1981	1986	1981:	15	1986:	11	26.67	
		1991			1991:	10	33.33	
		1996			1996:	9	40.00	
3. NIFFR	1969	1974	1969:	4	1974:	4	0.00	
		1979			1979:	1	75.00	
		1994			1994:	1	75.00	
	1974	1979	1974:	17	1979:	7	58.82	
		1984			1984:	5	70.59	
		1994			1994:	4	76.47	
	1981	1986	1981:	25	1986:	18	28.00	
		1991			1991:	16	36.00	
		1996			1996:	11	56.00	
4. RRIN	1976	1981	1976:	13	1981:	9	30.77	
		1988			1988:	3	76.92	
		1996			1996:	3	76.92	
	1981	1988	1981:	31	1988:	11	64.52	
		1991			1991:	9	70.97	
		1996			1996:	6	80.65	
1988	1996	1988:	18	1996:	11	38.89		
5. FRIN	1960	1965	1960:	15	1965:	6	60.00	
		1970			1970:	3	80.00	
		1980			1980:	0	100.00	
	1976	1996	1976:	81	1996:	0	100.00	
		1981			1981:	55	32.10	
		1986			1986:	40	50.62	
	1986	1996	1986:	89	1996:	22	72.84	
		1991			1991:	54	39.33	
		1996			1996:	40	55.06	
6. NAPRI	1976	1981	1976:	18	1981:	9	50.00	
		1986			1986:	9	50.00	
7. NVRI	1985	1990	1985:	74	1990:	40	45.95	
		1995			1995:	35	54.05	
8. NAERLS	1975	1980	1975:	21	1980:	14	33.33	
		1991			1991:	5	76.19	
1980	1991	1980:	29	1991:	7	75.86		
9. NSPRI/ WASPRU	1956	1961	1956:	9	1961:	2	77.78	
		1966			1966:	1	88.89	
	1960	1965	1960:	8	1965:	4	50.00	
		1970			1970:	2	75.00	
		1980			1980:	0	100.00	
	1980	1985	1980:	19	1985:	9	52.63	
		1990			1990:	7	63.16	
		1995			1995:	5	73.68	

Notes: 1. NCRI is National Cereals Research Institute; 2. NRICT is National Research Institute for Chemical Technology; 3. NIFOR is Nigerian Institute for Oil Palm Research; 4. RRIN is Rubber Research Institute of Nigeria; 5. FRIN is Forestry Research Institute of Nigeria.; 6. NAPRI is National Animal Production Research Institute; 7. NVRI is Nigerian Veterinary Research Institute.; 8. NAERLS is National Agricultural Extension and Research Liaison Service; 9. NSPRI is Nigerian Stored Products Research Institute/WASPRU is West African Stored Products Research Unit.

Source: Underlying data from Field Survey, 1996

since 1979, the longest serving Director in the Nigerian NARS. The remarkable research staff stability at NRICT refutes the proposition that an institute can only be stable if its research staff are drawn largely from the institute's catchment area (the "indigene factor"). In the NRICT case, neither the Director nor the majority of research staff come from Kaduna state or the catchment area broadly defined.

This is a significant finding in multiethnic societies where the ethnic origins of institute managers and research staff often ignite popular sentiments. The NRICT experience suggests that the leadership and the majority of the research staff do not have to come from the catchment area to attain research staff stability. On the other hand, the CRIN experience suggests that, even when the Director and the majority of research staff are from the catchment area, an institute can witness considerable research staff instability. The NRICT evidence suggests a very strong positive correlation between stable institute leadership and research staff stability. Ethnic homogeneity on its own does not guarantee research staff stability.

National Institute for Freshwater Fisheries Research (NIFFR)

There was perfect stability in the early years at the National Institute for Freshwater Fisheries Research: all 4 staff from 1969 were still in post in 1974; ten years later, however (1979), only 1 staff member from 1969 was left. With a 1974 base year, 10 of the 17 staff in post had left by 1979; twenty years later (1996), only 4 of those staff were still left. Instability has decreased over time in recent years: with a 1981 base year, 11 of the 25 staff were still in post by 1996. The remote location of the institute, though compensated for by the spectacular scenic beauty of the Kainji Dam and Kainji Lake, might have contributed to the high instability of the 1970s.

Forestry Research Institute of Nigeria (FRIN)

There was high instability in the early years at the Forestry Research Institute of Nigeria: by 1965, 9 of the 15 research staff from 1960 had left (an instability index of 60.00 percent). There was some improvement later: with a 1976 base year, 41 out of the 81 staff from 1976 had left by 1986 (an instability index of 50.62 percent). The situation has worsened in the most recent period: 49 of the 89 research staff from 1986 had left the institute by 1996—an instability index of 55.06 percent).

Rubber Research Institute of Nigeria (RRIN)

The instability profile from the Rubber Research Institute of Nigeria is mixed. High instability levels have compounded consequences in tree crop research institutes with their long gestation research projects. The program instability consequences of high research staff instability are greater for tree crop research than for arable crop research, for the same level of research staff instability. The constancy of the instability index from the 1976-88 period to the 1976-96 period reflected the institutional commitment of three staff who remained at the institute over the 1976-96 period (V.O. Otoide, I.K. Ugwa and O.B.C. Uraih).

National Animal Production Research Institute (NAPRI)

With a 1976 base, half of the research staff at the National Animal Production Research Institute had left by 1981, only five years later.

Nigerian Veterinary Research Institute (NVRI)

Within five years (1985-90), almost half of the 1985 research staff had left the Nigerian Veterinary Research Institute.

National Agricultural Extension and Research Liaison Science (NAERLS)

Within five years of the establishment of the National Agricultural Extension and Research Liaison Services, one third of the research staff in post in 1975 had left by 1980.

The West African Stored Products Research Unit (NSPRI/WASPRU)

The high instability index for the West African Stored Products Research Unit over the 1956-61 period reflects the mass departure of expatriate research staff with the attainment of Nigerian Independence in 1960. By 1966, only 1 of the 9 expatriate staff from 1956 was still in post. The surviving expatriate (Riley) stayed till 1980, in contrast to the situation at the Nigerian Institute for Oil Palm Research and Cocoa Research Institute of Nigeria, where all expatriate staff left soon after independence and the dismantling of the West African Research Organization in September 1962.²³

Table 19 presents a summary and classification of research staff instability. Over five-year periods from a given base year, the most unstable institutes were NIFOR (1964-69, 76.92%); WACRI (1954-59, 66.67%) and WAITR (1954-59, 63.64%). The most stable over any given five-year periods were NIFFR (1969-74, 0.00%; 1981-86, 28%), and NRICT (1976-81, 25.00%; 1981-86, 26.67%). Over ten-year periods the most unstable institutes were WACRI (1954-64, 100.00%), WAITR (1954-64, 90.91%) and WAIFOR (1953/54-1963/64, 91.67%). These were the pan-territorial research institutes that witnessed mass exit of expatriate staff from the 1950s to the 1960s. The most stable over any given ten-year periods were NRICT (1976-86, 25.00%, 1981-91, 33.33%) and NIFFR (1981-91, 36.00%). Over any given twenty-year period, the most unstable insti-

23 The Nigerian Stored Products Research Institute (NSPRI) presents one example for comparing research staff instability under an all-expatriate staff regime with an all-Nigerian staff regime over 5 and 10 year periods:

Period	Remarks	Instability Index (%)
1956-61	All expatriate, pre-Independence	77.78
1960-65	All expatriate, post-Independence	50.00
1956-66	All expatriate	88.89
1960-70	All expatriate	75.00
1980-85	All Nigerian	52.63
1980-90	All Nigerian	63.16
1980-95	All Nigerian	73.68

Research staff instability was higher during the colonial era than during the period of all-Nigerian research staff.

Table 19. Summary and Classification of Research Staff Instability of Research Institutes, Nigeria, Selected Periods

Institute	Base year	Period	Instability index (%)	Classification of index
1. WAITR	1954	1954-59	63.64	Severe-Systemic
		1954-64	90.91	Severe-Systemic
		1954-76	100.00	Perfect instability
2. NITR	1964	1964-69	63.64	Severe-Systemic
		1964-76	81.82	Severe-Systemic
		1964-84	100.00	Perfect Instability
	1976	1976-81	44.44	Moderate Instability
		1976-86	62.96	Severe-Systemic
		1976-96	85.19	Severe-Systemic
3. WACRI	1954	1954-59	66.67	Severe Systemic
		1954-64	100.00	Perfect Instability
4. CRIN	1964	1964-69	34.38	Moderate Instability
		1964-74	68.97	Severe Systemic
		1964-84	93.10	Severe Systemic
	1976	1976-81	55.17	Severe Systemic
		1976-86	68.97	Severe Systemic
		1976-96	79.31	Severe Systemic
	1986	1986-91	38.10	Moderate
1986-96		42.86	Mild	
5. WAIFOR	1953/54	1953/54-63/64	91.67	Severe Systemic
6. NIFOR	1964	1964-69	76.92	Severe Systemic
		1964-74	76.92	Severe Systemic
		1964-84	92.31	Severe Systemic
	1974	1974-79	33.33	Moderate
		1974-84	63.33	Severe Systemic
		1974-94	70.00	Moderate
	1976	1976-81	34.88	Moderate
		1976-86	55.81	Severe Systemic
		1976-96	60.47	Moderate
	1981	1981-86	34.47	Moderate
1981-91		70.83	Severe Systemic	
1981-96		55.55	Moderate	
7. FIIRO	1970	1970-75	38.89	Moderate
8. IAR	1967	1967-82	94.94	Severe Systemic
		1976-87	100.00	Perfect Instability
9. NCRI	1976	1976-81	49.33	Moderate
		1976-86	78.67	Severe Systemic
		1976-96	92.67	Severe Systemic
10. NRICT	1976	1976-81	25.00	Mild Individual
		1976-86	25.00	Very Mild Individual
		1976-96	50.00	Mild
	1981	1981-86	26.67	Mild Individual
		1981-91	33.33	Mild
		1981-96	40.00	Mild individual

Table 19. Summary and Classification of Research Staff Instability of Research Institutes, Nigeria, Selected Periods (continued)

Institute	Base year	Period	Instability index (%)	Classification of index
11. NIFFR	1969	1969-74	0.00	Zero Instability
		1969-74	75.00	Severe Systemic
		1969-94	75.00	Severe Systemic
	1974	1974-79	58.82	Severe Systemic
		1974-84	70.59	Severe Systemic
		1974-94	76.47	Severe Systemic
	1981	1981-86	28.00	Mild Individual
		1981-91	36.00	Mild
		1981-96	56.00	Moderate
12. RRIN	1976	1976-81	30.77	Moderate
		1976-88	76.92	Severe Systemic
		1976-96	76.92	Severe Systemic
	1981	1981-88	64.52	Severe Systemic
		1981-96	70.97	Severe Systemic
	1988	1988-96	38.89	Moderate
13. FRIN	1960	1960-65	60.00	Severe Systemic
		1960-70	80.00	Severe Systemic
		1960-80	100.00	Perfect Instability
		1960-96	100.00	Perfect Instability
	1976	1976-81	32.10	Moderate
		1976-86	50.62	Severe Systemic
		1976-96	72.84	Moderate
	1986	1986-91	39.33	Moderate
		1986-96	55.06	Severe Systemic
14. NAPRI	1976	1976-81	50.00	Moderate
15. NVRI	1985	1985-90	45.95	Moderate
		1985-95	54.05	Severe Systemic
16. NAERLS	1975	1975-80	33.33	Moderate
		1975-91	76.19	Severe Systemic
	1980	1980-91	57.86	Severe Systemic

Notes:

1. WAITR is West African Institute for Trypanosomiasis Research, Kaduna, Kaduna State.
2. NITR is Nigerian Institute for Trypanosomiasis Research, Kaduna.
3. WACRI is West African Cocoa Research Institute (Ibadan Substation).
4. CRIN is Cocoa Research Institute of Nigeria, Onigambari, Ibadan, Oyo State.
5. WAIFOR is West African Institute for Oil Palm Research, near Benin City.
6. NIFOR is Nigerian Institute for Oil Palm Research, near Benin City, Edo State.
7. FIIRO is Federal Institute for Industrial Research, Oshodi, Lagos State.
8. IAR is Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria.
9. NCRI is National Cereals Research Institute. Badeggi, Niger State.
10. NRICT is National Research Institute for Chemical Technology, Zaria, Kaduna State.
11. NIFFR is National Institute for Freshwater Fisheries Research, New Bussa, Niger State.
12. RRIN is Rubber Research Institute of Nigeria, Iyanomo, Edo State.
13. FRIN is Forestry Research Institute of Nigeria, Ibadan, Oyo State.
14. NAPRI is National Animal Production Research Institute, Ahmadu Bello University, Shika, Zaria, Kaduna State.
15. NVRI is Nigerian Veterinary Research Institute, Vom, Plateau State.
16. NAERLS is National Agricultural Extension and Research Liaison Service, Ahmadu Bello University, Samaru, Zaria, Kaduna State.

Source: Underlying data from Field Surveys, 1996.

tutes were IAR (1967-87, 100.00%), NITR (1964-84, 100.00%), CRIN (1964-84, 93.10%); FRIN (1960-80, 100.00%) and NCRI (1976-96, 92.67%). The most stable over any twenty-year period were NRICT (1976-96, 50.00%) and NIFOR (1976-96, 60.47%). The high research staff instability in most institutes over short periods must have crippled the development of sustainable research programs that normally require much more than five years gestation from the commencement of research to the release of validated agricultural technologies.

Governance Instability

The index of governance instability measures the turnover of Boards of Governors of research institutes, that is, the ratio of the number of members of the Governing Board who have been removed or retired over a given period to the number of Board Members at the beginning of the period. It is formally the same as that for agricultural research staff instability. Table 20 presents computed governance instability indices for those institutes for which data is available. Where possible, base years have been chosen to coincide with base years used for the computation of agricultural research staff instability. Five years is considered a desirable minimum subsisting tenure for Board members to provide continuity. Most institutes had perfect governance instability or zero stability for five-year periods and beyond. There are three aspects of governance instability that are worrisome. One is the short duration of tenure for most of the Boards. Second is the wholesale replacement of Boards, unlike the private sector where Board appointments and retirements are staggered to assure continuity. With high instability of governing boards of research institutes, there are no institutional memories. It is rare for a Board member to get re-appointed, almost as rare as the appearances of the Hale-Bopp comet.

Ordinarily, the governance instability index for a longer time period should be higher than that for a shorter period. However, at NIFOR, the governance instability index for 1965-80 (88.89 percent) was lower than that for 1965-69 because Menakaya, who was on the Board in 1965, was not on the Board in 1969 but reappeared, like the sighting of a comet, in a “second coming” in 1980 as a Board member, providing a rare instance of institutional memory.

In a few instances, governance instability was moderated over time by the presence of a surviving Institute Director as an *ex-officio* member. At the NRICT, the instability index fell to 88.89 percent in 1991 (with 1981 as base year) because Mshelbwala, Director since 1979, survived from the 1981 Board. At the NIOMR, governance instability index was 100.00 percent over the 1981-86 period and 80.00 percent over the 1981-91 period, because Tobor, as Director, survived as a Board Member in 1991 from the 1981 base year. However, his presence on site in 1986 could not prevent NIOMR from recording perfect instability (100.00%) because, technically, there was no Board, and though he functioned as Director/Chief Executive Officer, it was not within the context of a Supervising Governing Board. This explains the “anomalous” result of an instability index of a longer period being lower than that of a shorter time period. The same applies to NIHORT where Adeyemi was Director in 1986 but there was no Board; by 1991, the

Table 20. Computed Indices of Governance Instability of Research Institutes, Nigeria, 1954-96

Institute	Base	Terminal	No. of board members in base year		No. of those base year board members still on the board in terminal year		Instability index (%)		
1.1 WAIFOR	1954	1959	1954:	9	1959:	2	77.78		
		1965			1965:	0	100.00		
1.2 NIFOR	1965	1969	1965:	9	1969:	0	100.00		
		1980			1980:	1	88.89		
	1980	1985	1980:	8	1985:	0	100.00		
		1990			1990:	0	100.00		
2. CRIN	1964	1969	1964:	6	1969:	1	83.33		
		1974			1974:	1	83.33		
	1976	1981	1976:	9	1981:	1	88.89		
		1988			1988:	0	100.00		
		1996			1996:	0	100.00		
3. NITR	1976	1981	1976:	5	1981:	0	100.00		
		1986			1986:	0	100.00		
	1980	1988	1980:	7	1988:	1	85.71		
		1990			1990:	1	85.71		
4. NRICT	1976	1992	1988:	8	1992:	0	100.00		
		1981			1976:	9	1981:	0	100.00
		1986					1986:	0	100.00
	1981	1996	1981:	9	1996:	0	100.00		
		1986			1986:	0	100.00		
1991		1991:			1	88.89			
5. NCRI	1976	1981	1976:	6	1981:	0	100.00		
		1986			1986:	0	100.00		
	1981	1986	1981:	6	1986:	0	100.00		
		1991			1991:	0	100.00		
6. NIHORT	1976	1981	1976:	9	1981:	0	100.00		
		1986			1986:	0	100.00		
		1996			1996:	0	100.00		
	1981	1986	1981:	9	1986:	0	100.00		
		1991			1991:	1	88.88		
1996		1996:			0	100.00			
7. IAR+T	1979	1984	1979:	11	1984:	5	54.55		
8. FRIN	1976	1981	1976:	7	1981:	1	85.71		
		1986			1986:	1	85.71		
		1996			1996:	0	100.00		
9. NIOMR	1976	1981	1976:	6	1981:	0	100.00		
		1986			1986:	0	100.00		
	1981	1986	1981:	5	1986:	0	100.00		
		1991			1991:	1	80.00		
10. NSPRI	1978	1983	1978:	4	1983:	0	100.00		
		1988			1988:	0	100.00		
		1996			1996:	0	100.00		
	1983	1988	1983:	8	1988:	0	100.00		
		1993			1993:	0	100.00		
		1996			1996:	0	100.00		

Table 20. Computed Indices of Governance Instability of Research Institutes, Nigeria, 1954-96 (continued)

Institute	Base year	Terminal year	No. of board members in base year	No. of those base year board members still on the board in terminal year	Instability index (%)
11. NIFFR	1976	1981	1976: 7	1981: 0	100.00
		1986		1986: 0	100.00
	1981	1986	1981: 9	1986: 9	0.00
		1991		1991: 0	100.00

Notes:

- 1.1 WAIFOR: West African Institute for Oil Palm Research.
- 1.2 NIFOR: Nigerian Institute for Oil Palm Research.
2. CRIN: Cocoa Research Institute of Nigeria.
3. NITR: Nigeria Institute for Trypanosomiasis Research.
4. NRICT: National Research Institute for Chemical Technology.
5. NCRI: National Cereals Research Institute.
6. NIHORT: National Horticultural Research Institute.
7. IAR+T: Institute of Agricultural Research and Training.
8. FRIN: Forestry Research Institute of Nigeria.
9. NIOMR: Nigerian Institute for Oceanography and Marine Research.
10. NSPRI: Nigerian Stored Products Research Institute.
11. NIFFR: National Institute for Freshwater Fisheries Research.

Board had been reconstituted, with Adeyemi as the only surviving Member from the 1981 Board.

The constancy of the index at CRIN during (1964-69) and (1964-74) arose from the long presence of Opeke, Director, as *ex-officio* Board member. Though not as dramatically as Menakaya in NIHORT, Akinwolemiwa did survive from the CRIN Board of 1976 when it was reconstituted in 1981.

The third aspect of governance instability is the non-constitution of Boards for many institutes for long periods of time. For example, NITR had no Board during 1981-87; NSPRI had no Governing Board during 1984-87 and, most serious of all, NIFOR, a first-generation research institute, has not had a Governing Board since 1983.

All institutes have had severe systemic governance instability from being without Governing Boards since 1992. The excessively high institute governance instability is rooted in political instability. New regimes dissolve old Boards with relish and reconstitute new Boards with their own appointees. In 1992, the institutes were transferred from the Ministry of Science and Technology to the Ministry of Agriculture and Natural Resources. Babangida's regime did not constitute new Boards before it gave way to Shonekan's Interim Government of August 1993. The Shonekan government was overthrown in a bloodless *coup* in November 1993 before anything could be done about the Boards of Institutes. The Abacha Administration has demonstrated that it is in no particular hurry to reconstitute the Boards of government parastatals, research institutes included.

The void in institute governance created by the non-constitution of Governing Boards over long periods of time deprives the institutes of institutionalized supervision, monitoring, research policy and program accountability. Four reasons can be adduced for the persistent void in institute governance created by the prolonged non-constitution of Governing Boards. First is political instability, as seen above. Second is the apparent low value that the political leadership places on the NARS. Third is the freedom that the political leadership has to intervene directly in the management of the research institutes without the “irritating” buffer provided by the Governing Boards between the supervising ministry and the research institutes. For better or for worse, the supervising ministry exercises direct control over appointments and the award of contracts in the institutes in consultation with the Directors. The decision-making process under these circumstances is seriously affected. Finally, stakeholders (users and beneficiaries of research) remain weak and ineffective in their demand for transparent institute governance.

Institute governance in the Nigerian NARS has undergone specific traumatic episodes. In 1979, the National Science and Technology Development Agency (NSTDA) carried out unprecedented massive cross-transfers of Institute Directors, regardless of the relevance of their disciplinary background to the mandates of the new institutes they were to manage. The NSTDA Director, Olunloyo, rationalized the redeployment on the grounds that many Directors had long abandoned their disciplinary calling, had become routine administrators, and could therefore be transferred to any institute without much damage to the system. This did not go down well and some Directors resigned rather than transfer to their new stations (for example, Ojehomon).²⁴ Frequent changes in the supervising ministry also contributed to governance instability.

Governance instability in research institutes and the private sector compared

Board Governance in research institutes contrasts sharply with board governance in private sector companies in three ways. One, average tenure of board members is longer in the private sector, a long-term view of their contribution to the business of the Company being more important than their political patronage. Two, Board members of a private-sector company are not all appointed or sacked at the same time. Board members have rotating directorships and are re-elected or not re-elected at Annual General Meetings, depending on the performance of the company and of the individual Board Member. The tenures of Board Members are staggered and they can expect to remain on the Board so long as the corporate and individual Board Member performances remain satisfactory.²⁵ Three, while changes in the Institute Governing Boards of research institutes mirror

24 This was the era of arbitrary, military transfers. Some Vice Chancellors were also arbitrarily transferred, often with disastrous and near-tragic consequences. Professor Akinkugbe, who was transferred by military fiat from the University of Ilorin to Ahmadu Bello University (ABU) Zaria, narrowly escaped being murdered by an irate mob of unknown persons when his official lodge was set on fire. The puzzle is why highly respected academics in such esteemed positions found it easy to comply with such unprecedented unilateral directives.

25 Some company Board Members get special approval from the Annual General Meeting to continue in office beyond the age of 70. By contrast, there is no record of any (non *ex-officio*) Board Member of a research institute who has served more than two full terms in the history of the Nigerian NARS.

changes in the political regime, changes in corporate governance are not susceptible to routine changes in political regime.

Table 21 presents computed indices of governance instability of some leading blue chip companies quoted on the Nigerian Stock Exchange. Members of the Boards of these companies were tracked at 10, 16, 17 and 20 years. The Nigerian Bottling Company (NBC), the Coca - Cola Bottling Company, is arguably the most stable in the sample: six out of the seven members from the 1975 Board were still on the Board 10 years later (1985) and 3 of the 1975 members were still on the Board 20 years later (1995). This gives governance instability indices of 14.29 percent and 57.14 percent over the (1975-85) and (1975-95) periods, respectively, the lowest of any institution -public or private- examined in this study. Cadbury, Texaco, Total and Mobil similarly recorded impressive governance stability. Together with NBC, these companies stand in sharp contrast to the research institutes, most of which recorded 100 percent governance instability in just five years. The evidence on governance instability from these companies reveals certain features. Though there is a high turnover of expatriate Board Members as part of global cross-postings from the overseas headquarters of these multinationals, it is

Table 21. Computed Indices of Governance Instability of Some Blue Chip Companies Quoted on the Nigerian Stock Exchange, 1975-95

Company	Base year	Terminal year	No. of board members in base year		No. of base year board members still on the board in terminal year		Instability index (%)
1. Nigerian Battling Company (Coca Cola)	1975	1985	1975:	7	1985:	6	14.29
		1995			1995:	3	57.14
	1985	1995	1985:	9	1995:	6	33.33
2. Cadbury	1979	1989	1979:	9	1989:	4	55.56
		1995			1995:	1	88.89
	1989	1995	1989:	13	1995:	4	69.23
3. Texaco	1982	1992	1982:	9	1992:	4	55.56
		1995		12	1995:	2	77.78
4. Total	1978	1988	1978:	12	1988:	4	66.67
		1995			1995:	2	83.33
	1988	1995	1988:	13	1995:	5	61.54
5. Mobil	1979	1989	1979:	9	1989:	3	66.67
		1995			1995:	1	88.89
	1989	1995	1989:	8	1995:	2	75.00
6. UAC, Nigeria	1975	1985	1975:	12	1985:	2	83.33
		1995			1995:	0	100.00
	1985	1995	1985:	14	1995:	4	71.42
7. Lever Brothers	1981	1991	1981:	12	1991:	2	83.33
		1995			1995:	2	83.33
8. Nigerian Breweries PLC	1985	1995	1985:	14	1995:	2	85.71
9. Union Bank of Nigeria PLC	1985	1995	1985:	12	1995:	0	100.00

Source: Underlying data from Company Annual Reports, various years.

the Nigerian Board members who account for the remarkable governance stability of these companies. For example in Total, G.E. Mbonu and S.A.O. Jegede survived from the 1978 Board into 1995. In Texaco, three of the five Board members from the 1982 Board, still on the Board in 1992, were Nigerians (G.A. Adegboyega, M.O. Feyide and E.I. Nwizu). And in Lever Brothers, the constancy of the governance instability index in 1991 and 1995 (83.33 percent) with reference to the 1981 base year, was due to the continuous membership of two Nigerian Board Members, A. Ayida and R.F. Giwa, over the 1981-95 period. While the expatriate Board Members were continuously redeployed by the headquarters of the multinational companies, the Nigerian Board Members provided the stabilizing influence and institutional memory. Private-sector companies assured continuity in other ways. In Cadbury, C. Kolade, Board member in 1979, had become chairman by the 1995 reference year.²⁶ In the Nigerian Bottling Company (Coca-Cola), H.S.A. Adedeji, Board Member in 1975, had become Chairman by 1985. In Total, J. Chateau, a Board Member in 1988, had become Chairman by 1995. In Lever Brothers, R.F. Giwa, Board Member in 1981, had become Chairman by 1991. In UAC, E.A.O. Shonekan, Board Member in 1975, had become Chairman by 1985, while E. Edun, Company Secretary in 1985, had joined the Board by 1995, again ensuring institutional memory and corporate history. In the research institutes, there is no record of any orderly progress from ordinary Board Membership to Chairmanship of the Board. Indeed, there are no Executive Directors, except for the Institute Director who serves as an *ex officio* member of the Board.

Companies also practiced the reverse procedure: company Chairmen reverting to ordinary Board Membership to provide continuity. For example, C.R. Clarke, Managing Director of Cadbury in 1979 had reverted to ordinary Board Membership by 1989; M.J. Papignani, Managing Director of Total in 1978, had reverted to ordinary Board Membership by 1988, again to preserve institutional memory. In the public-sector research institutes, there is no record of such practices. Fundamentally, corporate governance and appointments to Boards of research institutes seem to be all about political patronage. This accounts for the episodic wholesale dismissal and reconstitution of Boards of research institutes by successive governments, with no institutional mechanism for the preservation of institutional memories. Finally, governance instability in quoted companies with the government as majority shareholder is similar to governance instability in research institutes. From Table 21, Union Bank scored 100 percent governance instability because the federal government, as majority shareholder, periodically dissolved and reconstituted the Board in one fell swoop, as it did with the research institutes: in 1985, none of the Members from the 1975 Board of the Union Bank survived the government's episodic dismissal and reconstitution of the Bank's Board.²⁷

26 "had become Chairman *by* 1995" or any other year as used here should not be interpreted to mean "had become Chairman *in* 1995" or any other year. It only means that, by the respective terminal (reference) year, the Board Chairman was already Chairman, including the possibility that he might have been appointed Chairman many years before the reference (terminal) year.

27 Important changes have occurred recently with the full privatization of the Bank. Government keeps threatening to use the "golden share" option to maintain its presence in the governance of the big banks but so far, and quite happily for all stakeholders, it has not made good its threat.

Policy Instability

A National Science and Technology Policy was formulated in 1986 (FMST, 1986) but Nigeria does not have a National Agricultural Research Policy. An Agricultural Research Strategy Plan document has been formulated (Shaib, Aliyu and Bakshi, 1997).²⁸ The absence of a national agricultural research policy probably accounts for the observed high degree of institutional instability.

Several factors explain the long absence of a national agricultural research policy. On the supply side, there has been a long absence of sustained political will and commitment to the Nigerian agricultural research system. Flashes of support for the Nigerian NARS as a system have not been sustained. Second, the high degree of political instability has meant that key actors have been swept off the scene long before they had time to formulate a national policy. Third, the formulation of a national science and technology policy has been presumed to be a substitute for a national agricultural research policy. Finally, the leadership of the Nigerian NARS has for long been dominated largely by biological and physical scientists with limited capacity for policy analysis, especially for situating a national agricultural research policy within the hierarchy of other national policies. The social science capacity in the Nigerian NARS still remains relatively weak. On the demand side, the community of stakeholders of agricultural research-beneficiaries and users- has been weak and unable to effectively demand for the formulation of a coherent national agricultural research policy.

28 Ideally, the formulation of a National Agricultural Research Policy should have preceded the formulation of a strategy aimed at realizing the objectives of national policy. The strategy document cannot be a substitute for a National Policy Document that sets out overall policy frame and defines the policy agenda.

4. Constraints of the Nigerian NARS

A Framework for the Constraints Analysis of NARS

To be complete, the analysis of NARS instability must be supplemented by an examination of the underlying constraints considered relevant for instability. This study goes beyond the mere listing and discussion of NARS constraints to the analytical specification and empirical measurement of hierarchies of constraints.

A hierarchy of constraints

There are three levels of instability-inducing constraints confronting a NARS; primary constraints, secondary constraints and tertiary constraints.

Primary constraints: Primary constraints are at the apex of the hierarchy of constraints. A primary constraint is system-wide in its effects and is manifested in other lower-order constraints. For example, the persistent lack of political will and commitment of the political leadership to the NARS has, as a primary constraint, profound ramifications for the system. This constraint translates into secondary constraints such as the unstable and inadequate funding of the NARS. This, in turn, translates into a tertiary constraint such as unstable and inadequate levels of funding for maintenance, operations or training. The more restrictive the primary constraint, the more restrictive the derivative secondary and tertiary constraints will be. Conversely, if the primary constraint is not as restrictive in its effects, then the secondary and tertiary constraints will tend to be less adversely affected. The emergence of a new political leadership with a strong political will and commitment to the NARS can be expected to result in stable and adequate funding for the NARS, and this can, in turn, be expected to translate into the stable and adequate funding of NARS' operations, maintenance and training events. On the other hand, the emergence of a new political leadership at the national or agricultural sector level that does not appreciate the value of the NARS can be expected to exacerbate the funding constraints of the NARS.

Secondary constraints: Instability-inducing secondary constraints have crippling effects on the NARS but their roots can be traced to more fundamental primary constraints, as seen above. They are only secondary in terms of hierarchy, but not in their harmful effects on the NARS. Secondary constraints are concrete and directly visible. For example, inadequate and unstable funding is a direct and visible constraint, but the underlying primary constraint of lack of political will and commitment may not be directly observable and identifiable. For example, unduly long delays in the disbursement of budget funds to the NARS is a secondary constraint that has its roots in the primary constraint of weak political will and the insufficient commitment of the political leadership to the NARS. Similarly, the instability of institutional arrangements for managing the NARS is a secondary constraint derived from the primary constraint of the underlying political instability. In this instance, both the political instability and the institutional instability to which it gives rise are concrete and directly observable.

Tertiary constraints: Tertiary constraints are lower-order constraints, not in terms of their harmful effects, but in terms of their generic roots and the level at which they become restrictive. A research institute might be constrained by lack of funds for running its diesel generators to service its tissue culture laboratories and genebanks, but this becomes a binding constraint only because the power supply from the national grid has failed. Similarly, research institutes are unable to finance the purchase and repair of imported laboratory equipment such as atomic absorption spectrophotometers and research consumables at new exchange rates because of the primary constraint of bad macroeconomic management that leads to successive rounds of devaluation of the foreign exchange rate. Bad macroeconomic policies and an unstable macroeconomic environment that lead to the steep depreciation of the domestic currency are particularly harmful to research in developing countries, as this is often import-intensive in terms of laboratory equipment, workshop machinery, research materials, books and journals, training, and conference attendance by researchers. Constraints facing the Nigerian NARS at different levels, and which are considered relevant for instability of NARS, require detailed examination.

Primary constraints

Persistently weak political will and insufficient commitment to the NARS: Political will and commitment to the NARS in Nigeria is of strategic importance because of the central role of government in agricultural research. The colonial government was committed to agricultural research (particularly export crops) for two reasons. One, research to generate new high-yielding technologies boosted the production of export crops such as the cotton, cocoa and vegetable oils that were needed as raw materials in Europe. Two, increased production made possible by research produced a larger tax base for the marketing-board tax system. Governments at all levels funded agricultural research with zeal and keen political commitment: for example, the West African Institute for Oil Palm Research was actively funded by the Palm Produce Marketing Board, the Western Nigeria Marketing Board, the Eastern Nigeria Marketing Board and the Federal Government. During the (1960-74) post-Independence period, the Regional/State and Federal Governments demonstrated political will and commitment to agricultural research at the Institute for Agricultural Research (cotton and groundnuts (peanuts), Rubber Research Institute of Nigeria, Cocoa Research Institute of Nigeria and the Nigerian Institute for Oil Palm Research, mostly for their anticipated contributions to the government treasury through the Marketing Board System.

The post-1974 period has witnessed a sharp drop in the political will and commitment of government to the NARS. The advent of petroleum has made export crops fiscally irrelevant, with the abolition of the fiscal role of marketing boards by the Gowon regime in 1974. Petroleum has led to the effective neglect of agriculture. Government pronouncements and visible gestures on agriculture were not translated into concrete budgetary and program support because the political will and commitment were lacking.

Persistently weak political will and insufficient commitment have given rise to a set of derivative secondary and tertiary constraints facing the NARS. An illustrative sample includes the following:

Secondary and tertiary constraints

Absence of a national agricultural research policy: The lack of a National Agricultural Research Policy frame after more than 100 years of government presence in agricultural research has provided a conducive environment for frequent research paradigm shifts, as well as frequent changes in institutional arrangements for managing agricultural research. Such frequent shifts have sent conflicting, confusing and demoralizing signals to the scientific research community, as they do not provide a stable basis of support for the NARS. With no Agricultural Research Policy frame, policy makers have tended to adopt a “muddling through” approach on issues ranging from program objectives to institutional arrangements and research management at the NARO and institute levels. The absence of a research policy frame has meant the absence of a restraining factor on policy makers, who have felt free to tinker with institutional arrangements, program objectives and research priorities as they think fit.

Unstable research funding: Feeble political commitment to the NARS has produced unstable funding, as policy makers have shifted loyalties to new priorities with the changing fortunes in government finances (see Section III).

Inadequate funding: Weak political will and feeble commitment have meant that agricultural research has been treated as a residual issue that is attended to when other “pressing government priorities” have been met.

Delayed disbursement of approved budget funds: With no clear signals from the political leadership on high priority for research, the NARS experiences undue delays in the disbursement of approved budget funds (see Section III).

Weak research management capacity: The Nigerian NARS has been constrained by weak management capacity in many institutes especially with respect to priority setting, monitoring and evaluation, and program accountability. Weak political will and feeble commitment have also meant that no clear guidelines exist on organizational modes for conducting research at the institute level. The historical sequence followed by most institutes was, first, to organize research around disciplinary divisions, only to realize that research was more efficiently organized in multidisciplinary teams (see Table 22). The colonial legacy was to build research around disciplinary teams. When the idea of multi-disciplinary teams caught on, the commodity divisions were created to coexist with the disciplinary divisions, with the former catering for program accountability and the latter for administrative accountability. For some institutes (for example, IAR), commodity divisions were created long after establishment. The distribution of substations reveals great variations: while CRIN, with well-defined geographical enclaves for its mandate crops, has 6 substations, NIHORT, with mandate crops covering all agroecological zones, has only 2 substations to cover the entire country.

Table 22. The Distribution of Commodity Divisions, Disciplinary Divisions and Substations of Research Institutes, Nigeria

Institute	Headquarters location	Year established	No. of commodity divisions	Year created	No. of disciplinary divisions	Year created	No. of substations
1. CRIN	Ibadan, Oyo	1964	5	1970	6	1965	6
2. FRIN	Ibadan, Oyo	1975		1973	13	1973	5
3. IAR+T	Ibadan, Oyo	1969	7	1969	7	1969	5
4. NIHORT	Ibadan, Oyo	1975	3	1976	4	1976	2
5. NSPRI	Ilorin, Kwara	1979	6	1979	5	1956	5
6. NIOMR	Lagos	1975			5	1976	1
7. NIFOR	Near Benin City, Edo	1964	6	1979	12	1964	10
8. RRIN	Iyanomo, Edo	1964	3	1961	10	1975	3
9. NRCRI	Umudike, Abia	1975	7	1980	6	1980	
10. IAR	Samaru, Kaduna	1962	4	1983	8	1962	3
11. NAPRI	Shika, Samaru, Kaduna	1975	8	1986	8	1986	4
12. NAERLS	Samaru, Kaduna	1975		1075	3	1975	5
13. NRICT	Zaria, Kaduna	1976	5	1988	5	1988	4
14. NITR	Kaduna, Kaduna	1964	4	1981	7	1981	11
15. LCRI	Maiduguri, Borno	1975	n.a		n.a		1
16. NCRI	Badeggi, Niger	1975			n.a		n.a
17. NIFFR	New Bussa, Niger	1975	n.a		6		5
18. NVRI	Vom, Plateau	1975	4	1975	7	1975	9

Notes:

1. CRIN: Cocoa Research Institute of Nigeria.
2. FRIN: Forestry Research Institute of Nigeria.
3. IAR+T: Institute of Agricultural Research and Training.
4. NIHORT: National Horticultural Research Institute.
5. NSPRI: Nigerian Stored Products Research Institute.
6. NIOMR: Nigerian Institute for Oceanography and Marine Research.
7. NIFOR: Nigerian Institute for Oil Palm Research.
8. RRIN: Rubber Research Institute of Nigeria.
9. NRCRI: National Root Crops Research Institute.
10. IAR: Institute for Agricultural Research.
11. NAPRI: National Animal Production Research Institute.
12. NAERLS: National Agricultural Extension and Research Liaison Service.
13. NRICT: National Research Institute for Chemical Technology, formerly Leather Research Institute of Nigeria.
14. NITR: Nigerian Institute for Trypanosomiasis Reserach
15. LCRI: Lake Chad Research Institute.
16. NCRI: National Cereals Research Institute.
17. NIFFR: National Institute for Freshwater Fisheries Research, formerly Kainji Lake Research Institute
18. NVRI: Nigerian Veterinary Research Institute.

Source: Field Survey, 1996

The decentralization of research capacity through a network of functioning substations remains a daunting challenge for most research institutes. Many institutes have not moved beyond the recognition of the need to conduct adaptive research in outstations in the major agroecological zones. There is a dearth of qualified and experienced researchers in the substations. This has been largely due to the grossly deficient state of infrastructural facilities in the substations, especially with respect to electricity supplies, potable water, and access roads. Other infrastructural inadequacies include telecommunication facilities, health-care services and educational facilities for children. Experienced researchers normally have school-age children and are unwilling to uproot children from their school environments in the vicinity of institute headquarters. In some institutes (e.g. CRIN), a determined effort to compel senior experienced researchers to man substations and outstations led to destabilizing resignations that forced management to rescind the policy. The discrimination in national macroeconomic management against the rural sector in the provision of basic infrastructural facilities has destabilizing consequences for the NARS, thereby limiting the agroecological relevance of research. The infrastructural environment at substations must be made conducive to attract senior experienced researchers to settle and conduct research away from headquarters.

Weak research infrastructure: Weak infrastructure constitutes one of the most important constraints of the Nigerian NARS. Large stocks of unserviceable laboratory equipment, vehicles and workshop machinery have accumulated in most institutes over the years. Electricity supplies are erratic in most institutes and telecommunication facilities have remained poor for most of the history of these institutes. Library facilities deteriorated in the 1980s. Rural roads constitute perhaps the most critical physical constraint hindering the easy access of institutes to sites where substations should ideally be located. Nigeria's rural roads remain primitive and vehicle operating and user costs remain prohibitively high and beyond the operating budgets of most institutes. The wide variety of African soils and operating environments requires extensive networks of on-farm adaptive trials that should be closely supervised by the institutes, a requirement not being met on account of the grossly deficient network of rural roads. Other infrastructure constraints include inadequate and unstable potable water supplies and physical insecurity of life and property in many institutes, including the safety of field crops, animals and research plots. Pilfering constitutes a major source of frustration for researchers as there are flagrant cases of villagers harvesting crops on experimental plots, many of which are the product of many years of painstaking research and measurements. These are manifestations of the nationwide problem of insecurity afflicting the larger society.

For example, the IAR+T laboratory complex on the main campus of Ife-Ife, almost 60 percent completed, has been abandoned since 1981. The project, originally contracted at a total cost of N2mill. in 1979 was estimated in 1994 to require no less than N78mill. for completion, an increase of 3,800 percent. The access road linking NRCRI, Umudike, to Umuahia, the State capital, has been in such a deplorable state since 1970 that the distance of 15 Kms takes 45 minutes by car. Internal and farm roads are in a similarly deplorable state. The two laboratory building projects remain abandoned. NITEL telephone lines, disrupted by contractors since 1992, remain dead, and NRCRI's only radio link is with IITA. Residential, laboratory, and green-house buildings are in a state of

disrepair - hardly any new building structures have been erected at NRCRI since the end of the civil war (1970).

At both NIHORT and NCRI, there is no residential accommodation on institute grounds. This poses serious transportation and security problems after office hours. LCRI and NCRI have uncompleted laboratory buildings, while LCRI is located in an area of Maiduguri prone to the theft of telephone and electricity cables. For most institutes, electricity supplies are irregular, with considerable damage to sensitive scientific equipment by large voltage fluctuations; some other institutes, such as first-generation NIFOR, are not connected to the NEPA national grid for electricity supplies.

Telecommunications facilities are grossly inadequate. For example, NVRI, NRCRI and NAPRI have no functional telephone/telex/fax linkages with the outside world. The gross inadequacy of telecommunications infrastructure, system wide, is virtually shutting off the Nigerian NARS from the information super highway, with specific reference to E-mail and Internet connectivity.

Where institutes generate power from isolated thermal plants (generators) or rely on irregular NEPA power supplies, water supplies from institute boreholes become unstable on account of unstable power supplies. The combination of unstable supplies of electricity, potable water and telecommunications services severely disrupts routine research activities and operations.²⁹

Heavy post-harvest losses caused by bad rural roads and distorted rural markets act as disincentives to new technology adoption. This has a demoralizing effect on both farmers and researchers. Whenever there has been weak political will and commitment, the infrastructure needs of the NARS have not been seriously addressed.

Shortage of qualified agricultural researchers: The staff instability problem is compounded when those who leave the NARS also tend to be well qualified and experienced researchers. Table 23 shows that there has been a rapid loss of researchers with Ph.Ds. in some institutes, and insignificant growth in most. Researchers with Ph.Ds. fell from a high of 25 in CRIN in 1979-80 to only 7 during 1989-91, a fall of 72 percent. Researchers with Ph.Ds fell from 73 in IAR in 1984-85 to 32 in 1995, a fall of over 55 percent. In NIFOR, they fell from 31 in 1988 to 23 in 1996, a fall of almost 26 percent. The erosion or inadequate growth of high-caliber research staff in the research institutes could have been dealt with if there had been adequate political will and commitment. Individual institute programs and deadlines suffer from the exit of qualified and experienced researchers, though the system-wide losses could be less if staff moved to other institutes and the universities within the NARS.

Instability of research staff: Strong political will and commitment can create the necessary enabling environment to minimize instability of research staff. Part of the problem has been the historical policy-induced identity crisis of the civil-servant-scientist in

²⁹ For more details, see Shaib, Aliyu and Bakshi, 1997.

Table 23. The Exit of Researchers with a Ph.D from the Research Institutes, Nigeria, 1963-96

Year	CRIN	FRIN	IAR+T	NSPRI	NCRI	NIFOR	RRIN	NRCRI	IAR	NRICT	NITR	NVRI	LCRI	NIFFR	NIHORT
1963	2	3							9		3				
1964	2	1							17		3				
1965	3	1							22		3				
1966	3	1							23						
1967	3	1							23		1				
1968	5	1			2	1		n.a	n.a		3				
1969	9	1			2	3		n.a	n.a		2				
1970	13	2				3		n.a	n.a			2			
1971	12	2				2		n.a	n.a			3			
1972	12	2				2		2	n.a			6			
1973	12	1				3		n.a	n.a			6			
1974	16	1				5		2	50			4			
1975	17	6				4	1	n.a	50			4			
1976	18	3				9	1	n.a			7	4	2		3
1977	17	3				16	3	n.a	36			5	3	3	6
1978	12	4				19	2	n.a	36	2	7	6	3	5	5
1979	25	4				15	2	2	n.a	2	7	6	3	3	5
1980	25	5				15	4	2	69	3	7	5	3	3	8
1981	23	8				21	4	n.a	69	3	7	6	4	4	13
1982	21	8				26	7	3	n.a	2	7	5	6	4	14
1983	15	11				28	n.a	n.a	n.a	2	7	6	6	4	13
1984	14	11				22	n.a	2	73	2	8	6	6	4	10
1985	13	16				24	n.a	1	73	3	6	4	3	3	7

Table 23. The Exit of Researchers with a Ph.D from the Research Institutes, Nigeria, 1963-96 (continued)

Year	CRIN	FRIN	IAR+T	NSPRI	NCRI	NIFOR	RRIN	NRCRI	IAR	NRICT	NITR	NVRI	LCRI	NIFFR	NIHORT
1986	13	15	28	6	8	23	n.a	3	n.a	3	6	7	0	2	8
1987	12	15	28	6	12	23	n.a	4	n.a	2	7	9	1	2	8
1988	7	15	7	7	13	31	7	n.a	54	5	7	9	1	1	7
1989	7	19	7	7	15	29	6	2	58	6	5	14	1	1	9
1990	7	17	6	6	16	26	6	4	50	7	5	14	2	5	9
1991	7	18	5	5	15	29	6	2	50	7	7	14	2	5	8
1992	7	17	25	5	13	28	7	2	n.a	7	7	11	2	4	9
1993	10	16	26	4	12	26	7	n.a	n.a	6	6	11	1	7	8
1994	9	14	26	3	14	24	6	n.a	33	6	6	15	1	6	9
1995	9	14	26	7	14	24	7	n.a	32	6	6	15	0	6	10
1996	8	13	26	7	13	23	6	n.a	n.a	6	6	17	1	7	9

Notes:

- CRIN: Cocoa Research Institute of Nigeria.
- FRIN: Forestry Research Institute of Nigeria.
- IAR+T: Institute of Agricultural Research and Training.
- NSPRI: Nigerian Stored Products Research Institute.
- NIOMIR: Nigerian Institute for Oceanography and Marine Research.
- NIFOR: Nigerian Institute for Oil Palm Research.
- RRIN: Rubber Research Institute of Nigeria.
- NRCRI: National Root Crops Research Institute.
- NAPRI: National Animal Production Research Institute.
- NRICT: National Research Institute for Chemical Technology.
- NITR: Nigerian Institute for Trypanosomiasis Research.
- NVRI: Nigerian Veterinary Research Institute.
- LCRI: Lake Chad Research Institute.
- NIFFR is National Institute for Freshwater Fisheries Research.
- NIHORT: National Horticultural Research Institute.

Source: Field Survey, 1996

the research institutes. He could choose to identify with the civil service system on issues such as promotion based on seniority, bureaucratic control over subordinates and entitlement to the perks of office according to civil service conditions of service. Under this system, researchers were not motivated to be result-orientated and problem-solving, and still be engaged in professionally respectable research. Institute researchers coped with this identity crisis until the universities secured a different university salary scale that was better than that of the regular civil service. This induced a mass exit of researchers from the institutes to the universities until 1987, when the research institutes were put on the university salary scales. This has stemmed the drift of staff from the research institutes to the universities. But it has created a new identity crisis. While universities have multiple professorships and ample opportunities for career advancement, the career structure in the research institutes is a suffocating pyramid in which researchers are stranded, especially at the Chief Research Officer grade, and cannot move up unless there is a vacancy at the Assistant Director grade caused by retirement or death. Unless the constriction in this pyramidal structure is opened up, the research institutes will continue to lose senior researchers to the universities.

Macroeconomic instability

Macroeconomic instability as a primary constraint in relation to NARS instability has three elements:

Exchange rate instability: The regime of overvalued exchange rates in the wake of the oil boom was inevitably followed by the Structural Adjustment Program, entailing, among other things, steep devaluations of the foreign exchange rate. The era of overvalued exchange rate discriminated against exports and favored food imports at heavily subsidized foreign exchange rates. The disincentive effects on export crop and domestic food production of the overvalued exchange rates demoralized researchers engaged in export and food crop research through the dampening effects on the uptake of new technologies. This must have contributed to the observed research staff instability of the 1970s and 1980s. The era of upward adjustments in the foreign exchange rates has created a new generation of problems for the stability of the NARS. The costs of imported laboratory equipment, workshop machinery, library facilities and overseas training at the current exchange rates is far beyond regular budgetary provisions. Salaries of researchers in dollar terms have been rendered uncompetitive.³⁰ This has created large pools of demoralized researchers with large stocks of laboratory equipment and workshop machinery in a state of disrepair. The drift into near-total paralysis of research in the institutes was arrested with the recent launching of the World Bank-assisted National Agricultural Research Project (NARP). Instability in the exchange rate has led to instability in the costs of research hardware and introduced great uncertainty into research planning and management.

30 If an Institute Director earned an annual salary of N12,420.00 in 1979/80, this equaled \$12,420.00 at an exchange rate of \$1 = N1.00. An Institute Director's annual salary of N96,000.00 in 1996 equals a mere \$1,200.00 at the exchange rate of \$1 = N80.00, a fall of 90.34 percent in dollar-equivalent salary.

Inflationary fiscal and monetary policies: Huge fiscal deficits financed with bank credit to government and high rates of growth in the money supply have combined to fuel domestic inflationary pressures in most SSA countries. High domestic inflation rates have eroded researchers' salaries and the purchasing power of budgetary allocations to research institutes for personnel costs, operating costs, maintenance costs, and capital costs. Responses from the institutes in Table 24 reveal the primacy of inflation, insufficiency of funds, instability of funds and untimely release of funds as constraints of research institutes, as seen by them. High domestic inflation rates, especially in the face of grossly deficient rural infrastructures, tend to worsen the domestic terms of trade against agriculture and reduce farmers' adoption of new technologies. This has ripple effects on the NARS.

Unstable trade policy: International trade policy has witnessed frequent policy changes and reversals of direct consequence for the stability of the Nigerian NARS. Imports and exports of food staples have been banned and unbanned with confusing frequency. Rice, wheat, cassava, maize and yams have gone through cycles of import bans, the lifting of import bans and the re-imposition of import bans in the last two decades. Each import ban has raised hopes of protected domestic markets and favorable price effects for domestic food import substitutes and renewed research activity, only to be followed by the lifting of import bans and confusion amongst farmers and researchers alike over government's next moves. The more unstable international trade policy in the country's staples becomes, the more unstable and confusing the signals on opportunities and constraints being transmitted to farmers and researchers within the NARS.

Agricultural policy constraints

Agricultural policy constraints as primary constraints on the NARS operate at two levels: one, the direct effects of sector policies on the NARS, and, two, the effect of unstable agricultural policies on NARS instability. Examples of such policies include the following, among others.

Research-extension dualism: The Federal Government has virtually monopolized all agricultural research in Nigeria since 1975. Ironically, the Federal Ministry of Agriculture has not had a Department of Agricultural Research since 1975, when the erstwhile Federal Department of Agricultural Research became the National Cereals Research Institute. Though the federal government operated 18 research institutes directly or indirectly involved in agriculture, it was not until 1992 that the Federal Department of Agricultural Sciences was transferred to the Federal Ministry of Agriculture and Natural Resources. For 17 years after the creation of the second-generation research institutes in 1975, the Federal Ministry of Agriculture did not have the statutory mandate or the institutional capacity for supervising and monitoring the agricultural research institutes.

State governments exercised their constitutional responsibility for agricultural extension through regional State ministries of agriculture during 1954-75, and through enclave and state-wide World-Bank-assisted Agricultural Development Projects (ADPs) since 1975. The linkages between State-run ADPs and Federal-run research institutes have been

Table 24: Responses on Ranking of Constraints of Research Staff, by Research Institutes, Nigeria, 1996

Institutes	Inadequate real wages and salary	Insufficient funds for research	Instability of research funds	Untimely release of research funds	Harsh location of research institutes	General economic conditions	Inflation	Instability of institutional arrangements	Inadequate opportunities for further training	Lack of employment for spouses	Lack of educational facilities for children	List of health care facilities for family
CRIN	1	2	2	1	0	2	2	1	0	1	0	1
FRIN	2	1	2	2	0	3	1	3	1	1	0	2
IAR+T	3	3	2	2	0	1	3	2	2	0	1	1
NSPRI	3	3	3	3	0	2	3	1	3	1	1	3
NIOMR	2	3	3	3	0	2	3	1	1	1	2	0
NIFOR	3	2	2	2	0	3	3	1	2	1	0	0
RRIN	2	3	2	3	0	1	2	0	2	2	0	0
NRCRI	3	3	3	2	1	3	3	2	2	1	1	0
NAPRI	1	2	1	1	1	2	2	1	1	0	0	0
NAERLS	3	3	3	3	0	3	3	2	2	0	0	1
NRICT	2	3	2	2	1	1	2	1	0	1	2	1
NITR	0	3	3	2	0	2	3	2	3	0	2	0
NVRI	0	2	1	3	0	3	3	0	1	1	0	1
LCRI	3	1	1	1	2	2	2	1	1	1	2	1
NIFFR	3	3	3	3	0	1	2	1	1	3	1	3
Composite ranking	207	247	2.2	2.2	0.33	2.07	2.47	1.13	1.47	0.95	0.8	0.93

Notes: Score Legend: 0 = not a problem; 1 = a problem; 2 = a severe problem; 3 = acute problem.

CRIN: Cocoa Research Institute of Nigeria; FRIN: Forestry Research Institute of Nigeria; IAR+T: Institute of Agricultural Research and Training; NSPRI: Nigerian Stored Products Research Institute; NIOMR: Nigerian Institute for Oceanography and Marine Research; NIFOR: Nigerian Institute for Oil Palm Research; RRIN: Rubber Research Institute of Nigeria; NRCRI: National Root Crops Research Institute; NAPRI: National Animal Production Research Institute; NAERLS: National Agricultural Extension and Research Liaison Service; NRICT: National Research Institute for Chemical Technology; NITR: Nigerian Institute for Trypanosomiasis Research; NVRI: Nigerian Veterinary Research Institute; LCRI: Lake Chad Research Institute; NIFFR: National Institute for Freshwater Fisheries Research.

Source: Field Survey, 1996

weak, progress made through the Monthly Technology Review Meetings notwithstanding. Nigeria has essentially been running two parallel systems: a NARS made up largely of Federal researchers in the institutes and universities, and State extension systems run by employees of State ministries of agriculture and the ADPs, with no effective integration of the two. The research institutes complain of the slow uptake of proven technologies already on the shelf; the state-run extension services complain not only about their own constraints (which are not treated in this study) but about technologies from the NARS which are ill-adapted to local environmental niches. Two parallel systems under two tiers of government constitute an almost perfect recipe for an unstable and ineffective NARS, especially with respect to research impact. The protracted absence of a fully integrated national agricultural research system is central to an explanation of the failure to scientifically transform Nigerian agriculture in the last 100 years.

Weak research institute - university linkages: The weak linkage between research institutes and the universities has limited the overall effectiveness of the Nigerian NARS. The universities have the largest concentration of qualified researchers. For example, the faculties of agriculture at the University of Ibadan (94 PhDs) and the University of Nigeria, Nsukka (49 PhDs) have more Ph.Ds than all the research institutes put together. With 28 faculties of agriculture and veterinary medicine and three Universities of Agriculture, the universities remain vastly untapped for their research potential. To the extent that the Universities exert a gravitational pull on researchers from the research institutes, they are a source of research staff instability in the institutes. This is obvious from the fact that there has always been a one-way movement of staff from research institutes to the universities; and it is rare to find the reverse flow of staff from the universities to the research institutes, except as Directors of the institutes. The modal pull factor for researchers leaving the research institutes is the university system. ISNAR, through its universities in NARS Project, is exploring ways to strengthen the contribution of universities to the NARS in sub-Saharan Africa.

The analysis must go beyond the recognition of the need for institute-university linkages to the identification of the reasons for the persistence of the linkage failure. First has been the historical fact that the universities (with the exception of the Universities of Agriculture) on the one hand, and the research institutes on the other, have had different parent ministries. Bureaucratic bottlenecks have prevented the forging of linkages because of the need (or alleged need) for the research institutes and the universities to obtain ministerial approval through their Boards and Councils respectively. Second is fear on the part of the institute leadership of being swallowed by the university, the fear of losing their political power and authority. Institute Directors jealously guard their autonomy and are cautious about, and sometimes hostile to, proposals for tighter links with universities with, consequently, closely linked research and training. Third is fear on the part of the research institutes of being forced into the performance criteria career system of universities, with particular reference to the quantity and quality of scientific publications. Fourth, some members of research institutes fear that close links with universities may pull them away from problem-solving research into what they regard as academic research in the universities. Finally, the political will or appreciation of the value of functional linkages between institutes and universities has been lacking.

It is hoped that the present arrangements by which Universities of Agriculture and research institutes are under the same Federal Ministry of Agriculture will provide a unique opportunity for their functional integration.

Input and output pricing policies as a constraint on the NARS: The Federal Government has operated a massive fertilizer input subsidy scheme since 1976. The original intentions were good: to promote the fertilizer market in the early stages of adoption of a desirable new technology when the private sector might be reluctant to enter because of the smallness of size; the need to co-ordinate conflicting fertilizer subsidy schemes operated by the State and Regional Governments during the 1954-76 period; and the prospects of obtaining quantity discounts on bulk buying in world markets. As always, good intentions are not enough. The fertilizer subsidy scheme has created a Federal Government fertilizer procurement and distribution monopoly that has crowded out the private sector and stunted the growth of the fertilizer industry and the sustained mass adoption of fertilizers. The huge subsidy has turned civil servants in the Ministries of Agriculture at State and Federal levels into fertilizer middlemen and distributors and diverted attention away from required extension work on extensive fertilizer trials adapted to local soil types. This has delayed the realization of the full yield potential of new fertilizer-responsive seed varieties of maize, rice and other crops. Scientists engaged in fertilizer research are demoralized and confused by the distortions in fertilizer prices brought about by public-sector distribution scandals and inefficiencies. The preoccupation of policy makers with the procurement and importation of fertilizer types for large agroecological zones leaves little encouragement for painstaking fertilizer trials to identify the fertilizer types most suited to particular local soil profiles.

Output pricing policies that seek to fix procurement prices depress product/input price ratios and reduce farmers' profitability and incentives for the adoption of new technologies. Fortunately, output pricing policies in Nigeria were not as crippling as in East Africa because Nigeria operated a system of multiple grain market outlets. The disincentive effects of producer pricing policies of the Nigerian Grains Board on fertilizer (and other input) adoption would have been much worse if the Grains Board had operated as a grain marketing monopoly.

The disincentive effects of agricultural sector policies on farmers' adoption of new inputs and on the NARS are bad enough. They are compounded when these policies are also unstable. For example, government distribution policy on fertilizers has been most unstable, involving frequently changing roles for State Governments, local Governments, the Federal Government and the private sector, with policy changes and policy reversals occurring almost on an annual basis during the 1992-95 period. This has sent conflicting and confusing signals to researchers and the scientific community within the NARS.

Political instability

Political instability constitutes a primary constraint on the NARS that translates into secondary constraints such as policy instability and institutional instability. At the tertiary

level, political instability could translate into research program and research management instability. Political instability does not, however, result in NARS instability only in a linear fashion. Agricultural crisis itself could be a source of political instability, and a NARS that succeeds in the scientific transformation of traditional agriculture removes food insecurity as a possible source of political instability. At other times, political instability leads to NARS instability through its first-round effect on policy or institutional instability.

External economic environmental constraints

Exogenous developments in world markets for agricultural commodities throw up new challenges and opportunities. The development of synthetic substitutes in the developed countries throws up new challenges; so does the sudden collapse of world market prices of a country's main agricultural exports.

Technology constraints

There may be technology frontiers confronting a NARS as defined by the nature of a particular crop and its peculiarities. For example, yam breeding and genetic improvement have made little progress because of the constraints imposed by the nature of the crop. While much progress has been made on cassava, yam research has not gone much beyond the selections of land races, fertilizer trials and the control of yam pests. The international science community, together with the Nigerian NARS, must double their efforts to achieve worthwhile progress in the genetic improvement of yams.

Constraints analysis of the Nigerian NARS indicates that some constraints are system-wide, while others are institute-specific. System-wide constraints such as unstable and inadequate supplies of electricity, potable water, telecommunications and rural transportation facilities can be traced to poor and biased macroeconomic policies, political instability and a demonstrated lack of sincerity of purpose, while institute-specific constraints are the product of the individual circumstances of each institute.

5. Strengthening the Stability of the Nigerian NARS: Summary and Conclusions

The central proposition of this study is that NARS leaders and NARO managers in sub-Saharan Africa are not just concerned about the adequacy of resource support for the NARS, but also about NARS stability. The effectiveness and efficiency of the NARS depend not only on the quantity and quality of research resources, but also on the stability of the policy and institutional environment, funding, staffing and governance. Many NARS leaders and managers will readily point out their preference for stable but smaller levels of resources over larger but highly fluctuating resources. Instability creates uncertainty and renders research management much more difficult.

The study set out to define and measure different types of NARS instability. Six analytical types of NARS instability were defined: policy instability, institutional instability and program instability. Others were funding instability, research staffing instability and governance instability. Four categories of funding instability were identified: mild-transient instability; mild-chronic instability; severe-transient instability and severe-chronic instability. While the distinction between mild and severe instability is the magnitude of the instability, the distinction between transient and chronic instability is the duration. Similarly, four types of research staff instability were defined: individual-transient; individual-chronic; systemic-transient, and systemic-chronic instability. The distinction between individual and systemic instability is whether the factors that cause frequent movements of researchers from an institute can be regarded as applicable only to individual researchers or whether these factors operate in unison across many individuals, have common causes and can be presumed to have joint probability distributions.

The study develops analytical and empirical tools with which NARS leaders and managers can sensitize and confront policy makers in the Presidency or Cabinet Office, the Ministry of Finance, the National Planning Commission (Ministry) and the Ministry of Agriculture. A basically unstable NARS is incapable of sustaining the transformation of a country's traditional agriculture. This study rests on the proposition that approaches which focus on the levels of funds, staffing and other resources while ignoring the system dynamics of the NARS are narrow and incomplete, as they fail to incorporate the equally important problem of instability of resources and institutions, and also fail to provide insights into early periods of relatively adequate resource support in the past that were not accompanied by appreciable productivity gains. Data showing impressive year-to-year funding levels typically conceals unduly long disbursement delays that drastically reduce the effectiveness of the funds allocated to the NARS. Over time, levels of research staffing may look impressive on a year-to-year basis but these may conceal exits of experienced staff who might have been replaced by inexperienced researchers within the year. A static examination of staffing levels in a NARO/NARS fails to reveal the internal dynamics of the changing composition of research staff. A description of elaborate institutional structures and processes at a given point in time may conceal con-

siderable amounts of institutional instability and metamorphosis that might have occurred over a given period and which reduces the effectiveness of a NARS. These components of the systems dynamics of the NARS have not been analyzed in the past, either because previous analysts have underestimated their importance or because they have failed to appreciate their nature, characteristics and consequences for the effectiveness and efficiency of the NARS.

Nigeria was selected as the pilot phase of the empirical analysis of this study, partly because it is arguably the largest NARS in sub-Saharan Africa, and partly because Nigeria offers a classic case study in NARS instability. The analysis will be extended in subsequent phases to selected countries in Sub-Saharan Africa.

Summary of Findings

The findings from the study could be summarized as follows:

On policy instability: Nigeria does not have a National Agricultural Research Policy. In virtually all the institutes, there is a lack of understanding of what constitutes a National Agricultural Research Policy. There is general confusion on whether such a policy exists, and those NARS leaders and NARO managers who claimed a policy existed were unable to identify it. Generally, there was a tendency to equate research programs with a National Agricultural Research Policy. A National Agricultural Research Strategy Plan has been produced under the auspices of the World Bank - assisted National Agricultural Research Project. The strategy document should ideally have evolved from a general National Agricultural Research Policy frame. The absence of a National Agricultural Research Policy after more than 100 years of government presence in organized agricultural research has provided fertile ground for *ad hoc* programs and paradigm shifts depending on the preferences of successive governments. This has created room for much program instability. Supply-side and demand-side determinants of policy and program instability were identified. The dominance of supply-side determinants over demand-side factors as causes of policy and program instability was explained.

On institutional instability, two levels of instability were identified: first, frequent changes in the macro institutional arrangements for managing the NARS, and second, the many changes in the parent ministry affecting each institute. . The confusing institutional arrangements for managing the Nigerian NARS are a direct legacy of the colonial past. In the 37 years since Nigeria's independence in 1960, agricultural research institutes have been under five different supervising ministries, which gives an average parentage life of 7.4 years per ministry, not counting those occasions when a ministry was recreated exactly in its old form. Agricultural research institutes were statutorily under two parastatals for 4 years, giving an average parental life of just 2 years per parastatal. The Federal Ministry of Science and Technology has been the institutional equivalent of the cat with many lives: it was created or recreated three times over a period of 13 years. The ministry's fortunes mirrored the country's political instability: it was created or recreated three times by new incoming regimes (the Shagari regime, January 1980; the Babangida regime, August 1985 and the Shonekan administration, 1993), and the ministry

was scrapped once by a new regime (the Buhari/Idiagbon regime, January 1984). The ministry had the rare misfortune of being scrapped by the same regime that had seen fit to recreate it only a few years earlier: the same Babangida regime that recreated the ministry in 1985 had a change of mind and scrapped it (again) in 1992.

The “macro” view of institutional arrangements for managing the Nigerian NARS conceals variations in the changing parentage of individual research institutes. Over the 1912-96 period, the number of changes in parent ministries or supervising parastatals of research institutes and their precursors ranged from 7 parents each for the National Horticultural Research Institute, the National Institute for Freshwater Fisheries Research, the Lake Chad Research Institute and the Nigerian Institute for Oceanography and Marine Research and Project Development Institute to 11 parents each for the National Root Crops Research Institute, the National Animal Production Research Institute and the Nigerian Veterinary Research Institute. The median number of parent ministries is 9 for the Cocoa Research Institute of Nigeria, the Nigerian Oil Palm Research Institute, the Institute of Agricultural Research and Training and the Nigerian Stored Products Research Institute. As with any child with many serial parents, these rapidly changing supervising parent ministries and parastatals have left a confusing trail in the institutional memories of the country’s research institutes.

Factors accounting for the high degree of institutional instability that were examined include the colonial legacy, political instability and the lack of socio-political consensus on the basic thrusts of Science and Technology policy. On the colonial legacy, the Nigerian NARS appears to have been born into institutional instability, in marked contrast to the stable, almost tranquil, institutional arrangements for managing the Indian NARS. It has been argued that Britain did not have much experience with organized national agricultural research systems at the time it was establishing government agricultural research institutes in the colonies (Ruttan, 1982). But Britain’s methodical and holistic approach to organizing the Indian NARS was in sharp contrast to the *ad hoc* trial and error approach in Nigeria. While the Indian Council for Agricultural Research (ICAR) has lasted 50 years since Indian Independence, the average life of a supervising Ministry for Nigerian NARS since Independence is 7 years.

Political instability produced discontinuities in institutional structures and processes. Changes in political regime often resulted in institutional changes for any or all of three reasons. One, new regimes may create new institutional structures to reflect the higher priority they give to Science and Technology, as when a new Ministry of Science and Technology is created, as was the case in 1979 and 1985, or when a new parastatal is created to co-ordinate the NARS, as was the case with the establishment of the National Science and Technology Development Agency in 1977. The converse was the case when a new regime scrapped the Supervising Ministry because of its implied lower priority for Science and Technology, as was the case with the scrapping of the Federal Ministry of Science and Technology in 1984. Or the Ministry may be scrapped by the same regime to reflect, on second thoughts, the down-grading of the need for a ministry to oversee the Nigerian NARS, as was the case in 1992. Two, political instability could result in institutional instability because new regimes create or scrap institutions as a legitimizing exer-

cise to demonstrate that they are different from the previous regime. New regimes may also introduce institutional changes because inherited institutional structures and processes fail to achieve the desired technological transformation of agriculture. Finally, the dominance of the military in Nigeria's political history since independence (they have ruled for 27 years out of 37 years, or 73 percent of the time)³¹ has entrenched a culture of creating new institutions or abolishing existing institutions by military fiat. While the Shagari civilian regime had to obtain parliamentary approval for the establishment of a new Ministry of Science and Technology (1980), successive military regimes took unilateral decisions to create or scrap the Ministry with "immediate effect" with little or no consultation with key stakeholders. Military regimes, by their nature, have neither the culture, patience nor the institutional mechanisms for extensive consultations with the civilian stakeholder community. Military governments have a greater tendency towards abrupt institutional changes than civilian governments because of the former's greater freedom to tinker with existing institutional arrangements without fear of rebuke from aggrieved civilian interest groups. A central theme of this study is the failure at all levels to develop an effective community of stakeholders. The users and beneficiaries of research-researchers, farmers, agroindustrialists, processors, agricultural transporters and consumers - have failed to organize effective demand for more stable institutional arrangements for managing the Nigerian NARS. Neither have groups of stakeholders organized to demand the necessary changes in institutional arrangements for managing the Nigerian NARS. Ownership structures have been weak, with the attendant poor prospects for institutional sustainability.

High levels of institutional instability and metamorphosis have resulted in low morale among NARS leaders and managers, and the research community. The lack of institutional sustainability has created generations of doubting and cynical scientists, cynical about the sincerity of purpose of the latest round of institutional changes, and doubtful about their prospects of surviving the next regime.

On funding instability, two measures of instability were used: the "raw" coefficient of variation and the trend-corrected coefficient of variation, where the latter was estimated from a linear trend equation. This involved the estimation of a large number of trend

31 The frequent changes in government and the predominant role of the military can be seen from the table below:

Date	Regime	Remark
Oct 1, 1960-Jan 15, 1966	Civilian (Balewa)	First post-Independence civilian government
Jan 15, 1966-Jul 29, 1966	Military (Irons)	Military overthrew civilian government
Jul 29, 1966-Jul 29, 1975	Military (Gowon)	Military overthrew military
Jul 29, 1975-Feb 13, 1976	Military (Mohammed)	Military overthrew military
Feb 13, 1976-Oct 1, 1979	Military (Obasanjo)	Military overthrew military
Oct 1, 1979-Dec 31, 1983	Civilian (Shagari)	Military voluntarily handed over to civilians
Jan 1, 1984-Aug 29, 1985	Military (Buhari/Idagbon)	Military overthrew civilian government
Aug 29, 1985-Aug 26, 1993	Military (Babangida)	Military overthrew military
Aug 26, 1993-Nov 17, 1993	Military/Civilian (Shonekan)	Military/civilian hybrid
Nov 17, 1993 to date	Military (Abacha)	Military overthrew hybrid

equations whose estimated standard errors were used to estimate the trend-corrected coefficients of variation. The major findings were the following, among others.

1. Most research institutes witnessed high or severe levels of funding instability on both capital and recurrent accounts, that is, in allocations of capital and recurrent funds to research institutes. Only in a few institutes and for specific periods was the funding instability mild or moderate (see Table 7).
2. Instability in funding seems to be getting worse on both capital and recurrent accounts. Estimated trend-corrected coefficients of variation for the latter periods (mid 1980s - early 1990s) were generally higher than those of the earlier periods. Two reasons could be adduced. One, economic conditions have generally been more unstable in recent times than in the earlier periods. The latter period has been characterized by prolonged economic recession, structural adjustment program and steep periodic increases in the salaries and wages of researchers, together with the payment of lump-sum arrears of various "relief packages". Two, while the earlier period of the 1950s - early 1970s was marked by a plurality of government funding sources, including marketing boards, the post-1974 period of marketing board reforms and dependence on oil revenues as the primary source of revenue has witnessed an increasingly narrower base of funding for the Nigerian NARS. Fluctuations in Federal Government revenues have tended to be transmitted to fluctuations in NARS funding without the prospect of any compensating fluctuations in funding contributions from the States as was the case in the earlier periods. The possible stabilizing effect of marketing board funding should not, however, be construed to mean an argument in their favor. On the contrary, their harmful production and allocative effects have been extensively documented. The empirical findings are consistent with the working proposition that instability has tended to increase over time.
3. Capital budget allocations to research institutes have tended to be more unstable than recurrent budget allocations. This is consistent with *a priori* expectation. The political leadership endeavors to prevent industrial strikes in institutes that would result from non-payment of salaries and wages by maintaining a relatively steady flow of recurrent funds that are mostly used to pay salaries, wages and allowances. However, recurrent fund allocations to some research institutes were more unstable than capital budget allocations for some periods
4. Estimated trend-connected coefficients of variation of actual capital and recurrent budget disbursements (as opposed to budget allocations or approvals) show similar patterns to funding allocation instability (Tables 8-9). In some cases, disbursements were more unstable than approved or allocated budgets, as expected (especially on capital account). Instability of disbursements was generally high, and in some institutes and periods, severe.
5. Releases of approved budget funds to the institutes encountered unduly long delays. Though budget funds were supposed to be released at the beginning of each

quarter, delays of up to three to five months were not uncommon. The prompt release of funds was the rare exception rather than the rule.

6. Delays in the release of capital funds were much longer than delays in the release of recurrent budget funds. In the interest of industrial peace, government pursued a policy of releasing recurrent budget funds much ahead of capital budget funds to assure the “prompt” payment of workers’ salaries and wages. Government did not always succeed with this, as some institutes had to resort to costly bank overdrafts when recurrent funds were not released on time in order to avoid industrial unrest.
7. Delays in the release of budget funds were partly due to delays in revenue accruals to the government treasury, to nonfunctioning bureaucracy at the level of the Ministry of Finance and the Ministry of Agriculture, and partly due to political instability. It is not clear to what extent the change in the budget year from April 1 - March 31 to January 1 - December 31 is contributing to the unusually long delays in budget disbursement - a comparison of computed budget fund release delay indices for the pre-1980 (old budget year) period with the post-1980 (new budget year) period should provide some insight on the correlation between the budget year and the incidence of delays in the release of budget funds to research institutes. There has been a noticeable deterioration in the quality of the public bureaucracy with respect to the timeliness of the budgetary process. The evidence shows that periods of political crisis (e.g. 1993) were also the years in which institutes witnessed the longest delays in the release of budget funds. Political crisis years were the years in which institute budget funds were not only *too little, but also too late*. Empirical evidence on computed indices of delay in the release of budget funds, presented in this study for the first time, provide tools with which NARS leaders and managers can directly confront policy makers in the Presidency, Finance Ministry and Agriculture Ministries with evidence on the degree and relative magnitudes of budget release delays. Empirical evidence on these delays has never before been provided in this comprehensive format for their graphic effects and use by policy makers. NARS leaders and managers can employ these tools of analysis in policy dialogue as a first step towards eliminating the gross forms of avoidable delays.
8. Delays in the disbursement of budget funds create uncertainty in research programming, disrupt research activities and distort results of research trials and experiments that are related to patterns of rainfall and the seasons. Budget release delays create a certain inertia within the NARS whereby leaders, managers and the scientific community develop a “delay-is-unavoidable syndrome” by which all actors expect every other activity to be delayed on account of the delayed fund release.
9. Released budget funds sometimes fall short of approved budgets. This may be due to shortfalls in the realized revenues of government or midstream shifts in budget priorities. In an extreme case, no capital budget funds were released (dis-

bursed) to institutes during 1992-94. Analytically, non-release of funds during this period was equivalent to infinite delays. It was bad enough for approved budgets not to be released. What compounded the situation for NARS leaders and managers in the management of the institutes was the great uncertainty and anxiety created by the failure of government to make a categorical statement as to whether or not fourth quarter capital funds would be released. NARO managers kept hoping against hope during the October 1-December 31 period that funds would be released. It was only with the passage of December 31 that NARS leaders and managers knew for certain whether funds would be released or not. The non-release of funds resulted in poorly completed, partly completed and, quite often, abandoned capital projects.

10. Actual capital and recurrent expenditures were highly unstable, with evidence of increasing instability over time. As with funding allocations, actual capital expenditures were generally more unstable than actual recurrent expenditures, again consistent with the proposition that government ensures that recurrent expenditure flows are not as unstable as capital expenditure flows, in the interest of industrial peace and harmony. Again, as with funding allocations, there is some evidence of increasing instability of actual expenditures over time, for the same set of reasons (increasing macroeconomic instability, pattern of increasing episodic salary increases and lump-sum payments of arrears, etc.).
11. Among categories of expenditures, personnel expenditures were more stable than operating cost expenditures, maintenance expenditures, training expenditures and capital expenditures. This implies that fluctuations in research budgets impact more adversely on other expenditure categories than personnel costs. As with funding allocations and aggregated actual expenditures, the instability of individual expenditure categories seems to be getting worse over time.

On research staffing instability, the findings could be summarized as follows. First, most research institutes witnessed severe-systemic instability over relatively short periods of time. Second, the erstwhile pan-territorial research institutes, precursors to the first-generation institutes, witnessed severe-systemic instability with the mass departure of expatriate staff after the attainment of Nigerian independence and the dissolution of the West African Research Organization. For example, at the West African Cocoa Research Institute, all research staff in post in 1954 had left by 1964, giving a staff instability index of 100.00 percent; at the West African Institute for Oil Palm Research, less than 10 percent of the staff in post in 1953/54 were still on the job by 1963/64; while at the West African Institute for Trypanosomiasis Research, more than 60 percent of research staff had left over the five years leading up to Nigerian Independence (over the 1954-59 period, the staff instability index was 63.64 percent, and 100.00 percent over the 1954-76 period). A situation in which the majority of research staff resign within just five years must be regarded as highly unstable. Most research would require a minimum of 5 years gestation for validated output that can be translated into usable technologies. Third, the belief by some that research staff are generally stable for want of alternative opportunities is contradicted by the evidence from the Nigerian case study. Research

staff do not just move; they migrate in large numbers over short periods of time in most institutes. In most institutes, more than 60 percent of research staff resigned over a ten-year period (Tables 17-19). Fourth, instability in the 1960s appears to have been worse than in subsequent periods, over five - and ten-year periods. Fifth, the evidence from the National Research Institute for Chemical Technology (NRICT) contradicts the hypothesis that institutes with research staff from their ethnic and geopolitical catchment areas tend to be more stable than those whose research staff come from outside their catchment areas. The NRICT, with its leadership and the majority of its research staff drawn from outside its catchment area, is arguably the most stable of the institutes. It also has the longest serving Director (since 1979). Sixth, the high staff instability in most institutes must have crippled sustainable research, introduced long time-lags between the commencement of research and its translation into new agricultural technology, and resulted in the abandonment of many research projects. Finally, observed research staff instability must have been due to a variety of causes including, among others, the mass departure of expatriate research staff in the 1950s and 1960s; the adverse consequences of inflation and foreign exchange rate devaluations on real wages of research staff, and the simultaneous creation of several research institutes in 1975. Other causes include disparities in wages and salaries of research staff of the institutes on the one hand, and university lecturers on the other (up till 1987), as well as the pyramidal career structure in the institutes that frustrates upward mobility, especially beyond the Chief Scientific Research Officer grade.

The following findings could be summarized with respect to **governance instability**. One, all institutes witnessed severe-systemic governance instability, with virtually all institutes recording 100.00 percent instability index over any five-and ten-year periods (Table 20). Two, it is the very rare exception for a Board Member to be re-appointed to a second term. Three, a comparison of governance instability in the institutes with private sector companies shows that governance instability is much higher in the research institutes than in the private-sector companies. Private-sector companies record instances in which Board Members serve more than two terms, and in the case of NBC (Coca-Cola), some Directors had served on the Board for upwards of 30 years. Finally, contrary to expectations, governance stability in private-sector (multinational) companies was provided, not by expatriates, but by the Nigerian Board Members. Expatriate members were continuously changed by their multinational headquarters as part of global transnational cross-posting exercises. While private-sector companies had mechanisms for assuring institutional memory, research institutes did not have any such memory beyond the occasional longevity of the Director as an *ex-officio* Member. The overlay of governance instability on research staff instability compounds the instability problem of the Nigerian NARS.

Implications of findings

The empirical findings from the study have several implications. First, since the absence of a National Agricultural Research Policy creates an enabling environment for frequent paradigm shifts, it becomes imperative that a National Agricultural Research Policy be urgently formulated. A nation without a strategic vision of where it wants its NARS to be

is fertile ground for “muddling through” experimentation with *ad hoc* programs and institutional arrangements that are not sustainable. Many sub-Saharan African countries operate agricultural research programs and projects that are not derived from or guided by an explicitly formulated national agricultural research policy. Second, the high degree of institutional instability implies a lack of broad sociopolitical consensus on the optimal institutional arrangements for agricultural research. Succeeding governments have experimented with different institutional arrangements for science and technology in general, and agricultural research in particular. Unless there is general consensus on optimal institutional arrangements, succeeding regimes may continue to establish their preferred institutional structures. A related implication is the need to broaden the spectrum of participation and consultation among key stakeholders on alternative institutional arrangements for organizing the Nigerian NARS. Most of the institutional metamorphosis of the Nigerian NARS has occurred under the military. Military regimes, by their nature, engage in very little consultation with civilian stakeholders. They effect institutional changes, such as the scrapping of the Ministry of Science and Technology, with military fiat that takes “immediate effect”. Learning curves with institutional arrangements, as with other areas under the military, are truncated in a generally militarized environment in which the leadership is intolerant of arrangements that do not work or show results with military precision. This implies that processes for decision making on the Nigerian NARS need to be democratized to broaden the spectrum of participation and consultation within the stakeholder community (researchers, farmers, agroindustrialists and consumers in the larger Nigerian society). The analysis also suggests a redefinition of the functional roles of the different tiers of government in agricultural research. The Federal government alone has been responsible for all the tinkering with institutional arrangements for agricultural research since 1973 with no consultation with the State and local governments. One implication is the need for greater involvement of the lower tiers of government in all discussions and proposals for changes in institutional arrangements for agricultural research. Consensus building should not only be among private-sector stakeholders but also among the different tiers of government.

Second, the high degree of funding instability suggests the need to move from the narrow dependence in the past on Federal government sources of funding of the NARS to a more diversified plurality of funding sources. That funding instability in the earlier period of diverse sources of funding research was less than instability in the more recent era of a narrow base of (Federal only) funding suggests that funding instability could be lessened by the appropriate diversification of research funding sources. The emphasis on “appropriate diversification” is derived from the analytical results of this study that not all forms of diversification lead to the stabilization of research funding. Under certain conditions relating to the nature of correlations and standard deviations of the different sources of funding, diversification might make NARS funding more unstable than would have been the case without diversification. Not all forms and types of diversification are good for the stability of NARS funding. One implication is that international agricultural research aid funds should be evaluated, not only for their positive scale effects on national systems, but also for their possible destabilizing effects on NARS funding. Aid flows that are strongly positively correlated with the domestic fund flows are likely to be destabilizing. The challenge is for national systems to source research aid funds

where the flows exhibit compensating fluctuations to fluctuations in domestic research fund flows. Similarly, donor co-ordination in agricultural research aid should be assessed, not only for its positive effects in reducing duplication and overlapping wastes, but also for its consequences on the stability of recipient NARS funding. Though common positions of aid donors on such important issues as economic liberalization, democratization and human rights often lead to desirable reforms in recipient countries, they could end up destabilizing NARS funding more than would have otherwise been the case in the absence of donor co-ordination and “common umbrella” initiatives, if the resultant research aid funding flows are strongly positively correlated with domestic research fund flows. The implication is that research funding diversification, international research aid and donor co-ordination proposals should in the future be evaluated, not just for their additive scale effects, but also for their consequences for the overall stability of NARS funding.

The empirical results on research staff instability suggest that analysis of manpower resources of NARS must go beyond traditional concerns with scale and adequacy of staffing levels to the analysis of staff instability or turnover. Conventional analysis of trends in research staff full-time equivalents might provide a false sense of security if the figures conceal dynamic internal movements involving the constant exits of experienced researchers and their “compensating” replacements that reveal net gains in research staff full-time equivalents over time. An explanation of failed national agricultural research systems in the face of rising research staffing levels over time must include the frequent exits of experienced research staff that have consequences for the effective and successful execution of on-going research activities. Severe-systemic research staff instability suggests an urgent need for system-wide policy reforms and the removal of institute-specific constraints that might be compelling the forced exit of extremely valuable research staff from institutes. The analysis suggests that an institute with much lower but stable research staff full-time equivalents might be more effective in its research program than one with much higher but highly unstable research staff full-time equivalents.

The empirical results on governance instability suggests that little or no institutional memory resides in institute governance in most institutes. Board Members are appointed not so much for their sustained professional input over time, but more as political patronage. Institute governance is severely affected as Board Members are unable to provide the required critical mass professional advice, integrity and transparency to guide institute management. This suggests a need for urgent governance reform that will guarantee minimum continuity in governance.

The contrasting performances of the institutes and private sector companies in governance stability suggests the need to identify those factors that favor governance stability in the private sector which can be adapted for improved governance stability in the institutes.

Strategies for strengthening NARS stability and sustainability in Nigeria

The conceptual framework and the empirical results from this study suggest a number of strategies for strengthening NARS stability and sustainability in Nigeria. These include the following, among others.

1. **National agricultural research policy:** The absence of an explicitly formulated National Agricultural Research Policy has provided a conducive environment for frequent program shifts and institutional changes. Though a National Agricultural Research Strategy Plan has been formulated, Nigeria still does not have a vision statement whose ultimate objectives are to be realized by the Strategy Plan Document. Without a vision, the assortment of agricultural research efforts are likely to perish.
2. **Democratic polity:** Much of the institutional metamorphosis and instability that has plagued the Nigerian NARS is rooted in the underlying political instability characterized by frequent changes in military governments. Military governments by their nature have little regard for the stakeholder community. For their part, civilian stakeholders have, after many years of military rule, developed a “military dependency syndrome” by which researchers, farmers and beneficiaries of agricultural research, like their other civilian counterparts, have come to depend on the military and their narrow band of advisers for all initiatives in agricultural research policy and programs. The militarization of society has crippled civilian capacity for advocacy on behalf of agriculture in general, and agricultural research in particular. Progress towards democratization should be accelerated as a basis for the development of civilian stakeholder capacity to play the required advocacy roles on behalf of agricultural research. The development of domestic stakeholder capacity is necessary for attaining broad sociopolitical consensus on the basic values, beliefs and goals of science and technology policy in general, and agricultural research policy in particular. The development of a vibrant stakeholder capacity constitutes a countervailing force to supply-side sources of NARS instability. It also guarantees a minimum NARS stability in the face of political instability. Unless such capacity is developed, political instability and other supply-side factors will translate linearly into frequent changes in agricultural research policy and in institutional arrangements for agricultural research.
3. **Diversification of funding sources:** The movement from the colonial legacy of plurality of funding sources for agricultural research to the present narrow Federal funding monopoly needs to be reversed. Appropriate funding diversification strategies must be identified that are consistent with the NARS funding stability objective. Alternative sources of funding include state and local governments, the private sector and the international donor community. The present sole dependence on the federal government for the funding of the Nigerian NARS is unstable and unviable. What is required is a culture of disciplined political will and commitment to the domestic funding of NARS, with supplementary funding, as necessary, from the international donor community. The private sector should be ac-

tively involved in the funding of agricultural research through innovative re-financing schemes.³² Beneficiaries of research, particularly downstream food and fiber processors, should assume far greater responsibility for specific commodity research of direct relevance to their enterprises. While they can be expected to be interested in applied research, government at all levels will need to fund the more basic forms of research that are unable to attract private-sector funds.

4. **Research endowment fund:** The Petroleum Trust Fund should create an Agricultural Research Endowment Fund the income yield from which will be used to meet the basic needs of the Nigerian NARS.
5. **Appointment of Executive Directors to Boards of Governors:** To assure governance stability and continuity, at least two Executive Directors should be appointed from management to serve on the Governing Boards of Research Institutes. The present system in which the Institute Director is the only *ex-officio* member from management fails to provide the needed governance stability. The appointment of Executive Directors from Management will provide the needed institutional memory in institute governance.
6. **Repeal of Research Institutes Decree, 1973:** The Research Institutes Decree (1973) which empowers the Federal government to take over any existing state-owned research institute or facility should be repealed. At the minimum, this provision which confers monopoly powers for the ownership and operation of research institutes on the Federal government should be expunged. The ownership structure of research institutes should be decentralized to the lower tiers of government to close the existing dualism by which the Federal government owns the research institutes while the State governments run the agricultural extension services.
7. **Macroeconomic policy reforms:** Government should accelerate economic policy reforms to provide a conducive environment for research staff and stem the drift of staff to greener pastures.
8. **Institute - university linkages:** Efforts must be accelerated to functionally integrate research institutes and the universities. This will enhance the exploitation of complementarities between the institutes and the universities in research, training and extension and stem the drift of research staff from the institutes to the universities. The newly established Universities of Agriculture should play the vanguard role in developing these linkages. The relevant lessons of experience in the IAR/ABU functional integration should be utilized in the formulation and imple-

32 The Special Program for African Agricultural Research (SPAAR) has embarked on an innovative project *The Sustained Financing Initiative (SFI)* the full potential of which should be explored.

mentation of new institute-university integration schemes. The fact that the research institutes and the Universities of Agriculture are under the same Federal Ministry of Agriculture and Natural Resources provides a unique opportunity for these new linkages to be worked out.

Several lessons can be drawn for future research. First, is the need for analytical work on the meaning of terms used for the clearer understanding of policy makers. This study has offered typologies of instabilities, their characteristics, their causes and consequences. Such analytical work provides the framework for empirical analysis. Second is the need for hard-core empiricism and the need to go beyond heuristic notions and intuitions to the examination of the evidence in the field. While there are scattered references to the problem of funding and staffing instability, there has been little empirical analysis. Though there are casual references to delays in budget releases by NARS leaders and managers and analysts, this study is the first to provide detailed, empirical evidence at the institute level on a national scale. Researchers need to marshal such evidence to confront the Ministries of Finance, Agriculture and National Planning and the Presidency for domestic policy dialogue and streamlining of the budgetary process for the prompt release of funds for NARS. Researchers need to generate more measures of institutional funding, staffing and governance instability at the NARS/NARO levels for domestic and international policy dialogue on comparative instabilities of the NARS. Such analyses could indicate those country NARS requiring off-setting fluctuations from new sources of funding or staffing. Finally, there is a lacuna in frameworks of analyses of the agricultural research policy of sub-Saharan Africa.

Phase II of this study will develop frameworks for agricultural research policy analysis and extend the empirical analysis of policy and NARS instability to cover selected sub-Saharan African countries (Ghana, Zimbabwe, South Africa, Kenya, Tanzania and Uganda).

Appendix Table 1. Main Features of Nigeria's Agricultural Zones, 1997

Land area	States	Population (1991)	Ecology vegetation	Agricultural production/ Main crops	Livestock	Misc.	Constraints
1. Central zone 296,898 km ² (32% of country's land area)	Benue, Kogi, Kwara, Niger, Nassarawa, Taraba & Plateau	14.1 million (15.88% of country's population); density: 47/km ²	Forest/savannah mosaic (derived savannah), Southern Guinea Savannah and Northern Guinea Savannah; mountain vegetation on Mambilla Plateau; also Jos Plateau.	90% rainfed; only 25% of arable land cultivated. Rice and groundnut (over 40% of national output in each case); maize, rice, millet, sorghum, cowpea, yam, cassava, melon and beniseed, mango and orange. Zone produces 25% of nation's cowpea, 64% soybean, 34% yam and 98% Irish potato. High potential for fruits and nuts. Most of country's output of coffee and tea from Mambilla Plateau. Also, oil palm.	Cattle, goats, sheep, poultry, pigs, ducks, pigeons.	Forest reserves. Artisanal fisheries.	Labor scarcity; aging farm labor force; low agricultural productivity; low soil fertility; lack of good planting material; water shortage during dry season; poor rural infrastructure.
2. North-West zone 192,911 km ² (21.1% of country's land area)	Kaduna, Katsina, Sokoto, Zamfara, Kano and Kebbi	19.9 million (22.41 % of country's population); density: 103/km ²	Savannah (Sahel, Sudan Savannah and Northern Guinea Savannah); declining annual rainfall pattern in last 30 years; unimodal rainfall pattern; large fama (valley bottom) potential.	Leading producer of cereals and legumes 40% of which is sold to other zones: sorghum (35% of national output); millet (33%); maize (19%), rice (17%). Rice and maize have substantial scope for expansion. Produces 70% of national output of onion, 48% of tomato and 42% of pepper.	Produced 28% of national output of cattle, 25% of country's sheep, 19% of goats and 15% of poultry.	Agroforestry schemes: farm trees, boundary tree-planting, homestead gardens, woodlot planting, etc. Gum arabic important export crop. Artisanal fisheries.	Short dry season; drought; persistent fertilizer shortages; inadequate tools for animal traction; poor rural infrastructure; limited grazing facilities; poor credit facilities; weak live-stock extension services; unequal access of women to farm inputs.

Appendix Table 1. Main Features of Nigeria's Agricultural Zones, 1997 (continued)

Land area	States	Population (1991)	Ecology vegetation	Agricultural production/ Main crops	Livestock	Misc.	Constraints
3. North-East zone							
241,076 km ² (26% of country's land area)	Adamawa, Borno, Jigawa, Bauchi, Gombe, Yobe.	13.6 million (15.31% of country's population); density: 55/km ²	Sahel (Yobe and Bomo); derived savannah (South Adamawa).	Crops: 57% of national output of millet; 27% of sorghum; wheat, maize, cotton; legumes: largest producer of cowpea; also produces date palm, onions, peppers, carrots and other vegetables.	Produces 41% of nation's cattle; 32% of sheep and 26% of goats; poultry; most important livestock production zone.	Unimodal rainfall pattern. Artisanal fisheries.	Drought; desertification; poor rural infrastructure and credit facilities; incessant conflicts between pastoralists and arable farmers over land grazing rights; severe water shortage for livestock during dry season; lack of research scientists and weak extension services.
4. South-West zone							
114,271 km ² (12% of country's land area)	Delta, Bayelsa, Edo, Lagos, Ogun, Ondo, Ekiti, Osun, Oyo.	22.3 million (25% of national population); density: 195 /km ²	Swamp mangrove forest; dry lowland forest; forest/savannah mosaic (derived savannah); Southern Guinea Savannah.	Yam, cassava, cocoyam, plantain, maize, melon, okra, tomatoes, peppers, oil palm, rubber, cocoa, and timber resources.	Largest concentration of poultry and feedmills but depends on North-West and other zones for grains; 24% of national pig production.	Artisanal fisheries.	Labor scarcity caused by massive rural-urban migration (constrains expansion of scale and scope of farming); soil erosion; shortage of planting materials; limited research on small ruminants; weak extension services; heavy post-harvest losses.

Appendix Table 1. Main Features of Nigeria's Agricultural Zones, 1997 (continued)

Land area	States	Population (1991)	Ecology vegetation	Agricultural production/ Main crops	Livestock	Misc.	Constraints
5. South-East zone 78,612 km ² (8.5% of country's land area)	Abia, Akwa Ibom, Anambra, Cross River, Enugu, Ebonyi, Imo, Rivers.	18.9 million; density: 241/km ² ; the most thickly populated zone in the country.	Humid forest (salt water swamp; fresh water swamp; rain forest); derived savannah and mountain; equatorial climate with annual rainfall of 1500mm - 3000mm; delta region with many creeks and channels; main oil-producing area in country.	Produced 53% of country's yam, 74% of cassava, 70% of cocoyam, and 49% of leafy vegetables. Produced 20% of country's maize and rice. Rice, banana/plantain, pawpaw, egusi melon, tomato, pineapple, cocoa, rubber, oil palm, and cashew.	Livestock not as important as in other zones.	Artisanal fisheries.	Scarcity and high cost of labor and other inputs; oil, agro-chemical, and thermal pollution; soil erosion; problem of management of solid waste from high population density.

Source: Compiled from Shaib, B., A. Aliyu, and Bakshi. 1997. *Nigeria: National Agricultural Research Strategy Plan 1996-2010*. Federal Ministry of Agriculture and Natural Resources.

Appendix Table 2. Delays in the Release of Budget Funds to NIFOR⁽¹⁾, Nigeria, 1985-96

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1985	Release date	28-May	23-Aug	6-Dec			28-Feb	29-May	23-Aug	8-Nov 30-Dec		
	Delay in days	148	145	159	452	151	59	59	54	39	211	53
	Index (%)	164.44%	159.34%	172.83%			65.56%	64.84%	58.70%	42.39%		
1986	Release date	21-Feb	15-May	19-May	8-Dec		21-Feb	15-May	19-Aug	11-Nov		
	Delay in days	52	45	50	216	54	52	45	50	42	189	47
	Index (%)	57.78%	49.45%	54.35%	75.00%		57.78%	49.45%	54.35%	45.65%		
1987	Release date	13-Feb	15-May	6-Aug	9-Nov		6-Mar	15-May	6-Aug	26-Oct		
	Delay in days	44	45	37	166	42	65	45	37	26	173	43
	Index (%)	48.89%	49.45%	40.22%	43.48%		72.22%	49.45%	40.22%	28.26%		
1988	Release date	22-Feb	4-May	27-Jul	29-Nov		29-Jan	4-May	21 July; 3 Aug	10-Nov		
	Delay in days	53	34	27	174	44	29	34	27	41	131	33
	Index (%)	58.89%	37.36%	29.35%	65.22%		32.22%	37.36%	29.35%	44.57%		
1989	Release date	28-Mar	16-Jun	31-Aug			31-Jan	9-May	7-Aug	20-Oct		
	Delay in days	87	77	62	226	75	31	39	32	20	122	31
	Index (%)	96.67%	84.62%	67.39%			34.07%	42.86%	34.78%	21.74%		
1990	Release date	23-Feb	10 April, 4 June	17-Sep	5-Nov		25-Jan	24-Apr	18 May, 31 July	15-Nov		
	Delay in days	54	10	77	177	44	25	24	31	46	126	32
	Index (%)	60.00%	10.99%	83.70%	39.13%		27.78%	26.37%	33.70%	50.00%		
1991	Release date	4-Apr	3-Jun	22-Aug	22-Nov		1-Feb	9-May	5-Jul	28-Oct		
	Delay in days	94	64	53	265	66	32	39	5	59	135	34
	Index (%)	104.44%	70.33%	57.61%	58.70%		35.56%	42.86%	5.43%	64.13%		
1992	Release date	6-Feb	15-Jul	14-Oct	—		24 Jan, 6 Feb	6-May	28-Jul	27-Oct		
	Delay in days	37	106	106	245 (∞)		24	36	28	58	146	37
	Index (%)	41.11%	116.48%	115.22%	∞		26.67%	39.56%	30.43%	63.04%		

Appendix Table 2. Delays in the Release of Budget Funds to NIFOR(1), Nigeria, 1985-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1993 Release date							9-Jun	24-Aug	6-Dec	n.a		
Delay in days	150	78	86	∞	314(∞)	79	160	146	159	n.a	465	155
Index (%)	166.67%	85.71%	93.48%	∞			177.78%	160.44%	172.83%			
1994 Release date	n.a	n.a	n.a		n.a	n.a	7-Mar	16-Jun	24-Aug	7-Dec		
Delay in days							66	67	55	68	256	64
Index (%)				∞			73.33%	73.63%	59.78%	73.91%		
1995 Release date	n.a	n.a	n.a	n.a	n.a	n.a	16-Mar	25-May	16-Aug	9-Nov	217	54
Delay in days							75	55	47	40		
Index (%)							83.33%	60.44%	51.09%	43.48%		
1996 Release date	n.a	n.a	n.a	n.a	n.a	n.a	11-Mar; 30-May	2-Jul	14-Aug; 11-Nov	27-Nov	266	67
Delay in days							70	93	45	58		
Index (%)							77.78%	102.20%	48.91%	63.04%		
Total	569	526	571				688	682	569	497		
Median release date:	22-Feb	24-May	4-Sep	22 Nov			57	57	47	45		
Median no. of days delay:	53	54	66	53			24-Feb	15-May	10-Aug	8-Nov		
Median deaily index (%):	58.89	59.34	71.74	57.61			61.11	49.45	44.57	42.39		

Notes:

1. NIFOR: Nigerian Institute for Oil Palm Research.
2. First Quarter : January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing funds;(4) "Index (%)" is Index of Late Release of Funds to the Institute;.
4. "Full Year" is total delay in days for a given year.
5. "Average per Quarter" is average number of days delay per quarter for a given year, that is, (5) divided by the number of quarters.
6. "Total" is total number of days delay for a given quarter across all years in the sample.
7. "Average" is average number of days delay per year, for a given quarter, that is, (7) divided by the number of years in the sample.

Appendix Table 3. Delays in the Release of Budget Funds to IAR, Nigeria, 1991-96

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1991 Release date	22-Feb	15-Apr	28-Oct	1-Dec			22-Feb	25-Apr	28-Sep	29-Dec		
Delay in days	53	15	120	62	250	63	53	25	90	90	258	65
Index (%):	58.89%	16.48%	130.43%	67.39%			58.89%	27.47%	97.83%	97.83%		
1992 Release date	18-Feb	19-May	9 Oct	30-Oct			8-Mar	6-Aug	9-Oct	30-Oct		
Delay in days	49	49	99	30	227	57	67	126	101	30	324	81
Index (%):	54.44%	53.85%	107.61%	32.61%			74.44%	138.46%	109.78%	32.61%		
1993 Release date	26-Mar	18-May	19-Aug	7-Nov			29-Mar	21-Jun	15-Sep	3-Dec		
Delay in days	85	48	50	38	221	55	87	82	77	64	310	78
Index (%):	94.44%	52.75%	54.35%	41.30%			96.67%	90.11%	83.70%	69.57%		
1994 Release date	17-Mar	6-Jun	21-Jul	11-Nov			10-Feb	4-Aug	11-Sep	25-Oct		
Delay in days	76	67	21	42	206	52	41	126	73	25	265	66
Index (%):	84.44%	73.63%	22.83%	45.65%			45.56%	138.46%	79.35%	27.17%		
1995 Release date	3-Mar	22-Apr	22-Aug	1-Nov			10-Feb	2-May	31-Aug	8-Nov		
Delay in days	62	22	53	32	169	42	41	32	62	39	174	44
Index (%):	68.89%	24.18%	57.61%	34.78%			45.56%	35.16%	67.39%	42.39%		
1996 Release date		15-Apr	30-Jul				29 Feb	3-May	22-Jul	n.a.		
Delay in days		15	30				60	33	22	n.a.	115	38
Index (%):		16.48%	32.61%				66.67%	36.26%	23.91%			

Appendix Table 3. Delays in the Release of Budget Funds to IAR, Nigeria, 1991-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
Total	265	216	373	204			349	424	425	248		
Average	53	36	62	41			58	71	71	50		
Median release date:	3-Mar	5-May	9-Aug	7-Nov			25-Feb	28-May	13-Sep	8-Nov		
Median days delay:	62	35	40	38			56	58	75	39		
Median release delay index (%)	68.89	38.46	43.48	41.30			62.22	63.74	81.52	42.39		

Notes:

1. IAR: Institute for Agricultural Research, Samaru, Zaria, Kaduna State.
2. First Quarter: January 1 - March 31; Second Quarter: April - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing Budget Funds.
4. "Index" is Index of late release of funds to the Institute.
5. "Full Year" is total delay in days for a given year.
6. "Average per quarter" is average number of days delay per quarter for a given year, that is, (5) divided by the number of quarters.
7. "Total" is total number of days delay for a given quarter, across all years in the sample.
8. "Average" is average number of days delay per year for a given quarter, that is, (7) divided by the number of years in the sample.

Source: Underlying data from IAR Field Survey, 1996.

Appendix Table 4. Delays in the Release of Budget Funds to IAR+T, Nigeria, 1990-96

Year	Capital funds						Recurrent funds					
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1990 Release date	29 Feb	22-Jun	20-Sep	2-Nov			19-Jan	2-May	2-Aug	2-Nov		
Delay in days	60	83	82	33	258	65	19	32	33	33	117	29
Index (%):	66.67%	91.21%	89.13%	35.87%			21.11%	35.16%	35.87%	35.87%		
1991 Release date	8-Apr	30-May	21-Aug	2-Nov			18-Feb	30-May	15-Sep	2-Nov		
Delay in days	98	60	52	33	243	61	49	60	77	33	219	55
Index (%):	108.89%	65.93%	56.52%	35.87%			54.44%	65.93%	83.70%	35.87%		
1992 Release date	29-Jan	28-May					29-Jan	14-May	29-Aug	n.a.		
Delay in days	29	3					29	44	60		133	44
Index (%):	32.22%	3.30%					32.22%	48.35%	65.22%			
1993 Release date	4 Jan?	15-Mar	18-May	21-Oct			17-Mar	26-Jun	31-Aug	14-Dec		
Delay in days	4?	16	?	21			76	87	62	75	300	75
Index (%):		17.58%		22.83%			84.44%	95.60%	67.39%	81.52%		
1994 Release date	21-Jan	11-Apr	22-Jul				8-Mar	3-Jun	23-Sep	6-Dec%		
Delay in days	21	11	22		54	18	67	64	85	67	283	71
Index (%):		12.22%		0.25%			74.44%	70.33%	92.39%	72.83%		
1995 Release date	16-Jun	27-Jul	6-Oct	23-Jan 96			9-Feb	12-May	27-Jul	22-Feb 96		
Delay in days	167	118	98	115	498	125	40	42	27	145	254	64
Index (%):	185.56%	129.67%	106.52%	125.00%			44.44%	46.15%	29.35%	157.61%		

Appendix Table 4. Delays in the Release of Budget Funds to IAR+T, Nigeria, 1990-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average
Total	379	253	254	202			380	329	344	353		
Average	63	42	65	51			63	56	57	71		
Median release date	29 Feb	29 May	5 Sep	2 Nov			13 Feb	22 May	3 Aug	6 Dec		
Median days delay	60	59	67	33			44	52	34	67		
Median release delay index (%):	66.67	64.84	72.83	35.87			48.89	57.14	36.96	72.83		

Notes:

1. IAR+T: Institute of Agricultural Research and Training, Obafemi Awolowo University, Ibadan, Oyo State.
2. First Quarter: January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing budget funds.
4. "Index" is Index of late release of funds to the Institute.
5. "Full Year" is total delay in days for a given year.
6. "Average per quarter" is average number of days delay per quarter for a given year, that is, (5) divided by the number of quarters, across all years in the sample.
7. "Total" is total number of days delay for a given quarter, across all years in the sample.
8. "Average" is average number of days delay per year for a given quarter, that is, (7) divided by the number of years in the sample.

Source: Underlying data from IAR+T 1996 Field Survey.

Appendix Table 5. Delays in the Release of Budget Funds to NSPRI, Nigeria, 1988-96

Year		Capital funds						Recurrent funds					
		First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1988	Release date	22-Feb	9-May	1-Aug	13-Dec			1-Feb	9-May	1-Aug	11-Nov		
	Delay in days	53	39	32	74	198	50	32	39	32	42	145	36
	Index (%)	58.89%	42.86%	34.78%	80.43%			35.56%	42.86%	34.78%	45.65%		
1989	Release date	22-Mar	12-Jun	28-Aug	4-Nov			9-Feb	2-May	4-Aug	31-Oct		
	Delay in days	81	73	59	35	248	62	40	32	35	31	138	35
	Index (%)	90.00%	80.22%	64.13%	38.04%			44.44%	35.16%	38.04%	33.70%		
1990	Release date	24-Apr	15-Jun	28-Aug	4-Nov			2-Feb	11-May	3-Aug	6-Nov		
	Delay in days	114	76	59	35	284	71	33	41	34	37	145	36
	Index (%)	126.67%	83.52%	64.13%	38.04%			36.67%	45.05%	36.96%	40.22%		
1991	Release date	21-Mar	23-May	18-Sep	21-Nov			7-Feb	2-May	1-Aug	1-Nov		
	Delay in days	80	53	80	52	265	66	38	32	32	32	134	34
	Index (%)	88.89%	58.24%	86.96%	56.52%			42.22%	35.16%	34.78%	34.78%		
1992	Release date	3-Mar	21-May	3-Jul	16-Nov			13-Jan	21-May	3-Jul	16-Nov		
	Delay in days	62	51	3	47	163	41	13	51	3	47	114	29
	Index (%)	68.89%	56.04%	3.26%	51.09%			14.44%	56.04%	3.26%	51.09%		
1993	Release date	16-Apr	14-Jul	7-Oct	13-Dec			26-Mar	16-Aug	14-Oct	13-Dec		
	Delay in days	104	105	99	74	382	96	85	138	106	74	403	101
	Index (%)	115.56%	115.38%	107.61%	80.43%			94.44%	151.65%	115.22%	80.43%		
1994	Release date	29-Mar	3-Apr	19-Oct	2-Nov			4-Mar	7-Jun	18-Aug	10-Nov		
	Delay in days	88	3	111	32	234	59	63	68	49	41	221	55
	Index (%)	97.78%	3.30%	120.65%	34.78%			70.00%	74.73%	53.26%	44.57%		
1995	Release date	18-Apr	25-May	25-Jul	26-Oct			17-Feb	2-May	25-Jul	20-Nov		
	Delay in days	108	55	25	26	214	54	48	32	25	51	156	39
	Index (%)	120.00%	60.44%	27.17%	28.26%			53.33%	35.16%	27.17%	55.43%		
1996	Release date	11-Jan	2-May					7-Mar	8-May	21-Aug			
	Delay in days	11	32					66	38	52		1356	52
	Index (%)	12.22%	35.16%					73.33%	41.76%	56.52%			

Appendix Table 5. Delays in the Release of Budget Funds to NSPRI, Nigeria, 1988-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
Total	701	487	468	375			418	471	368	355		
Average	78	54	59	47			46	52	41	39		
Median release date	22-Mar	23-May	7-Sep	11 Nov			9-Feb	9-May	3-Aug	10-Nov		
Median days delay	81	53	69	42			40	39	34	41		
Median release delay Index %	90.00	58.24	75.00	45.65			44.44	42.86	36.96	44.57		

Notes:

1. NSPRI: Nigerian Stored Products Research Institute, Ilorin, Kwara State;(2) First Quarter : January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
2. "Delay" is number of days delay in releasing budget funds.
3. "Index" is Index of delay of release of budget funds to the Institute.
4. "Full Year" is total delay in days for a given year.
5. "Average per Quarter" is average number of days delay per quarter for a given year, that is, (5) divided by the number of quarters.
6. "Total" is total number of days delay for a given quarter, across all years in the sample.
7. "Average" is average number of days delay per year for a given quarter, that is, (7) divided by the number of years in the sample.

Source: Underlying data from NSPRI Field Survey, 1996.

Appendix Table 6. Delays in the Release of Budget Funds to NRICT, Nigeria, 1989-96

Year	Capital funds						Recurrent funds					
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1989 Release date	28-Mar	24-May	4-Sep				13-Mar	24-May	24-Jul	8-Nov		
Delay in days	87	54	66		207	69	72	54	24	39	189	47
Index (%)	96.67%	59.34%	71.74%				80.00%	59.34%	26.09%	42.39%		
1990 Release date	23-Mar	26-Jun	17-Sep	6-Nov			29-Jan	23-Apr	5-Aug	29-Oct		
Delay in days	82	87	79	37	285	71	29	23	36	29	117	29
Index (%)	91.11%	95.60%	85.87%	40.22%			32.22%	25.27%	39.13%	31.52%		
1991 Release date	9-Apr	9-Apr	11-Sep	2-Dec			5-Feb	14-May	2-Aug	5-Nov		
Delay in days	99	9	73	63	244	61	36	44	33	36	149	37
Index (%)	110.00%	9.89%	79.35%	68.48%			40.00%	48.35%	35.87%	39.13%		
1992 Release date	28-Feb	3-Jul	3-Jul				11-Feb	26-May	31-Jul	2-Nov		
Delay in days	59	94	3	∞			42	56	31	33	162	41
Index (%)	65.56%	103.30%	3.26%	∞			46.67%	61.54%	33.70%	35.87%		
1993 Release date				2-Dec			19-Feb	17-May	11-Aug	n.a.		
Delay in days				63			50	47	42		139	46
Index (%)				68.48%			55.56%	51.65%	45.65%			
1994 Release date	6-Apr	19-May	4-Oct				17-Feb	16-May	8-Aug	21-Nov		
Delay in days	96	49	96	∞	241(∞)	80	48	46	39	52	185	46
Index (%)	106.67%	53.85%	104.35%	∞			53.33%	50.55%	42.39%	56.52%		
1995 Release date	30-May	18-Jul	23-Oct	15/1/96			13-Feb	24-Apr	18-Jul			
Delay in days	150	109	115	107	481	120	44	24	18	68	86	27
Index (%)	106.67%	53.85%	104.35%				53.33%	50.55%	42.39%	56.52%		
1996 Release date	14-May	12-Jul	7-Oct									
Delay in days	134	103	99		336	112						
Index (%)	148.89%	113.19%	107.61%									

Appendix Table 6. Delays in the Release of Budget Funds to NRICT, Nigeria, 1989-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
Total												
Average	101	72	76	68			46	43	32	38		
Median release date:	6-Apr	26-Jun	7-Sep	2 Dec			13-Feb	16-May	2-Aug	5-Nov		
Median days delay:	96	87	69	63			44	46	33	36		
Median release												
Median release delay												
Index (%):	106.67	95.60	75.00	68.48			48.89	50.55	35.87	39.13		

Notes:

1. NRICT: National Research Institute for Chemical Technology, Zaria, Kaduna State.
2. First Quarter : January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing funds.
4. "Index" is Index of Delay in Fund Release.
5. "Full Year" is total Delay in days for a given year for all quarters.
6. "Average per Quarter" is average number of days delay per quarter for the given year, that is, (5) divided by number of quarters.
7. "Total" is total number of days delay for a given quarter across all years in the sample.
8. "Average" is average number of days delay per year for the given quarter, that is, (7) divided by the number of years.

Source: Underlying data from NRICT Field Survey, 1996.

Appendix Table 7. Delays in the Release of Budget Funds to NIOMR, Nigeria, 1989-95

Year	Capital funds						Recurrent funds					
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1989	Release date	6-Feb	15-May	20-Aug	16-Nov		20-Feb	18-May	15-Aug	7-Nov		
	Delay in days	37	45	51	47	180	51	48	46	38	183	46
	Index (%)	41.11%	49.45%	55.43%	51.09%		56.67%	52.75%	50.00%	41.30%		
1990	Release date	16-Feb	20-May	13-Aug	22-Nov		26-Jan	24-Apr	30-Jul	25-Oct		
	Delay in days	47	50	44	53	194	26	24	30	25	105	26
	Index (%)	52.22%	54.95%	47.83%	57.61%		28.89%	26.37%	32.61%	27.17%		
1991	Release date	26-Mar	21-May	13-Aug	22-Nov		29-Jan	2-May	25-Jul	30-Oct		
	Delay in days	85	51	44	53	233	29	32	25	30	116	29
	Index (%)	94.44%	56.04%	47.83%	57.61%		32.22%	35.16%	27.17%	32.61%		
1992	Release date	5-May	3-Jul	1-Sep	—		23-Jan	27-Apr	28-Jul	26-Oct		
	Delay in days	125	94	63	∞	225(∞)	23	27	28	26	104	26
	Index (%)	138.89%	103.30%	68.48%	∞		25.56%	29.67%	30.43%	28.26%		
1993	Release date	24-Apr	10-Jun	15-Dec	—		10-Feb	6-Aug	23-Sep	26-Nov		
	Delay in days	114	71	168	∞	353(∞)	41	128	85	57	311	78
	Index (%)	126.67%	78.02%	182.61%	∞		45.56%	140.66%	92.39%	61.96%		
1994	Release date	18-Mar	8-Jun	26-Sep	—		14-Feb	16-May	10-Aug	15-Nov		
	Delay in days	77	69	88	∞	234(∞)	45	46	41	46	178	45
	Index (%)	85.56%	75.82%	95.65%	∞		50.00%	50.55%	44.57%	50.00%		
1995	Release date	3-May	27-Jul	12-Oct			8-Feb	6-Apr	26-Jul	1-Nov		
	Delay in days	123	118	104		345	39	6	26	32	103	26
	Index (%)	136.67%	129.67%	113.04%			43.33%	6.59%	28.26%	34.78%		

Appendix Table 7. Delays in the Release of Budget Funds to NIOMR, Nigeria, 1989-95 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
Total	608	498	562	153			254	311	281	254		
Average	87	71	80	51			36	44	40	36		
Median release date:	26-Mar	8-Jun	1-Sep	22 Nov			8-Feb	2-May	30-Jul	1-Nov		
Median days delay:	85	67	63	53			39	32	29	31		
delay index %:	94.44	73.63	68.48	57.61			43.33	35.16	31.52	33.70		

Notes:

1. NIOMR: Nigerian Institute for Oceanography and Marine Research.
2. First Quarter : January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing funds.
4. "Index" is index of late release of funds to the Institute.
5. "Full Year" is total delay in days for a given year for all quarters.
6. "Average per Quarter" is average number of days delay per quarter for the given year, that is, (5) divided by number of quarters.
7. "Total" is total number of days delay for a given quarter across all years in the sample.
8. "Average" is average number of days delay per year for the given quarter, that is, (7) divided by the number of years.

Source: Underlying data from NIOMR Field Survey, 1996

Appendix Table 8. Delays in the Release of Budget Funds to NAPRI, Nigeria, 1985-96

Year	Capital funds						Recurrent funds					
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1985 Release date	7-Mar	18-May	6-Aug	18-Oct			7-Mar	18-May	6-Aug	10-Oct		
Delay in days	66	48	37	18	169	42	66	48	37	10	161	40
Index (%)	73.33%	52.75%	40.22%	19.57%			73.33%	52.75%	40.22%	10.87%		
1986 Release date	29-Mar	10-May	17-Aug	11-Nov			8-Mar	14-May	10-Aug	1-Nov		
Delay in days	88	40	48	42	218	55	67	44	41	32	184	46
Index (%)	97.78%	43.96%	52.17%	45.65%			74.44%	48.35%	44.57%	34.78%		
1987 Release date	2-Apr	4-May	8-Oct				2-Apr	10-May	9-Jul	1-Nov		
Delay in days	92	34	100		226	75	92	40	9	32	173	43
Index (%)	102.22%	37.36%	108.70%				102.22%	43.96%	9.78%	34.78%		
1988 Release date	3-Mar	6-May	8-Oct				3-Mar	9-Jun	9-Oct	11-Nov		
Delay in days	62	36	100		198	66	62	70	101	42	275	69
Index (%)	68.89%	39.56%	108.70%				68.89%	76.92%	109.78%	45.65%		
1989 Release date	7-Mar	10-Apr	27-Aug	30-Nov			7-Mar	10-Apr	27-Aug	30-Nov		
Delay in days	66	10	58	61	195	49	66	10	58	61	195	49
Index (%)	73.33%	10.99%	63.04%	66.30%			73.33%	10.99%	63.04%	66.30%		
1990 Release date	12-Mar	28-Aug	n.a	6-Nov			n.a	n.a	21-Aug	26-Oct		
Delay in days	71	150		37	258	86			52	26		
Index (%)	78.89%	164.84%		40.22%					56.52%	28.26%		
1991 Release date	4-Apr	22-Aug	21-Sep	3-Dec			21-Feb	22-Aug	5-Sep	4-Dec		
Delay in days	94	144	83	67	388	97	53	144	67	68	332	83
Index (%)	104.44%	158.24%	90.22%	72.83%			58.89%	158.24%	72.83%	73.91%		
1992 Release date	2-Mar	20-Jun	5-Oct				1-Feb	14-May	7-Aug	6-Oct		
Delay in days	61	81	97	∞	239(∞)	80	32	44	38	6		
Index (%)	67.78%	89.01%	105.43%	∞			35.56%	48.35%	41.30%	6.52%		

Appendix Table 8. Delays in the Release of Budget Funds to NAPRI, Nigeria, 1985-96 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1993 Release date	10-Mar	15-Jun	20-Aug	—			Feb	17-May	18-Aug	30-Oct		
Delay in days	69	76	51	∞	196(∞)	65	n.a	47	49	30	126	42
Index (%)	76.67%	83.52%	55.43%	∞				51.65%	53.26%	32.61%		
1994 Release date	15-Feb	30-May	n.a.				14-Jan	25-Apr	27-Jul	n.a.	66	22
Delay in days	46	60					14	25	27			
Index %	51.11%	65.93%					15.56%	27.47%	29.35%			
1995 Release date	25-May	21-Jul	n.a.	29 Dec			15-Feb	20-Jul	25-Sep	30-Nov	305	76
Delay in days	145	112		90	347	116	46	111	87	61		
Index %	161.11%	123.08%		97.83%			51.11%	121.98%	94.57%	66.30%		
1996 Release date	30-May	20-May	n.a.	n.a.			12-Feb	24-Apr	19-Jul	n.a.	86	29
Delay in days	140	50					43	24	19			
Index %	155.56%	54.95%					47.78%	26.37%	20.65%			
Total	1000	841	574	(315)			541	607	585	368		
Average:	83	70	72	(53)			49	55	49	37		
Median release date:	11-Mar	25-May	8-Sep	20 Nov			26-Feb	14-May	14-Aug	1-Nov		
Median days delay:	69	55	78	51			57	44	45	31		
Median delay Index (%)	76.67	60.44	84.78	55.43			63.33	48.35	48.91	33.70		

Notes:

1. NAPRI: National Animal Production Research Institute.
2. First Quarter : January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing funds.
4. "Index" is index of late release of funds to the Institute.
5. "Full Year" is total delay in days for a given year.
6. "Average per Quarter" is average number of days delay per quarter for a given year, that is, (5) divided by the number of quarters.
7. "Total" is total number of days delay for a given quarter across all years in the sample.
8. "Average" is average number of days delay per year for a given quarter, that is (7) divided by the number of years in the sample.

Source: Underlying data from NAPRI Field Survey, 1996.

Appendix Table 9. Delays in the Release of Budget Funds to NIFFR, Nigeria, 1985-94

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1985 Release date	27-Feb	28-Jun	25-Oct	23-Dec			25-Jan	26-Jun	29-Oct	20-Dec		
Delay in days	58	89	117	84	348	87	25	87	121	81	314	79
Index (%):	64.44%	97.80%	127.17%	91.30%			27.78%	95.60%	131.52%	88.04%		
1986 Release date	19-Feb	26-Jun	24-Oct	22-Dec			28-Feb	25-Jun	31-Oct	19-Dec		
Delay in days	50	87	116	83	336	84	59	86	123	80	348	87
Index (%):	55.56%	95.60%	126.09%	90.22%			65.56%	94.51%	133.70%	86.96%		
1987 Release date	20-Feb	28-May	29-Oct	17-Dec			26-Feb	20-May	27-Oct	23-Dec		
Delay in days	51	58	121	78	308	77	57	50	119	84	310	78
Index (%):	56.67%	63.74%	131.52%	84.78%			63.33%	54.95%	129.35%	91.30%		
1988 Release date	28-Feb	28-Apr	23-Sep	24-Dec			22-Feb	29-Apr	27-Sep	28-Nov		
Delay in days	59	28	85	85	257	64	53	29	89	59	230	58
Index (%):	65.56%	30.77%	92.39%	92.39%			58.89%	31.87%	96.74%	64.13%		
1989 Release date	23-Feb	22-Jun	17-Oct	20-Dec			24-Feb	28-Jun	28-Sep	12-Dec		
Delay in days	54	83	109	81	327	82	55	89	90	73	307	78
Index (%):	60.00%	91.21%	118.48%	88.04%			61.11%	97.80%	97.83%	79.35%		
1990 Release date	21-Feb	24-Jun	23-Oct	23-Nov			28-Feb	15-Jun	25-Oct	19-Dec		
Delay in days	52	85	115	54	306	77	59	76	117	80	332	83
Index (%):	57.78%	93.41%	125.00%	58.70%			65.56%	83.52%	127.17%	86.96%		
1991 Release date	8-Feb	30-May	11-Sep	21-Nov			22-Feb	27-Jun	9-Oct	19-Oct		
Delay in days	39	60	73	52	224	56	53	88	101	19	261	65
Index (%):	43.33%	65.93%	79.35%	56.52%			58.89%	96.70%	109.78%	20.65%		
1992 Release date	13-Feb	18-Apr	12-Oct	10-Dec			21-Feb	14-Jun	24-Sep	26-Nov		
Delay in days	44	18	104	71	237	59	52	75	86	57	270	68
Index (%):	48.89%	19.78%	113.04%	77.17%			57.78%	82.42%	93.48%	61.96%		

Appendix Table 9. Delays in the Release of Budget Funds to NIFFR, Nigeria, 1985-94 (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1993 Release date	4-Feb	27-May	10-Sep	16-Dec			18-Feb	20-May	21-Oct	19-Nov		
Delay in days	35	57	72	77	241	60	49	50	113	49	261	65
Index (%):	38.89%	62.64%	78.26%	83.70%			54.44%	54.95%	122.83%	53.26%		
1994 Release date	14-Feb	24-Jun	8-Sep	16-Dec			17-Feb	12-Jul	11-Oct	9-Dec		
Delay in days	45	85	70	77	277	69	48	103	103	70	324	81
Index (%):	50.00%	93.41%	76.09%	83.70%			53.33%	113.19%	111.96%	76.09%		
Total												
Delay (days):	487	650	982	742			510	733	1062	652		
Average:	48	65	98	74			51	73	106	65		
Median release date:	19 Feb	11 June	14 Oct	16 Dec			22 Feb	20 June	16 Oct	10 Dec		
Median delay (days):	50	72	106	67			53	81	108	71		
Median delay index (%):	55.55	79.12	115.22	72.83			58.58	89.01	117.39	77.17		

Notes:

1. NIFFR: National Institute for Freshwater Fisheries Research, Kainji Lake, New Bussa, Niger State.
2. First Quarter: January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing funds; (4) "Index" is Index of Delay in fund release (%).
4. "Full Year" is total delay in days for a given year for all quarters.
5. "Average per quarter" is average number of days delay per quarter for the given year, that is, (5) divided by number of quarters.
6. "Total" is total number of days delay for a given quarter, across all years in the sample.
7. "Average" is average number of days delay per year for the given quarter, that is, (7) divided by the number of years in the sample.

Source: Underlying data from NIFFR Field Survey, 1996.

Appendix Table 10. Delays in the Release of Budget Funds to NIHORT, Nigeria, 1985-96 (Dates of Release, with Number of Days Delay and Delay Indices)

Year	Capital funds						Recurrent funds					
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1985 Release date	23-Apr	17-May	17-Aug	8-Nov			1-Mar	29-May	19-Aug	8-Nov		
Delay in days	113	47	48	39	247	62	60	59	50	39	208	52
Index (%)	125.56%	51.65%	52.75%	42.39%			66.67%	64.84%	54.95%	42.39%		
1986 Release date	18-Feb	13-May	7-Aug	22-Dec			18-Feb	13-May	7-Aug	12-Nov		
Delay in days	49	43	38	83	213	53	49	43	38	43	173	43
Index (%)	54.44%	47.25%	41.76%	90.22%			54.44%	47.25%	41.76%	46.74%		
1987 Release date	13-Feb	13-May	30-Jul	5-Nov			12-Mar	13-May	30-Jul	5-Nov		
Delay in days	44	43	30	36	153	38	71	43	30	36	180	45
Index (%)	48.89%	47.25%	32.97%	39.13%			78.89%	47.25%	32.97%	39.13%		
1988 Release date	18-Jan	1-May	22-Jul	22-Nov			8-Jan	1-May	22-Jul	11-Nov		
Delay in days	18	31	22	53	124	31	8	31	22	42	103	26
Index (%)	20.00%	34.07%	24.18%	57.61%			8.89%	34.07%	24.18%	45.65%		
1989 Release date	1-Feb	9-May	12-Sep				1-Feb	9-May	1-Aug	26-Oct		
Delay in days	32	39	74		145	36	32	39	32	26	125	32
Index (%)	35.56%	42.86%	81.32%				35.56%	42.86%	35.16%	28.26%		
1990 Release date	7-Mar	14-Jun	9-Nov	18-Dec			24-Jan	30-Apr	1-Aug	20-Oct		
Delay in days	66	75	40	79	260	65	24	30.00	32	20	106	27
Index (%)	73.33%	82.42%	43.96%	85.87%			26.67%	32.97%	35.16%	21.74%		
1991 Release date	2-Apr	14-Jun	22-Aug	26-Nov			4-Feb	3-May	26-Jul	1-Nov		
Delay in days	92	75	53	57	277	69	35	33	26	32	126	32
Index (%)	102.22%	82.42%	58.24%	61.96%			38.89%	36.26%	28.57%	34.78%		
1992 Release date	10-Mar	15-Jul	n.a.	—			24-Jan	5-May	11-Aug	5-Nov		
Delay in days	69	106		∞			24	35	42	36	137	34
Index (%)	76.67%	116.48%		∞			26.67%	38.46%	46.15%	39.13%		

Appendix Table 10. Delays in the Release of Budget Funds to NIHORT, Nigeria, 1985-96 (Dates of Release, with Number of Days Delay and Delay Indices) (continued)

Year	Capital funds					Recurrent funds						
	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter	First quarter	Second quarter	Third quarter	Fourth quarter	Full year	Average per quarter
1993 Release date	30-May	17-Jun	—	—	—	—	2-Mar	26-May	1-Sep	25-Dec	—	—
Delay in days	150	78	86	∞	314(∞)	79	61	56	63	86	266	137
Index (%)	166.67%	85.71%	94.51%	∞	∞	∞	67.78%	61.54%	69.23%	93.48%	—	—
1994 Release date	7-Apr	8-Jul	27-Oct	—	—	—	28-Feb	13-Jun	14-Sep	22-Nov	—	—
Delay in days	97	69	27	∞	193	48	59	74	76	53	262	66
Index %	107.78%	75.82%	0.29	∞	∞	∞	65.56%	81.32%	83.52%	57.61%	—	—
1995 Release date	21-Jan	29-Aug	31-Oct	21-Jan 96	—	—	24-Feb	12-May	29-Aug	31-Oct	—	—
Delay in days	21	151	123	94	389	97	55	42	60	31	188	47
Index %	23.33%	165.93%	135.16%	102.17%	—	—	61.11%	46.15%	65.93%	33.70%	—	—
1996 Release date	9-May	9-May	20-Aug	n.a	—	—	12-Feb	24-Apr	19-Jul	n.a	—	—
Delay in days	129	39	51	—	219	73	43	24	19	—	86	27
Index %	143.33%	42.86%	56.04%	—	—	—	47.78%	26.37%	20.88%	—	—	—
Total												
Delay in days:	880	796	592	441	—	—	521	504	490	444	—	—
Average:	73	66	49	63	—	—	43	42	41	40	—	—
Median release date:	21-Mar	31-May	22-Aug	26 Nov	—	—	15-Feb	10-May	4-Aug	5-Nov	—	—
Median days delay:	80	61	53	57	—	—	46	40	35	36	—	—
Median delay index (%):	88.89	67.03	57.61	61.96	—	—	51.11	43.96	38.04	39.13	—	—

Notes:

1. NIHORT: National Horticultural Research Institute.
2. First Quarter : January 1 - March 31; Second Quarter: April 1 - June 30; Third Quarter: July 1 - September 30; Fourth Quarter: October 1 - December 31.
3. "Delay" is number of days delay in releasing funds.
4. "Index" is index of late release of funds to the Institute.
5. "Full Year" is total delay in days for a given year.
6. "Average per Quarter" is average number of days delay per quarter for a given year, that is, (5) divided by the number of quarters.
7. "Total" is total number of days delay for a given quarter across all years in the sample.
8. "Average" is average number of days delay per year for a given quarter, that is (7) divided by the number of years in the sample.

Appendix 1

Probabilities of NARS Funding Allocations and Disbursements

The maximum funds that could be allocated or disbursed to a NARS/NARO is the full amount it requests from government in a given year. It is rarely the case that government gives a NARS/NARO all or more than it requests. It is also unlikely that a NARS/NARO will continuously receive funds that are an absolute critical minimum below which staff must be cut back, programs closed, and operations drastically scaled down.

Let Y_1 and Y_2 be random variables representing funding disbursements to two NAROs in a NARS in a given year with the joint density function:

$$f_{y_1, y_2}(y_1, y_2) \text{ for all } y_1, y_2 \quad (1)$$

Suppose it can be presumed that the values of Y lie between, say, the mean actual budgetary disbursements in the preceding three years (a_1) and the full budgetary request of the first NARO to government for funding in year (b_1). This means that a_1 and b_1 represent the minimum and maximum limits within which NARS leaders and NARO managers expect fund disbursement in year t to be. Let the corresponding intervals or limits for disbursements to the second NARO be a_2 and b_2 . The planning question facing the NARS is: what is the probability that disbursements to the NARS next year will be within these intervals or limits?

The probability that budgetary disbursements to the two NAROs in the next financial year will lie between the arithmetical mean of actual disbursements to the NARS in the preceding 3 years and the current year's budgetary requests submitted by the two NAROs to government is:

$$P(a_1 < y_1 < b_1, a_2 < y_2 < b_2) = \int_{a_2}^{b_2} \int_{a_1}^{b_1} f_{y_1, y_2}(y_1, y_2) dy_1 dy_2 \quad (2)$$

Suppose from previous experience, NARS leaders and NARO managers feel that the joint density function of their budgetary disbursements can be represented by the uniform distribution:

$$f_{y_1, y_2}(y_1, y_2) = \frac{1}{10}, a_1 < y_1 < b_1; a_2 < y_2 < b_2 \\ = 0, \text{ otherwise} \quad (3)$$

Generalizing, let there be n NAROs within a NARS. The joint density function of the n -dimensional random variable (y_1, \dots, y_n) representing the unknown budgetary disbursements to the n NAROs in the NARS in a given year is given by:

$$f_{y_1, \dots, y_n}(y_1, \dots, y_n), y_i \text{ in the sample space} \quad (4)$$

The probability that all n NAROs will receive funds that lie somewhere between the arithmetical mean of their actual disbursements in the last 3 years and their nominal budgetary requests in the given year is:

$$P(a_1 < y_1 < b_1, \dots, a_n < y_n < b_n) = \int_{a_n}^{b_n} \int_{a_{n-1}}^{b_{n-1}} \dots \int_{a_1}^{b_1} f_{y_1, \dots, y_n}(y_1, \dots, y_n) dy_1 \dots dy_n \quad (5)$$

If, from previous experience, as above, y_1, \dots, y_n can be presumed to be uniformly distributed as below, the joint density function in this n-NARO NARS case is:

$$f_{y_1, \dots, y_n}(y_1, \dots, y_n) = \frac{1}{10}, a_1 < y_1 < b_1, \dots, a_n < y_n < b_n \quad (6)$$

$$= 0, \text{ otherwise,}$$

then the probability that each of the n-NAROs will receive fund disbursements that lie within the defined intervals is:

$$P(a_1 < y_1 < b_1, \dots, a_n < y_n < b_n) = \int_{a_n}^{b_n} \dots \int_{a_1}^{b_1} \frac{1}{10} dy_1 \dots dy_n \quad (7)$$

From (3), the marginal density functions of fund disbursements to the first NARO and second NARO can be derived. From the marginal density functions, we can compute the expected values of fund disbursements to each of the two NAROs in the given year. Also, from (3), we can compute expected values of the sum of fund disbursements to the two NAROs, $E(Y_1 + Y_2)$. We can also compute the standard deviation of the sum of fund disbursements to the two NAROs in the NARS. Computed expected values and standard deviations of fund disbursements, based on assumed density functions and domains of the random variables, can be made available to NARS leaders and managers as planning tools. This becomes all the more relevant and potentially useful as they must contend with the reality of an uncertain flow of disbursements throughout the year.³³

33 Additional results can be derived using specific assumptions. For example, if it is assumed that the random variables y_1, \dots, y_n are independently distributed, their joint density function is the product of their marginal density functions. This could be the case if the effect of the totality of random influences on fund disbursements to the different NAROs is such that they can be presumed to be independent of one another — the assumption of independence becomes plausible under these circumstances.

Appendix II

The Effect of Funding Diversification on NARS Funding Stability

Suppose a NARS or a NARO seeks and adds a new source of funding (e.g. donor funds) (F_2) to an existing (government) source of funding (F_1) so that total funding available to the NARS (F) becomes³⁴:

$$F = F_1 + F_2 \quad (1)$$

and the variance of total NARS funding after funding diversification becomes:

$$\sigma_{F^2} = \sigma_{F_1^2} + \sigma_{F_2^2} + 2\rho\sigma_{F_1}\sigma_{F_2} \quad (2)$$

Where σ_{F^2} is variance of total NARS funding; $\sigma_{F_1^2}$ is variance of old source of funding; $\sigma_{F_2^2}$ is variance of the new source of funding; ρ is the correlation coefficient between F_1 and F_2 and σ_{F_1} and σ_{F_2} are the standard deviations of F_1 and F_2 , respectively. From (2),

$$\frac{\sigma_{F^2}}{\sigma_{F_1^2}} = 1 + \frac{\sigma_{F_2}}{\sigma_{F_1}} \left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) \quad (3)$$

$$\frac{\sigma_{F^2}}{\sigma_{F_1^2}} - 1 = \frac{\sigma_{F_2}}{\sigma_{F_1}} \left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) \quad (4)$$

From equation (4),

$$\frac{\sigma_{F^2}}{\sigma_{F_1^2}} - 1 < 0, \text{ if } \frac{\sigma_{F_2}}{\sigma_{F_1}} \left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) < 0; \quad (5)$$

that is, when:

$$\left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) < 0;$$

that is, when:

³⁴ For the classic treatment, though with slightly different formulation within the context of employment stabilization, see Friedman, 1953.

$$2\rho < -\frac{\sigma_{F_2}}{\sigma_{F_1}}$$

or:

$$\rho < -\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}}, \quad (6)$$

which says that so long as:

$$\rho < -\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}},$$

the variance of NARS funding with the new source of funding is less than the variance of NARS funding before the new source of funding was added. Using variance as a measure of funding instability, equation (6) says that so long as instability of NARS funding with the addition of the new source of funding is less than instability of NARS funding without the new source of funding. In this instance, funding diversification by the NARS, including new donor funding, assists in reducing total NARS funding instability.

But it is not always the case that adding new sources of funding leads to a reduction of funding instability. The question facing NARS leaders and NARO managers is: *under what conditions might new sources of funding make NARS funding more unstable?*

From equation (4), it follows that:

$$\frac{\sigma_{F^2}}{\sigma_{F_1^1}} - 1 > 0, \text{ if } \frac{\sigma_{F_2}}{\sigma_{F_1}} \left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) > 0 \quad (7)$$

From (7),

$$\left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) > 0 \text{ implies that: } 2\rho > -\frac{\sigma_{F_2}}{\sigma_{F_1}},$$

or:

$$\rho > -\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}}, \quad (8)$$

Which says that so long as:

$$\rho > -\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}},$$

the variance of total NARS funding with the addition of the new source of funding exceeds the variance of NARS funding before the new source of funding was added, that is, diversification increases NARS funding instability.

When might adding a new source of funding not affect instability of NARS funding?

From equation (4)

$$\frac{\sigma_{F_2^2}}{\sigma_{F_1^2}} - 1 = 0, \text{ if } \frac{\sigma_{F_2}}{\sigma_{F_1}} \left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) = 0; \quad (9)$$

that is, when:

$$\left(\frac{\sigma_{F_2}}{\sigma_{F_1}} + 2\rho \right) = 0;$$

that is, when:

$$2\rho = -\frac{\sigma_{F_2}}{\sigma_{F_1}};$$

that is, when:

$$\rho = -\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}} \quad (10)$$

which says that adding new sources of funding does not affect NARS funding instability so long as $\rho = -\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}}$.

Combining the three scenarios

Combining the three results in equations (6), (8) and (10), we get:

$$\left(\frac{\sigma_{F^2}}{\sigma_{F_1^2}} - 1 \right) \begin{matrix} \geq 0 \\ < 0 \end{matrix} \text{ as } \rho \begin{matrix} \geq -\frac{1}{2} \\ < -\frac{1}{2} \end{matrix} \frac{\sigma_{F_2}}{\sigma_{F_1}} \quad (11)$$

which says that the variance of total NARS funding with the new source of funding is greater than, is equal to or is less than the variance of NARS funding without the new source of funding, as the correlation coefficient exceeds, equals or is less than:

$$-\frac{1}{2} \frac{\sigma_{F_2}}{\sigma_{F_1}}.$$

Stated alternatively, if:

$$-1 < \rho < -\frac{1}{2}$$

adding a new source of funding will stabilize total NARS funding, while if:

$$-\frac{1}{2} < \rho < 1,$$

adding the new source of funding will destabilize total NARS funding.

How do changes in instability of NARS funding respond to changes in correlation between the sources of funding?

From equation (2),

let $\sigma^2 - \sigma_{F_1^2}$ be the difference between the variance of NARS funding with the new source of funding and the variance of NARS funding without the new source of funding ($\sigma_{F_1^2}$), that is, the variance of the old source of funding.

Then

$$\sigma^2 - \sigma_{F_1^2} = \sigma_{F_2^2} + \rho\sigma_1\sigma_{F_2} \quad (12)$$

where $\sigma_{F_2^2}$ is the variance of the new source of NARS funding. $\sigma^2 - \sigma_{F_1^2}$ can be interpreted as the instability in NARS funding arising from funding diversification. The question that agricultural research policy makers, NARS leaders and NARO managers ask, is:

How does instability on account of funding diversification respond to changes in the correlation between the old and the new sources of NARS funding?

From equation (12)

$$\frac{\partial(\sigma^2 - \sigma_{F_1^2})}{\partial\rho} = 2\sigma_{F_1}\sigma_{F_2} \quad (13)$$

$$\frac{\partial(\sigma^2 - \sigma_{F_1^2})}{\partial\rho} \frac{\rho}{(\sigma^2 - \sigma_{F_1^2})} = \frac{2\sigma_{F_1}\sigma_{F_2}\rho}{(\sigma^2 - \sigma_{F_1^2})} \quad (14)$$

Substituting from equation (12), equation (14) becomes:

$$\frac{\partial(\sigma^2 - \sigma_{F_1^2})}{\partial\rho} \frac{\rho}{(\sigma^2 - \sigma_{F_1^2})} = \frac{2\sigma_{F_1}\sigma_{F_2}\rho}{\sigma_{F_2^2} + 2\rho\sigma_{F_1}\sigma_{F_2}} \quad (15)$$

From equation (15), we derive the following results:

$$\frac{\partial(\sigma^2 - \sigma_{F_1^2})}{\partial\rho} \frac{\rho}{(\sigma^2 - \sigma_{F_1^2})} = \frac{2\sigma_{F_1}\sigma_{F_2}\rho}{\sigma_{F_2^2} + 2\rho\sigma_{F_1}\sigma_{F_2}}$$

> 0, whenever $\rho > 0$

> 0, whenever $\rho < 0$ and $\rho < -\frac{1}{2}\sigma_{F_2} / \sigma_{F_1}$

< 0, whenever $\rho < 0$ and $\rho > -\frac{1}{2}\sigma_{F_2} / \sigma_{F_1}$

That is:

$$\varepsilon\left(\sigma^2 - \sigma_{F_1^2}\right), \rho = \frac{2\sigma_{F_1}\sigma_{F_2}\rho}{\sigma_{F_2^2} + 2\rho\sigma_{F_1}\sigma_{F_2}}$$

$$> 0, \text{ whenever } \rho > 0 \quad (15.1)$$

$$> 0, \text{ whenever } \rho < 0 \text{ and } \rho < -\frac{1}{2} \sigma_{F_2} / \sigma_{F_1} \quad (15.2)$$

$$< 0, \text{ whenever } \rho < 0 \text{ and } \rho > -\frac{1}{2} \sigma_{F_2} / \sigma_{F_1} \quad (15.3)$$

Where $\varepsilon \left(\sigma^2 - \sigma_{F_1}^2 \right), \rho,$

is the NARS funding instability elasticity on account of diversification with respect to the correlation coefficient between the new and the old sources of funding and it measures the percentage change in instability index per unit percentage change in the correlation coefficient. When the correlation coefficient is positive, the instability elasticity is positive; when the correlation coefficient is negative and less than $-\frac{1}{2} \sigma_{F_2} / \sigma_{F_1}$, the elasticity is positive while the instability elasticity is negative whenever the correlation coefficient is negative and greater than $-\frac{1}{2} \sigma_{F_2} / \sigma_{F_1}$.

Appendix III

Assessing when Research Staff may Exit from a NARS/NARO

The NARS leader or NARO manager is often confronted with the problem of assessing the prospects of research staff staying or leaving. This arises from the disabling environment of many country NARS and the attractions of alternative employment opportunities for scientists. And it is the prospects of retaining key research staff that determine the continuity of research programs.

The probability distribution of NARS research staff instability

Let the decision of the individual researcher to leave or remain on the job in a NARO t years from now be a chance outcome, a random variable, whose value is not known in advance. The decision that the researcher eventually takes comes under many random influences, already discussed, that the individual researcher cannot foresee at a given point in time.

The decision to leave or remain on the job after some experience with the environment can be regarded as a Bernoulli trial with two possible outcomes: to leave or to remain on the job, depending on the experiences, opportunities and constraints that the researcher encounters. These will determine if by year t , he is still on the job or not. The time interval from the base year from which to examine if the researcher is still on the job or not is chosen so as to reflect the average gestation period for research output to be realized. Then X_1 and X_2 representing the decision outcomes of two researchers can be regarded as binomial random variables with the following distributions:³⁵

$$P_{X_1}(x_1) = \frac{1}{2}, x_1 = (0,1) \\ = 0, \text{ otherwise}$$

35 The assumption of a binomial distribution with an equal probability of leaving or remaining on the job sounds reasonable. The average researcher in a NARO at a given point in time does not determine in advance that he must remain at the NARO five or ten years ahead, no matter the circumstances; neither does he determine in advance that he must leave the NARO no matter how favorable his work experience is. To the average researcher when asked if he expects to leave the NARO or remain on the job 5 to 10 years hence, the normal answer is: "Maybe; it all depends", meaning that the chances are as likely as not that he would remain or leave the NARS. This is particularly true for a new entrant in the NARS. The probability of staying or leaving may change in the future in the light of experience on the job and emerging alternative employment opportunities.

$$P_{X_2}(x_2) = \begin{cases} \frac{1}{2}, & x_2 = (0,1) \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where

$x_1, x_2 = 0$ when researcher X_1 or researcher X_2 leaves the NARO; and

$x_1, x_2 = 1$ when researcher X_1 or researcher X_2 still remains on the job in the NARO.

Let the decisions of researcher X_1 and researcher X_2 to leave or to remain in a NARO be independent events so that the probability of their occurring together is the product of their individual probabilities. Assume that the influences on the two researchers are independent, or that the sets of influences on the two researchers' decisions to leave or stay on the job are independent so that the random variables X_1 and X_2 are independently distributed. Then the joint probability distribution of $(X_1$ and $X_2)$ becomes the product of their marginal probability distributions:

$$P_{X_1, X_2}(x_1, x_2) = P_{X_1}(x_1)P_{X_2}(x_2), \quad x_1, x_2 = 0,1 \quad (2)$$

where $P_{X_1, X_2}(x_1, x_2)$ is the joint probability distribution of (X_1, X_2) , $P_{X_1}(x_1)$, and $P_{X_2}(x_2)$ are the marginal probability distributions, and x_1, x_2 take on values on the sample space.

With independence of X_1 and X_2 :

$$P_{X_1, X_2}(x_1, x_2) = P_{X_1}(x_1)P_{X_2}(x_2) = \frac{1}{4}, (x_1, x_2) = (0,0), (0,1), (1,0), (1,1) \quad (3)$$

Where

$$\begin{aligned} P_{X_1, X_2}(x_1, x_2) = \frac{1}{4}, (x_1, x_2) = (0,0) & \text{ is the probability that both researchers leave} \\ & \text{the NARO by the terminal reference date,} \\ & \text{which may be 5, 10 or 20 years in the future;} \\ = \frac{1}{4}, (x_1, x_2) = (0,1) & \text{ is the probability that researcher } X_1 \text{ leaves the} \\ & \text{NARO while researcher } X_2 \text{ remains on the job;} \\ = \frac{1}{4}, (x_1, x_2) = (1,0) & \text{ is the probability that researcher } X_1 \text{ remains on} \\ & \text{the job within the NARO, while researcher } X_2 \\ & \text{leaves the NARO by the terminal reference} \\ & \text{date;} \\ = \frac{1}{4}, (x_1, x_2) = (1,1) & \text{ is the probability that the two researchers re-} \\ & \text{main on the job by the terminal reference date.} \end{aligned}$$

Generalizing the results to n researchers within a NARO, the joint probability function for the (X_1, \dots, X_n) multinomial random variable, assuming independence, becomes:

$$\begin{aligned}
 P_{X_1, X_2, \dots, X_n}(x_1, x_2, \dots, x_n) &= P_{X_1}(x_1)P_{X_2}(x_2) \dots P_{X_n}(x_n) \\
 &= \prod_{i=1}^n P_{X_i}(x_i) \\
 &= \left(\frac{1}{2}\right)^n, x_i = (0,1)
 \end{aligned}
 \tag{4}$$

$i = 1, \dots, n$ researchers

From these results, we can compute the relevant parameters of the probability distribution which can then be compared with their approximate empirical analogues.

Bibliography

- de Janvry, A. 1985. Technological innovation in agriculture: The political economy of its rate and bias. CGIAR staff paper number 1, World Bank, Washington D.C.
- Eicher, Carl K. 1990. Building African scientific capacity for agricultural development *Agricultural Economics* Vol. 4, No. 2 June.
- Federal Ministry of Science and Technology. 1986. A national science and technology policy.
- Food and Agriculture Organization of the United Nations. 1966. Agricultural development in Nigeria 1965-1980. FAO: Rome.
- Food and Agriculture Organization of the United Nations. 1994. Funding agricultural research. Proceedings of an FAO/SPAAR/KARI Expert Consultation, Nairobi, Kenya 6-8 July 1993.
- Food and Agriculture Organization of the United Nations. May, 1996. FAO Global information and early warning systems.
- Francis, J.C. and S.H. Archer. 1971. Portfolio analysis. Englewood Cliffs: Prentice Hall, Inc.
- Friedman, M. 1953. The effects of a full-employment policy on economic stability - a formal analysis. In Friedman, M. *Essays in positive economics*. Chicago: University of Chicago Press.
- Hill, J., M. Toure, and P Weatherly. 1995. Sustainable financing. Background paper for Sustainable Financing Workshop, Maastricht, The Netherlands, Sept. 12-15, 1995.
- Idachaba, F.S. 1980. Agricultural research policy in Nigeria. International Food Policy Institute Research Report 17, Washington D.C.
- Idachaba, F.S. 1981. Agricultural research staff instability. The Nigerian experience. *Nigerian Journal of Agricultural Sciences*, Volume 3 1, January: 71-82.
- Idachaba, F.S. 1987a. Agricultural research in Nigeria: Organization and policy. In *Policy for Agricultural Research*, ed. V. Ruttan and C.Pray. Boulder and London: Westview: 333-362.
- Idachaba, F.S. 1987b. Policy issues in sustainability. In *Sustainability issues in agricultural development*. Proceedings of seventh agricultural symposium, World Bank, Washington D.C: 19-53.
- Idachaba, F.S. 1991. Policy options for African agriculture. In *The political economy of hunger Vol. III. Endemic Hunger*, ed. J. Dreze and A. Sen. Oxford: Clarendon Press: 197-235.
- International Bank for Reconstruction and Development. 1955. Economic development of Nigeria. IBRD, Baltimore: John Hopkins University Press.
- ISNAR. 1991. ISNAR's collaboration with National Agricultural Research Systems. Paper prepared for the External Review Panel, ISNAR, May 1991: p. 20.
- ISNAR. 1992. Service through partnership. A strategy summary. 1992.
- Johnson, Glenn L. 1958. Supply function - some facts and notions. In *Agricultural Adjustment Problems in a Growing Economy*, ed. E.O. Heady, H.G. Diesslin, H.R. Jensen. and G.L. Johnson. Ames: Iowa State College Press

- Johnson, Glenn L. 1960. The state of agricultural supply analysis, *Journal of Farm Economics*, May.
- Massell, B.F. 1970. Export instability and economic structure. *American Economic Review* 60,4, September: 618-30.
- National Agricultural Research Project (NARP). 1996. Report of the External Review Panel on the National Agricultural Research Institutes, Vols. I + II.
- National Green Revolution Committee. 1981. *Report of the Research Institutes Review Panel*, 1980/81, Vols 1 and 2.
- Olayide, O. 1981. Scientific research and the Nigerian economy. Ibadan: University of Ibadan Press.
- Pardey, P.G., J. Roseboom, and J.P.A. Anderson. Eds. 1991. *Agricultural research policy: International quantitative perspectives*. Cambridge: Cambridge University Press.
- Pardey, P.G., J. Roseboom and N.M. Beintema. 1995. Investments in African agricultural research. EPTD Discussion Paper 14, International Food Policy Research Institute, Washington D.C.
- Randhawa, M.S. 1979. A history of the Indian council of agricultural research. Delhi Press.
- Roseboom, J., N.M. Beintema, P.G. Pardey and E.O. Oyedipe. 1994. Statistical brief on the National Agricultural Research System of Nigeria. ISNAR.
- Ruttan, V.W. 1982. Agricultural research policy. Minneapolis: University of Minnesota Press.
- Shaib, B., A. Aliyu and J.S. Bakshi. 1997. Nigeria: National agricultural research strategy plan 1996-2010. Abuja: Federal Ministry of Agriculture and National Resources.
- Tabor, S.R. Ed. 1995. *Agricultural research in an era of adjustment policies, institutions and progress*. Washington: World Bank.
- Tabor, S. 1996. Towards an appropriate level of agricultural research finance. Draft chapter in Agricultural Research Finance Sourcebook ISNAR (forthcoming).
- Trigo, E.J. and M.E.Pineiro. 1984. Funding agricultural research. In Selected issues in agricultural research in America. The Hague, The Netherlands: ISNAR, March.
- World Bank. 1986. Poverty and hunger issues and options for food security in developing countries. Washington: World Bank.
- World Bank. 1994. World development report. Washington.



Covers: Chlorine-free paper
Inside pages: Recycled paper

Produced by ISNAR Publications Services

Text editor: Judy Kahn

Layout: Fionnuala Hawes

Printer: Rapporten Service Drukkerij B.V., Rijswijk, The Netherlands

ISSN 1021-4429
ISBN 92-9118-033-5

isnar

International Service for National Agricultural Research



Laan van Nieuw Oost Indië 133, 2593 BM The Hague
P.O. Box 93375, 2509 AJ The Hague, The Netherlands
Tel: (31) (70) 349 6100 • Fax: (31) (70) 381 9677
www.cgiar.org/isnar • Email: isnar@cgnet.com